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INDEX OF VOL. VII.—1888.

INDEX OF AUTHORS' NAMES.

PAGE
Abbe. Optical Glass 846
Abbott, H. C. S., and Trimble, H. Hydrocarbons in Plants 757
Abel, Sir F. A. Discussion on Sulphur Recovery 175
  Explosive 589
Abel and Deering. Carbides of Iron 503
Ahriot, M. Cloisonné Designs on Glass 503
Abt, A. *See* Noelting, E. 562
Ackman. Discussion on Antiseptic Soap 194
Actienges f. Anilinfabrikation. Congo Red 386
  Azo-colours for Cotton 430
  Colours from Hydrazine-sulpho-Acids 431
  β-Naphthylamine-δ-Sulphonic Acid 840
  Azo-Dyestuffs 839
  Azo-Colours 563
Actien Ges. f. Chem. Ind., Rheinau. Retene 635
Actienges. f. Papier u. Druck Ind. Leykam Josefsthal. Bleaching Jute 624
Adamson, B. L. *See* Lockwood 433
Adlam, W., and Faulkner, F. Brewers' Wort 42
Ahrens. Metaxylylenediamine 742
Ahrens, F. B. Sparteïne 399
Aitken, J. B. *See* Davis 338
Akester, W. H. Secondary Batteries 505
Alber, W. Oil Cement 631
Albert, E. Emulsion Collodion 690
Aldunate, L. Chili Saltpetre 844
Aleksandrow, M. *See* Bukowski 348
Alexejeff. Heating Power of Coal 617
Alfieri, P. Disincrustant for Boilers 313
Algin Co. Specimens at Glasgow International Exhibition 482
Aliamet. Reagent for Copper 525
Alibegow, M., and Dolinin, W. Kerosene Lamps 112
Allen, A. H. Assay of Picric Acid 592
  Bromine Absorption of Oils 64
  Determination of Glycerol 136
  Technical Water Analysis 795
Allen, G. W., and Bowers, H. J. A. Purifying Water for Boilers 313
Allen, U. C. Separation of Fibres 33
Allhusen, A. Discussion on Recovery of Sulphur 177
  Discussion on Tees Salt 667
Alvarez, E. Indigo 386
Amagat. Thermo-dynamics 477
Amat, L. Phosphites 501
Amsler-Laffon, J. Resistance of Tissues (illus.) 564
Amthor, K. Analysis of Honey 136
  Fermentation 336
  Pure Alsatian Wine 527
Anderson. Pyridine Bases 478
Anderson, O. S. Separator for Milk 834
Anderson, R. Lithia 730
Anderson, W. Calorimetry 196
Andouard. Nitrogenous Superphosphates 647
André. Nitrogen in Plants 127
André. *See* Berthelot 222, 393
Andreoli, E. M. H. Electric Bleaching 844, 852
Andres, H. Mercury Phenate 865
Andrews. Thermo-dynamics 477
Andrews, E. F. *See* Coyle 314
Andrews, W. *See* Pearson 753
Angell, A., and Candy, F. Purification of Water 763
Appleyard. Valuation of Picric Acid 592
Appleyard, S. R. *See* Furstenhagen 621
Archbutt, L. Analysis of Grease 494
Archibald. Antiseptic Soap 192
Armstrong. Bromodinitrophenol 592
  Naphthalenedisulphonic Acid 619
  Oil Gas 199
Armstrong, H. E. Bleaching 293
  Discussion on Coal Distillation 62
Armstrong, J. T. Accumulators 328
Arnaud. Strophanthine 586
Arnois, C. Carbonic Acid Gas 626
Arth, G. Menthol 586
Arthur and Hinshaw. Indigo and Gums at Glasgow International Exhibition 483
Arzberger. Hydraulic Blower 29
Asboth, A. v. Estimation of Starch 528
  Starch Determination 77, 350, 448
  Sugar in Cereals 223, 685
Ashwell, J. R. Discussion on L. T. Wright's Address 28
Ashworth, W., and Wild, R. Bleaching 746
Aspdin, J. Cement 102
Atkins, G. J. Crystalline Surface on Glass 438
  Separation of Gold, &c. 126
Atwater, W. O. Errors in Nitrogen Determinations 697
Atwater and Ball. Nitrogen Determination 523
Anbel, E. v. Transparency of Platinum 215
Aner, H. *See* Bolton 437
Aydon. Calorific Value of Fuel 198
Ayres, A. Compressed Oil Gas 556

Bach. Commercial Carbolic Acid 826
Backelandt, L. Photographic Plate 401
Bäcker, W. Gas from Tar 112, 428
Bädecker. Corrosion of Steel Wire 388
Badische Anilin. u. Soda Fabrik. Violet Black 386
  Naphthazarine 431
  Rhodamines 745
Baeyer and Caro. Alizarin 669
Baeyer, F., and Duisberg, C. Naphthylamine-sulphonic Acid 33
Bailes, R. *See* Hallsworth 625, 626
Bailey, J. W., and Greaves, J. A. R. Saccharum for Brewers 638
Baillard, C. L. Treatment of Oils 507
Baird. Ammonia from Furnace Gases 478
  Phenols from Furnace Tars 808
Baither. Auramine Derivative 31
Baither, O. Tetramethyldiamidothiobenzophenone 118
Balanche. Bistre Colour 320
Balcke, J. *See* Matz 859
Baldwin, W. A. Aluminium Alloys 389, 851
Bale, F. Ammonia Manufacture 675
  Chlorine Manufacture 629
Balé, J. *See* Werms 441, 443

a 2

PAGE
Balé. *See* Worms 507
Ball. *See* Atwater 528
Bamberger. Corrosion of Leaden Pipes 15
  Retene 116
Bamberger, M. *See* Weidel, H. 384
Bancroft. Permanent Colours 817
Bandrowski, E. v. Azophenine 562
Bang, J. A. F., and Ruffin, M. C. A. Crude Spirit 224
Banner, S. Treatment of Resins, &c. 573
Barber-Starkey, W. J. S. Secondary Batteries 754
Barbier, P., and Vignon, L. Phenosafranines 31
  Substituted Safranines 116
Barkley, W. *See* Garton 573
Barnelle, G., fils. Treatment of Hides 574
Barnes, J. *See* Gartside 624
Barrett. Manganese Steel 212
Barsilowski, J. Formation of Colouring Matters 384
Barthel, A. E., and Möller, J. C. J. Tin Coating 326
Basswitz. Action of Carbon Dioxide on Diastase 514
Battut. Sugar from Beet 856
Baudin. Thermometer 616
Bauer. Coke Oven (illus.) 835
  Coniferyl Alcohol in Spirit 515
Bauer, A., and Hazura, R. Drying Oils 680, 681
Bauer, E. Dialyser 231
  Bone Charcoal 636
  Estimation of Potassium 237
  Fermentation 224
  Nitrogen Determination 239
  Peptone Reaction 238
  Vanillin in Alcohol 336
Bauer, R. W. Dextrose from Lichenin 512
Baum. Phenaceturic Acid 641
Baum, H. Pyrosulphates 210
Baumann. Estimation of Glycerol 696
Baumann, E. Sulphonal 585
Bay, G. Photographic Prints 519
Bayer. Naphthylaminesulphonic Acid 118
Bayer, C. J. Alkaline Aluminates 748
  Pure Alumina Compounds 625
Bayer and Co. Dyes, &c. at Glasgow International Exhibition 482
Bayer and Duisberg. Naphthylamine Sulphonic Acid 430
Bayley, T. Polarimeter 713
Bazin, L. R. Thermophosphates 684
Beam, W. *See* Leffmann 582
Beans. Treatment of Char 428
Beaumetz, D. Saccharine 688
Bechi, E. Adulteration of Olive Oil 135
Beck, A. L. Ricinus Communis 405
Beck, W. H. Sulphites of Ammonia 629
Becke and Mayer. Estimation of Glycerin 236
Beckurts. Vanillin in Spirit 513
Bedford, C. S. Dyes for Fustic 619
Bedson, P. P. Colliery Water 729
  Discussion on Colliery Waters 13
  Gases in Coal 729
  Water Analysis 803
Bedu, A. Tanning 39
Behrend. Anthrarobin 205
Behrend, P. Report of German Gas Experts 668
Béjot, A. J. Printing Colours 123
Belcher, G. C. W. Antiseptics 639
Belcher, J. C. Antiseptics 716
Bell Bros. Chemicals at Glasgow International Exhibition 481
  Tees Salt Bed 661
Bell, J. Estimation of Sugar 228
Bell, J. Carter. Discussion on Carbolic Powders 822
Bell, L. Annual Saving of Coal 24
Benardos, N. de. Secondary Batteries 678
Benedikt, R. Distilled Stearin 755
  Turkey-red Oil 321, 328
  See Ehrlich 671
Benedikt, R., and Cantor, M. Estimation of Glycerol 696
Benedikt, R., and Ehrlich, E. Shellac 391
Benedikt and Ulzer. Analysis of Oils 594
  Shellac 682
Benedikt and Ulzer, C. Turkey-red Oil 329
Benkiser. *See* Nietzki 839
Bennert, C. A. Naphthylthiazine 839
  Phenylhydrazine Colours 452
Bennett, J. Disinfectant 863
Bennett, J. A. B. Tin from Tin Scrap 633
Bennett, W. H. Enriching Coal Gas 741
Benoist, L. *See* Collin 331, 593, 635, 779
Benton, G. L. Refining Petroleum 116
Benzon, C. L. Aluminium Alloys 503

PAGE
Berens, Conrad. Antiseptics 716
Bergami. *See* Liebermann 382
Bergman. Theory of Dyeing 816
Bergmann, T. F. Testing Wine 860
Bergreen, H. Thiocarbonyl Chloride 204
Berkeley, H. B. Fixing Photographs 231
Berlese, A. *See* Targioni-Tozzetti 684
Bernard, C. G. Cocoa 397
Bernard, M. and E. Electrolysis of Aluminium Fluoride 328
Bernthsen. Methylene Blue 559
Berry, E. E. *See* Claus 435
Berthelot. Absorption of Nitrogen by Soil 332
  Drainage Water 331
  Explosiveness of Picric Acid 342
  Explosion of Picric Acid 642
  Graduation of Tubes 645
  Nitrates in the Soil 577
  Nitrogen in Plants 127
  See Renard, A. 115
  See Schlösing 757
Berthelot and André. Action of Magnesia on Ammonia Salts. 772
  Potassium in Plants, Humus, and Soil 393
  Sulphur in Plants 222
Berthollet. Theory of Dyeing 816
Berzelius. Realgar 870
  Sulphuric Acid Process 747
Beseler, O., and Heine, F. English Wheat 40
Bettink, W. Ophioxylin 340
Beutell. Wash-bottle Valve 643
Beutell, A. Hydraulic Blower (illus.) 29
  Water-bath Regulator, &c. (illus.) 231
Bevan, E. J. *See* Cross, C. F. 292
Beyer, C., and Claisen, L. Mixed Azo-Compounds 558
Bichel, C. E. Explosives 868
Bidron, J. P. N. Tanning 574
Biel, J. Nicotine Determination 348
Bigsby, J. A. Coloured Varnish 391
Binder, O. Aspirator with Constant Overflow (illus.) 691
  Burette Nozzle (illus.) 456
  Heating Value of Fire-places 759
Bindschedler. Green Dye 559
Binz. Medicinal Use for Hydroxylamine 865
Bird, H. Spent Iron Liquor 677
Bischof, G. Purification of Water 131
Bischoff, C. A. Azo-Colours from Ortho-diamido-stilbene 669
Bischoff, E. Tetramethyldiamidobenzophenone 742
Bishop, M. W. Estimation of Carbohydrates 695
Black. Theories of Chemical Action 475
Blagden. Spirit Tables 820
Blake, F. C. Cupels (illus.) 631
Blenkinsop, W. E. B. *See* Hartley 435, 437
Blondel, R. Conessa Bark 227
Blount, B. Discussion on the Gas Industry 548
Bluhme, O. Filtration of Beet Juice 857
Blum, L. Iron Determination in Ores 456
Boake, A., and others. Antiseptics 764
Boake, A., and Roberts, F. G. A. Disinfection 862
Bobœuf, P. A. F. Aniline Colours 498
Bock, J. Sugar Manufacture 509
Bockairy, P. Adulteration of Butter 350
Bocquet, G. Sugar Refining 447
Bodländer, G. Peptone 449
  See Traube 449
Bodlander, G., and Traube, J. Fusel Oil in Brandy 513
Boguski, J. Aluminium Bronze 852
Bohm. *See* Gomolka 511
Bohringer, C. Dyeing, &c. 625
Bokorny, T. Hydrogen Peroxide in Vegetables, &c. 394
Bolckow and Vaughan. Discovery of Bed of Salt 661
Bollemont, E. C. de. Wood Fibre 841
Belley. Action of Wool, &c. on Acids 621
  Calorimeter 308
Bolton, G. H., Wylde, J. R., and Auer H. Permanganates 437
Bouchard. α-Naphthol as an Antiseptic 450
Bondonneau, V. C. A. M. Saccharification of Starch 335
Bondonneau and Foret. Saccharification of Starch 514
Bonnier. Respiration of Fungi 686
Bookwalter, J. W. Malleable Iron (illus.) 633
  Treatment of Iron 505
Borgmann. Fermentation 336
Borgmann, E. Nitric Acid in Wine 457
Borland, W. D. Carbo-Dynamite 690
  Disinfectants 717
  Explosive 401
  Explosives 768
Borland and Reid. Carbo-Dynamite 588

PAGE
Bōrnstein, E. Saccharine 458
Borntrāger, H. Nitrosulphuric Acid 234
    Preserving Standard Solutions 771
Borntrazer. Rutin 382
Bosisto. Eucalyptus Oil 69
Bothamley, C. H. Orthochromatic Photography 767
Böttcher, W. *See* Kramer 202
    See Kraemer 380
Bottinger, C. Basic Aluminium Sulphate 322
    Compounds of Albumen with Tannin 331
    Tannin 517
Bouchard, C. Antiseptic Value of β-Naphthol 225
Bouchardat, G., and Voiry R. Terpinol 516
Boulouvard. Chlorine Manufacture 289
Boulton, M. P. W., Perrett, E., and Newlands. Kiln for Char. 423
Bourgeois. Silk 499
Bourquelot, E. Fermentation of Galactose 336, 511, 578
Bousfield, E. T. *See* Howard 203
Boussingault. Asphaltene 837
    Cacao Husks 583
Bouty. Electrical Resistances 691
Bowen, O., and Cobeldick, J. Treatment of Sewage 639
Bowers, H. J. A. *See* Allen 313
Bowick, T. G. Purification of Alcohol 130
Boyen, E. v. Fractional Distillination in Vacuo (illus.) 522
    Retene 116
Brunner, H., and Chuit D. Dichroïnes, &c. 315
Brunner, H., and Chuit P. Dichroïnes from Phenols 670
Brunner, P. Azo-Colours 180
Brunner, Mond, and Co. Concentrated Crystal Soda 481
    Decomposition of Ammonium Chloride 322
Bryant, R. M. Anti-incrustator for Boilers 313
Buchanan, G. Infection 714
Buchanan, J. *See* Mills, E. J 309
Buchanan and Vickers. Kiln for Char 422
Buchner, G. Analysis of Wax 871
    Electro-metallurgy 754
Buczkowski, H. Soluble Polish for Leather 39
Bühring, C. J. Filtering Medium 131
    Purification of Water 835
Buisine, A. Volatile Acids in Suint 219
Bukowski, A., and Aleksandrow, M. Tea Testing 348
Bull, C. A. G. Cotton Seed Husks 591
Bull, H. C. Electo-metallurgy 572
Bull, H. C., and Co. Alluminium Alloys 633
    Extraction of Metals 570
Bull, H. C. and Co., and Sendey, W. E. Sulphate of Ammonia. 437
Bunzener. Maltose 271
Bunsen. Chlorine Determination 344
Bunte. Calorimetry 197
    Gas Analysis 668
    Leaden Water Pipes 669
    Heating Power of Coal 617
Bunte, A., and Scheithauer. Illuminating Power of Candles 390
Bradshaw, J. *See* Lee 501
Bramley, W. Chlorine from Chloride of Calcium 437
Brassard. *See* Schlamm 206
Brauer, E. Ripeness of Yeast 510
Brauer, J. E. Artificial Yeast 223
    Boiling Fermentation 687
Braune, H. Sour Beet Leaves as Fodder 337
Bréal, E. Inoculated Plants 758
    Nitric Acid in Water 590
Breinl. F. Adulteration of Orchil and Cudbear 345
    Magenta in Cudbear 458
    Turkey-red Oils 871
Breinl, F., and Klaudy, J. Bistre Colour 323
Briem. Development of Beet 334
Brierley, W. Automatic Dyeing Vats 434
Brin, A. and L. Q. Bleaching by Chlor-ozone (illus.) 33
    Bleaching Sugar 41
    Chlorine Manufacture 322
    Sugar Refining 335
Brin, L. Q. Bleaching 624
Brinjes, J. F. Crushing machine (illus.) 427
British Alizarin Co. Dyes, &c. at Glasgow International Exhibition 482
Brōnner. Betanaphthylaminesulphonic Acid 742
    Naphthylaminemonosulphonic Acid 839
Brock. Discussion on Recovery of Sulphur 176
Brock, J. Monohydrated Sulphuric Acid 209
Brock, J., and Minton, T. Filter Press (illus.) 313
Brodbelt, J. B. Cheese Manufacture 42
Brogan, A. D., and Mallock, A. M. Rippled Glass 324
Brooke, Simpson, and Spiller. Primuline 386, 561
Brouardel. Saccharin 856
Brown. Brewing 259
Brown, J. Photographic Films 642
Brown, J. C. Discussion on Alkali Process 814
    Discussion on Application of Oxygen 184
    Discussion on Butter Analysis 186
    Discussion on Cement from Lime Mud 303
    Discussion on Chairman's Address (Liverpool) 726
    Discussion on Petroleum Acid Tars 376
    Discussion on Tintometer 426
    Discussion on Weldon-Pechiney Process 10
Brown and Heron. Transformation of Starch 267
Brown and Morris. Fermentation 336
Broxburn Oil Co. Specimens at Glasgow International Exhibition 482
Brucke. E. Congo Red as an Indicator 237
Bruère, S. *See* Ropp, E. 566
Brullé, R. Examination of Olive Oil 457
Brunel. Cement 102
Bruun, A. Peptone and Maltose 763
Brunner, H. Discussion on Chlorine Manufacture 11
Burghardt, C. A., and Twining, W. J. Aluminium 441
    Aluminium Bronze 634
Burkhard. Estimation of Sugar 595
    Raffinose 334
Burmeister, C. C. *See* Kräyenbühl 741
Burnat and Dubied. Combustion of Coal 615
Burnell, G. and A. Cleansing Wool 844
Burquelot. Action of Diastase 513
Burroughs. S. M. *See* Tinlin 313
Burton. Chrome Alum in Photographic Emulsion 690
Burton, W. M. *See* Morse 525, 690, 697
Busch, A. Cement from Slag 439
Butler, H. W. Electric Batteries 218
Butlerow. Formose 396
Butterfield, J. C., and Mason, H. H. Treatment of Sewage Sludge 43
Byron, W. A. Peat Charcoal 837

Cabanis, C. Action of Coal Gas on Malt 223
Caheu, F. *See* Judassohn, J 131
Cailletet. Flue Gases 615
Cailletet, L. Gas Thermometer (illus.) 521
Cailletet, M. Gas Thermometer (illus.) 691
Calvert, F. C., and Co. Carbolic Powders. 828
Campbell, A. Discussion on Desulphurising Coal Gas 7
    Manures 222
Candy, F. Decolourising Material 41
    See Angell 763
Cantor, M. *See* Benedikt 696
Carey, E. Discussion on Alkali Process 813
Carey, Gaskell, and Hurter. Sulphate of Soda Ammonia Process 813
Carlson, A. W. Urine as a Manure 40
Carnelley and Frew, W. Corrosion of Leaden Pipes (illus.) 15
    Corrosion of Leaden Pipes 78
Caro. *See* Baeyer 669
Caro, H. a-Naphthol Derivatives 563
    Azo-Colours 745
Caro and Schraube. Amidodisazobenzene 557
Carter-Bell, J. Action of Sulphur Chloride on Oils 552
Cartier, J. M. *See* Gilliard 501
Casella. Naphtholsulphonic Acid 33
Casella and Co. Naphthylamine sulphonic Acid 430
Casella, L., and Co. Diamine Red 386
    Naphtholdisulphonic Acid 431
Casper, E. Treatment of China Grass 599
Casse, A. Scutching Flax 320
Cazeneuve and Cotton. Methyl Alcohol in Spirits 404
Chadwick, R. and J. W. C. Dyeing Yarns 207
    Wool Dyeing 321
Chambers, A. *See* Manning 689
Chambrier, A. de Thomas. Slag for Vineyards 574
Chance, A. M. Sulphur Recovery (illus.) 162
Chance. Recovery of Sulphur 719
Chance, A. M. and J. F. Alkali Waste (illus.) 210
Chance Bros. Chemicals at Glasgow International Exhibition 481
Chandelon, T. Explosives 868
Chapman, L. *See* Ellice-Clark 845
Chappell, F. W. Sulphuric Acid 560
Charlton, T. *See* Stewart 495

PAGE
Charrin. Exhaled Air 225
Chastaing, P., and Rabillot, E. Morphine-blue 319
Chatelier, H. Le. Calcium Salts in Cements 567
  Cements and Mortars 676
  Plaster of Paris 675
Chatin, A. Treatment of Vines 758
Cheevers, B. W. Phosphorus in Iron 125
Chernoff. Tempering Steel 212
Chevreul. Absorption by Wool and Cotton 621
  Chemistry of Dyeing 817
Chibret. Mercury Compounds as Antiseptics 583
Chittenden. *See* Kühne 449
Christek. Temperature of Fermentation 223
Christy, T. Microscope Lamp (illus.) 719
  Discussion on Electrolytic Bleaching 299
Chuit, D. *See* Brunner 315
Chuit, P. *See* Brunner 670
Ciamician, G., and Silber, P. Apiol 399, 583
Cie Génle. p. la Production du Froid. Refrigerator 313
Cimbal, O. *See* Heine 331
Claassen, E. Catalpin 689
Claisen, L. *See* Beyer 558
Clamond. Gas Burner (illus.) 115
Clamond, C. Incandescent Gas Burner 23
  Incandescence Gas Burner 428
Clark. Hardness of Water 795
Clark, F. S. Distillation of Pine Wood 497
Clark, G. F. H. and R. J. Adhesive Composition 325
Clark, J. Phosphoric Acid Determination 311
Clark, J. B. Condensing Lead Fume 504
Clark. R. *See* Stephens 850
Clark, W. Limed Coal 113
Clark and Smith. Ammonia from Air 736
Classen, A. Electrolytic Analysis 344
  Separation of Titanium and Iron 344
  Electrolytic Analysis (illus.) 401
Claudon, G. E., and Morin, E. C. Fractional Still (illus.) 233
Claudon and Morin. Fermentation 513
  Still 224
Claus, A., and Cloet, S. v. d. Dichloro-α-naphthoquinone Sulphonic Acid 319
Claus, A., and Krauss, J. Sulpho-acids of Meta-cresol 32
Claus, A., and Meixner, A. Narceïne 399
Claus, A., and Stiebel, A. Metanitroquinoline 32
Claus, C. F. Sulphur Recovery 164
  Sulphur from Pyrites, &c. 440
Claus, C. F., and others. Ammonia-Soda Process 435
Clausen. Alkali Manufacture 807
Clayton. Discussion on Water Gas 101
Cleaver, E. Aluminium 36
Cleeves, J. F., and Platts, J. C. Water from Roundwood Colliery 729
Cleeves and Platts. Colliery Water 801
Clegg, C. T. and H. A., and Lee, F. Dyeing Wool, &c. 624
Clemm. Hydrochloric Acid 291
Clerget. Estimation of Cane Sugar 761
Clermont, A. Formation of Peptone 337
Cleve. Amidonaphthalenesulphonic Acid 118
  Naphthylamine-sulphonic Acid 670
Clift, S. Phenolate of Sodium 808
Clinch, C. Brewing 42
Cloet. *See* Claus 319
Clowes, F. Discussion on L. T. Wright's Address 27
Coad, T. Galvanic Batteries 679
Cobledick, J. *See* Bowen 639
Cochenhausen, E. v. Hardness of Water 524
Cogswell, W. B. Bicarbonate Columns (illus.) 110
Coleman, J. B. Discussion on L. T. Wright's Address 27
Coleman, J. J. Obituary 831
Colette. Probe for Beet 856
Collet, H. *See* Sawrey 834
Collin, C., and Benoist, L. Preservation of Animal Substances 331
  Estimation of Tannin 593, 779
Collin, C., and Errani, L. Black Varnish 434
Collin, C., and others. Treatment of Hides 635
Collins, D. L. *See* Thwaite 439
Collyer, R. H. Rhea Fibres 120
Combes. Flue Gases 615
Condon, M. *See* Cunliffe 330
Coninck, F. de. Incombustible Paint 443
Const, M., and Saytzeff, A. Solid Oleic Acid 442
Contarini, A. N. Extraction of Precious Metals 570
Cook. Treatment of Char 423
Cook, E. R., and Ingham, J. W. Charcoal Retort 837
Cook, W. Electrolytic Manufacture of Soda 722, 724

PAGE
Cooper, C. F. *See* Hermite 764
  See Hermite, E. 126
Cooper, W. J. Antiseptic 764
Cornu. Combustion of Coal 616
  Polarimeter 262
Cornut. Calorific Value of Coal 198
Cotton. *See* Cazeneuve 404
Coulon, M. *See* Godeffroy 863
  Dyeing Paper Pulp 843
Counceler. Free Acids in Tannin Liquors 529
Court, H. Hardness of Water 797
Cownley. *See* Paul 44
Cowper, E. A. Filter Presses 313
Coyle, A. McN., Andrews, E. F., and Davidson, E. C. Still for Water, &c. (illus.) 314
Craft, J. B. Refrigerator (illus.) 314
Craig, A. F., Neilson, A., and Snodgrass, J. Separation of Oils, &c. 126
Cramer. Fibroin 499
Creydt, R. Invertion of Sugar 696
Crichton's Oil House. Specimens at Glasgow International Exhibition 482
Crompton, R. E. B., and Howell, J. C. Secondary Batteries 389
Cronenberg, W. Expresstype 588
Crookes, W. Treatment of Gold Ores 571
Crookes, Odling, and Tidy. Action of Water on Lead 16
Croselmire, C. F. Extraction of Zinc 678
Cross, C. F., and Bevan, E. J. Electrolytic Bleaching (illus.) 292
Cross and Bevan. Bleaching 726
Crossley, A. M. Treatment of Ironstone Dust 633
Crossley, H. Magenta in Orchil, &c. 458
Crowder, W. Discussion on the Gas Industry 518
Crum, W. Art of Dyeing 817
Cuisinier. Fermentation 514
  Mashes 447
Cunliffe, H., and Condon, M. Varnish for Printing Ink 330
Cunningham, A. B. Sodium Manufacture 851
Curling, A. H., and Dunbar, J. Treatment of Sewage 639
Currie, C. H. Mineral Oils 682
Curry. Discussion on L. T. Wright's Address 28
Curtius. Hippurylamidoacetic Acid 641
Cutter, W. P. *See* Newbury 740
Czeczetka, G. Alcohol from Molasses 512

Dafert, F. W. Nitrogen Determination (illus.) 134
Dahl, S. T. Amalgamating Gold 852
Dahmo, H. O. Measuring Funnel (illus.) 345
Daisberg. Naphthylaminesulphonic Acid 118
Dambergis, A. K. Mineral Waters from Methana 133
Dames, C. R. Fuller's Earth 324
Danger, H., Simian, A., and de Marcieu. Dyeing Piece Goods. 386
Dannmüller. Estimation of Cane Sugar 761
Dannenborg. Prevention of Bumping 524
Danson. Bistre Colour 320
Danysz. Determining Ash in Sugar 348
Darapsky, L. Los Banetos Mineral Waters 237
  Saltpetre in Tarapaca 844
Darlington, F. Discussion on the Gas Industry 548
Darrow, J. W. Treatment of Hides 331
Darst, O. Yeast from Rye 513
Daudt, C. Manna 222
  Tincture of Iodine 227
Daux, G. Carbolic and Iodoform Gauze 131
Davenport, J. Manures 222
Davidson, E. C. *See* Coyle 314
Davis. Reduction of Gold Chloride 215
Davis, G. E. Alkali Manufacture 627
  Ammonia Still 749
  Carbolic Powders 828
  Softening Water 321
Davis, G. E., and Aitken, J. B. Treatment of Sewage 338
Davison, A. J. Anti-fouling Composition 854
Dawson, D. Magenta 118
Dawson, J. E. Gaseous Fuel 668
Deacon, H. Chlorine Manufacture 287
Deacon and Kingzett. Chlorine 739
Death, J., and Tomkins, A. S. Gelatinised Grain 337
Debette. Flue Gases 615
De Castro. Sugar Refining 422

PAGE
Deering. *See* Abel 503
Degener, P. *See* Lippmann 578
Degener and Herles. Sugar Solutions for Polarisation 349
Degener, P., and Lack. Action of Animal Charcoal 421
Dehérain, P. P. Farmyard Manure 577
Deissler, R. *See* Kuhnt 521
Delaire, G. Magenta 118
Delbrück. Concentrated Mashes 447
  Keeping Power of Beer 515
  Yeasts 687
Delbruck and Foth. Fermentation 447
Delhaye, A. Alkali Manufacture 387
Delmart, A. Bleaching Wool 120
Demme. Thermifugine 866
De Koningh. *See* Muter 826
Derham, B. Duty on Spirits 276
  Standard Temperature of Sykes' Spirit Tables 819
Derosne. Char in Sugar Refining 419
Determann. Manurial Experiments 854
Deutsche Sprengstaff Actiengesellschaft. Explosive 589
Deville. Constitution of Flame 476
  Dissociation 615
Dewar, J. Address at Seventh Annual Meeting 472
  Chlorine Manufacture 10, 286
  Discussion on Coal Distillation 63
  Discussion on Duty on Spirits 284
  Discussion on Electrolytic Bleaching 290
  Discussion on Recovery of Sulphur 178
  Electrolytic Bleaching 728
Dibdin, W. J. Standards of Light 367
Diesterweg, T. *See* Nietzki 557
Dieterich, E. Testings Oils 135
Dietz. Sulphur Determination 525
Diez, R. Estimation of Glycerol 397, 696
Dinsmore, J. R. H. Coal Gas 741
Dirks, V., and Werens, F. Retrograde Phosphoric Acid 345
Dittler. *See* Liebermann 618
Dittmar, W. Discussion on Calorimetry 308
  Hydrate of Lithia 730
  Vote of Thanks to Chairman at Seventh Annual Meeting 479
Dittmar, W., and Fawsitt, C. A. Methyl Alcohol 581
  Properties of Methyl Alcohol 510
Dobbin, L. Estimation of Caustic Alkali 829
Dobler, L. F. *See* Sengel 516
Döbner, O., and Petschow, G. Ketone Compounds 318
Dolinin, W. *See* Alibagow 112
Dollfus. Combustion of Coal 616
Dollfus, E. Fixing Tannin 206
Donath, E., and Müller, F. Recovery of Tin from Scrap 215
  Separation of Tin and Tungsten 344
Donkin. Heat lost by Radiation 617
Donovan, R. E., and McKenny, J. Blacking, &c. 127
Dott, D. B. Alcohol for Manufacturing Purposes 78
  Discussion on Antiseptic Soap 194
  Discussion of Manures 195
  Filter Stand (illus.) 830
Dougall, J. Antiseptics 716
Doulton, H. L., and Rix, W. P. Ornamenting Pottery, &c. 324
Dowson. Gas (illus.) 495
Drake, B. M., and Gorham, J. M. Secondary Batteries 390, 754
Dralle, C. *See* Schall 117
Dralle, G. *See* Schall 838
Dränert, M. *See* Leme 856
Drehschmidt. Absorption of Carbonic Oxide 403
Drehschmidt, H. Absorption of Carbon Monoxide 133
Drenckhan, C. *See* Scherff 43
Dreschfeld, J. Pyrodine 765
Drifield, V. C. Boiler Incrustation 800
Drouin, R. *See* Schlösing 757
Dubied. *See* Burnat 615
Du Bois, A. Chlorination of Ores 572
Dubois, R. Tincture of Litmus 646
Dubois, R., and Vignon, L. Physiological Action of Phenylenediamine 765
Duboscq. Polarimeter and Saccharimeter (illus.) 262, 263
Dubourg. *See* Gayon 512
Dubreuilh, W. *See* Straus 225
Duhl, R. G. Preserving Milk 43
Duisberg, C. *See* Baeyer 33, 430
Dujardin-Beaumetz. Antiseptic Value of Cresol 866
Dulong. Combustion of Coal 616
Dumas. Ammonium Chloride from Coal 735
Dumas, L. Moss in Meadows 220
Dun, A., and Hasslacher, F. Secondary Batteries 126
Dunbar, J. *See* Curling 689
PAGE
Duncan. *See* Stenhouse 423
Dundonald, Lord. Soda Manufacture 661
Dupré, A., and Hake, C. N. Disinfectants 44
Durand, L., and Huguenin. Dyes, &c., at Glasgow International Exhibition 482
Dutailly, G. *See* Lauth 630, 750
Dvorkovitch, P. *See* Ragosine 628

East, F. J. *See* Meldola 617
Ebell, P. Bleaching Wool 207
  Bleaching Wood 120
  Tints on Glass 123
Ebelmen. Flue Gases 615
Ebert and Merz. Naphthalenedisulphonic Acid 618
Eckenroth, H. Oils of Lavender and Rosemary 637
Eder. Orthochromatic Photography 767
Eder, J. M. Orthochromatic Collodion 690
  Potassium Metabisulphite 867
Edlar. Cultivation of Oats 40
Egger. Examination of Wine 457
Eggertz. Carbon in Steel 72
Egleston, T. Extraction of Copper at Agordo 503
Eglinton Chemical Co. Chemicals at Glasgow International Exhibition 481
Ehrlich, E., and Benedikt, R. Orthocinnamiccarboxylic Acid 671
Ehrlich, E. *See* Benedikt 391
Einhorn, A. Cocaïne 228
Eisfeld. Revivification of Char 424
Ekman, F. L. Determination of Fusel Oil 405
Ekstrand, A. G., and Johanson, C. J. Carbohydrates 128
Elbers, W. Decomposition of Antimonious Sulphide 322
Electrical Power Storage Co. Batteries 218
Elieson, C. P. Electric Batteries 572
Elion, H. Pure Yeast (illus.) 447
Ellenberger and Hofmeister. Oxynaphthoic Acid 130
Ellice-Clark, E. B., and Chapman, L. Oxygen from the Air 845
Ellis. Hardness of Water 804
Ellis, C. J. Waste Liquors 812
Elmore, F. E. Cleaning and Coating Metal 328
Elsner. Brandy 637
Elwell, P. B. *See* Salomons 126
Elwes. Sugar Refining 422
Emde, B. Iron in Oil 591
Emerson, E. Electro-deposition of Copper 572
Emmens, S. H. Explosive 868
Emmerling, A. Estimation of Soluble Phosphoric Acid 343
  Experiments on Barley 394
  Thomas-Slag Manure 633
Emmert. Dihydroxynaphthalene 618
Endler. Bistre Colour 320
Engelmann, T. W. Bacteriopurpurin 338
Engler. German Petroleum 202
  Thiobenzophenone 204
Engler, C. German Mineral Oil 505
  Petroleum 428
Enzinger, L. A. Filter Presses 313
Erdmann, F. H. β Naphthylamine-sulphonic Acid 430
Erdmann, H. Ketonaphthol 430
Erlenmeyer and Reissner. Narceine 866
Erroni, L. *See* Collin 434
Eschellmann, G. *See* Mond 845
Espeut. Sugar Refining 422
Estcourt, C., Veevers, H., and Schwab, M. Purification of Coal Gas 2 3
Evans, J. W. Percolators for Extraction of Oil 507
Evenstad, O., and Senstad, O. Wood-wool (illus.) 499
Everitt, P. Filters 833

Fahlberg, C. Phosphorus Trichloride 675
  Saccharin 856
Fahlberg, C., and List, R. Orthosulphamine Carboxylic Acids 333
Fahnejelm. Gas Burner 23, 112
Faija, H. Cement 108
Fairley. Lithium in Water 801
Fairrie. Bistre Colour 320
Faisst. Hardness of Water 869

PAGE
Faraday. Iridium Iron ... 212
  Law of Electrolysis ... 298
Farbenfabriken vorm. Bayer and Co. Azo-Dyes ... 31, 619, 620
  New Colours ... 386
Farbwerke vorm. Meister, Lucius, and Brüning. Nitroso-derivatives ... 120
  Auramines ... 205
  Methylene Blue ... 206
  Colours from Benzanilide Derivatives ... 130
Farley. Drier for Char ... 422
Farmer, E. H., and Tomkins, H. K. Photography ... 767
Faulkner, F. *See* Adlam ... 42
Faure, C. A. Soda Manufacture ... 724
Faurie, G. A. Aluminium ... 124
  Aluminium Alloys ... 633
Faust. Conessine ... 585
Favier. Explosives ... 519, 589
Favre and Silbermann. Calorimeter ... 196, 816
Fawsitt, C. A., Action of Sulphur Chloride on Oils ... 552
  Discussion on Alcohol for Manufacturing ... 78
  See Dittmar ... 510, 581
Feer, A. Diamidoethozydiphenyl Sulphonic Acid ... 839
Fehrmann, W. Auramines ... 117
  Thioketone ... 118
Feilitzer, C. V. Peat Moss Litter ... 855
Feldmann, A. Aluminium Alloys ... 633
  Fluorides ... 122
Feltmann. Yeast (illus.) ... 447
Fenner, H. J. and G. H. F. Moulding Naphthalene ... 741
Fenten, S. C. and J., and Fitton, J. Soap ... 682
Feraris. Gas Generator ... 203
Fesca, M., and Imai, H. Japanese Tobacco ... 759
Field. Polarimeter ... 831
Field, R., and Co. Polarimeter ... 713
Field, W. D. Pyroxyline Varnishes ... 443
Fife. Duration Test of Light ... 374
Filsinger, F. Estimation of Glycerol ... 359
Fischer. Calorimetry ... 197
  Connecting Lightning Conductors with Gas Mains ... 668
  Heating Power of Coal ... 617
  Photometric Value of Burners ... 113
  Reagent for Tannin ... 517
Fischer, B. Impurities in Reagents ... 645
  Iodine Trichloride ... 209
  β-Naphthol ... 226
  Salicylates ... 399
  Sulphonal ... 451
Fischer, E. Compounds of Phenylhydrazine with Sugars ... 396
  Hydrazones ... 404
Fischer, E., and O. Amidobenzaldehyde ... 384
  Rosaniline Salts ... 743
Fischer, E. and Hirschberger, J. Mannose ... 508
Fischer, E., and Schmidt, J. Pr. 3 Phenylindole ... 559
Fischer, E., and Tafel, J. Isodulcite ... 656
  Synthetical Experiments in Sugar Group ... 128
Fischer, F. Comparison of Gases ... 112
  Fires in Benzene Works ... 312
  Thermo-chemistry ... 739
  Value of Fuels (illus.) ... 690
Fischer, J. Cooler for Gases, &c. (illus.) ... 554
Fischer, O. Flavaniline ... 384
Fischer, O., and Hepp. Azophenine ... 562, 743
  Nitroso-derivatives ... 150
  Paranitroso-aniline, &c. ... 316
Fitch, A. S. Blasting Powder ... 643
Fittig. Metaxylylenediamine ... 742
Fitton, J. *See* Fenton ... 682
Fitton, J. J., jun., and E. Destruction of Vegetable Fibres (illus.) ... 620
Fitz. Fermentation of Glycerol ... 129
Fitz-Gerald, D. G. Oxide of Lead Battery Plates ... 37
Fives-Lille, La Cie. de. Diffusion Apparatus ... 129
Flavitzky. Isoterpenes ... 587
Fleischer. Estimation of Antimonic Acid ... 344
Fleming, J. Calcining Ores ... 504
Fletcher, A. E. Discussion on Recovery of Sulphur ... 175
Fletcher, G. Evaporation of Sugar Juice ... 686
Fletcher, J. Commercial Application of Oxygen ... 182
Flückiger. Diosphenol ... 585
Fluckinger, F. A. Antimonic Fluorides ... 624
Foerster, O. Extraction of Fats (illus.) ... 137, 455
Fogarty, T. B. Ammonia Manufacture ... 35
Fokke. Animal Ferment ... 514
Follenius. Invert Sugar ... 222
Forcrand, De, and Villard. Hydrate of Methyl Chloride ... 516
Forel, S. Tetrazo Colours ... 320
Foret. *See* Bondonneau ... 514

PAGE
Foret, A. J. M. G. Saccharification of Starch ... 335
Forrest, R. W. and W. *See* MacArthur ... 389, 678
Förster. Sugars ... 41
Forster, W. G. Aluminium Manufacture ... 851
Fortin, A. A. Galvanic Battery ... 572
Foster. Discussion on Standards of Light ... 373
Foster, F. Carbonic Acid Apparatus ... 749
Foth. Fermentation ... 510, 512, 513, 515
  See Delbruck ... 417
Foth, G. Aeration of Malt ... 637
Fox and Wanklyn. Determination of Glycerol ... 779
France, J. Aërated Milk ... 130
Francis, E. Discussion on L. T. Wright's Address ... 27
Francke, G. Distiller's Wash for Yeast ... 687
  Yeast Manufacture ... 637
Frank, B. Explosions in Coal Mines (illus.) ... 215
  Nitrification ... 760
  Nitrogenous Algæ in Soil ... 759
  Origin of Nitric Acid in Plants ... 444
  Sterilisation of Soil ... 758
Franke. Explosions in Mines ... 325
Fränkel, B. Lanolin ... 310
Frankel, C. Micro-organisms in Soil ... 854
Frankhausen, J. Softening Cell Walls with Barley ... 512
Frankland, P. Discussion on Antiseptics ... 717
  Water Analysis ... 799, 803
Franzen, C. H. J. Refined Sugar ... 42
Fraser, J. Lucifer Matches ... 231
Fraser, W. M., and Snodgrass, J. Retort for Shale ... 429
Freda, P. Italian Wines ... 688
Freire, D. Solanum Grandiflora ... 227
Frelinghuysen, G. *See* Higbie ... 846
Fremy. Bismuth Tetroxide ... 525, 694
French, A. Ammonium Chloride from Coke ... 735
Frère, G. Purification of Coal Gas ... 427
Fresenius, R. Estimation of Fusel Oil ... 396
  Water Analysis ... 800
Fresenius, R., and Hintz, E. Estimation of Arsenic in Fabrics ... 456
Frey, A. Antimony Fluoride ... 566
  Antimony Mordant ... 207
Fricker, B. Yeast ... 510
Frühling and Schulz. Examination of Beetroot ... 528
Fuchs. *See* Trottier ... 440
Fudakowski. Fermentation of Galactose ... 578
Fürbringer. Camphoric Acid ... 866
Fürstenhagen, O., and Appleyard, S. R. Absorption by Wool, &c. ... 621

Gabriel and Michael. Benzhydrylaceticcarboxylic Acid ... 671
Gall. *See* West-Knight ... 808
Gall, H., and Montlaur, A. de. Chlorates ... 327
Gall, W. D. *See* Knight ... 429
Galland. Malting ... 687
Gallois, N. *See* Hardy ... 586, 765
Gamble, J. C., and Son. Chemicals at Glasgow International Exhibition ... 481
Gaunter, F. Tannin Determination ... 238
Gans, R., Stone, W. E., and Tollens, B. Reactions for Dextrose and Arabinose ... 595
Gartside, J. H., and Barnes, J. Dyeing Cotton ... 624
Garratt, J. R., and Scott, W. Flax Fibre ... 501
Garton, T., and Barkley, W. Black Varnish ... 573
Gascard, A. Caoutchouc Varnish ... 573
Gaskell, Deacon, and Co. Chemicals at Glasgow International Exhibition ... 481
  Soda Manufacture ... 723
Gatty, F. A. Dyeing ... 321
Gaucher, E. *Hedwigia Balsamifera* ... 765
Gautier, A., and Mourgues, L. Cod Liver Oil ... 585
Gautier, A. *See* Schlosing ... 757
Gawalowski, A. Estimation of Sulphuric Acid ... 455
Gay Lussac. Silver Assay ... 457
Gayon, U. Determination of Aldehyde ... 238
Gayon and Dubourg. Ferments ... 512
Gehring, G. Earth Closet with Peat ... 333
Geigy, J. R. Red Azo-Colour ... 433
  Xanthaurin ... 386
Geinlue, A. de. Filter for Wine ... 638
Geitel, A. C. Action of Sulphuric Acid on Oleic Acid ... 218
  Borneo Tallow ... 391
Geitel. Oxystearic Acid ... 755
Geller, W. *See* Lellmann ... 642, 671

PAGE

Gentles, W. *See* Scott 754
George, P. *See* Lüteke 634
Gerard, M. P. E. Elastic Composition 127
Gerdes, W. Utilising Brewery Sediments 12
Gerlach, G. T. Specific Gravity of Solutions 521
Gerlicz, L. de. *See* Ostachiewicz 638
Gerlins, H. *See* Lookeren 595
Geromont. *See* Goldenberg 349
Gerson, E. Chemical Tanning 683
Geseknis. Stable Manure 127
Giacosa and Monari. Xanthoxylon Sengealense 310
Gibb, T. Cement from Slag 677
  See Scott 325
  See Snelus 631
  See Tyne Alkali Co. 675
Gibbons, R. A. Cement 106
Gibbs, Willard. Dissociation 477
Gibson, C. D. P. Secondary Batteries 755
  Storage Batteries 442
Giglioli, I. Phosphorite from Capo di Leuca 684
Gildemeister, E. *See* Wallach, O. 586
Giles, W. B. *See* Boake, A. 764
Giles, W. B., and Shearer, A. Antiseptic 764
  Phosphoric Acid 34
Gillet, M. Olive Seed Husk in Pepper 763
Gilliard, A., Monnet, P., and Cartier, J. M. Dyeing Fibres 501
Gilpin. Specific Gravity of Spirits 277
  Spirit Tables 820
Ginsberg, J. Apiol 399
Gionoli. Recovery of Soap 841
Girard, C. Magenta 118
  See Müntz, A. 577
Girard, F. *See* Tack 428
Girling, G. G. Artificial Stone 325
Gismondi, L. Filter Presses 834
Glaser, F. C. Explosives 857
  Regenerative Furnaces 836
Glaser, M. *See* Kalmann 870
  See Morawski 687
  See Thorawski 448
Glasgow Alum and Ammonia Co. Chemicals at Glasgow International Exhibition 482
Glennie, T. Disposal of Sewage 763
Gley, E. Ouabain and Strophanthin 765
Gmelin. Ultramarine 573
Gmelin, O. Carbon in Iron 646
Gniewosz, S., and Walfisez, A. Absorption of Gases by Petroleum 772
Godeffroy, R., and Coulon, M. Estimation of Wood in Paper. 863
Godefroy, L. Impurities in Alcohol 457
Godefroy, M. L. Spirit Manufacture 859
Goessmann, C. A. Fertilisers 576
Goldenberg. Analysis of Substances containing Tartaric Acid 136
  Tartaric Acid Determination 239
Goldenberg, Geromont, & Co. Analysis of Wine Lees 349
Goldie, Sir G. T. Indigo 429
Golding, H. Treatment of Leather 220
Goldmann. Starch Determination 348
Goldmann, F. Derivatives of Anthranol 671
  Testing Butter 238, 348, 527
Goldschmidt, H., and Molinari, E. Diazoamido Compounds .. 672
Gomolka and Bohm. Cooler for Yeast 511
Goodall, T., and Webster T. Strainer for Pulp (illus.) 339
Goodman, J. Calorimetry 196
Goodyear, W. A. Californian Petroleum 410
Goreham. Cement 105
Gorham, J. M. *See* Drake 390, 754
Görtz, A. Reduction of Gold Chloride 215
Gorup. Guaiacol 227
Gossage. Sulphur Recovery 163
Gosslich. Cement Lining for Spirit Reservoirs 514
Gössmann and Scheen. Earth Nut Oil 391
Gottfried. *See* Sachsenröder 222
Göttig, C. Compounds of Caustic Soda and Methyl Alcohol .. 453
Gottlieb. Dinitro-aniline 839
Goulborne, J. *See* Tuteur 220
Grabau, L. Aluminium Alloys 753
  Aluminium Fluoride 675
Graebe, C. Auramine 80
Graebe and Liebermann. Ruberythric Acid 382
Graham. Chlorine Manufacture 288
  Colloid Metallic Sulphides 34
Graham, Miller, and Hofmann. Action of Water on Lead 16
Grahn, E. Treatment of Gas Liquor 502, 557
Grancher. Exhaled Air 225
Grandeau. Milk Sugar 222

PAGE

Grangier, P. *See* Pichot 573
Grant, J. Cement 103
Grave, L. Cleaning Fabrics, &c. 747
Grawitz, W. J. S. Fleece Dyeing 321
  Preparing Cotton Fibres for Dyeing 622
  Treatment of Aniline Black 121
Gray. Discussion on Value of Fuel 309
  Electrolytic Deposition of Copper 293
Grazer, F. Cascara Sagrada 339
Greaves, J. A. R. *See* Bailey 638
Greaves, R. Cement 105
Grebel, A. Gas from Tar 112
Green, A. G. Primuline 386
  Cotton Colours (illus.) 179
Green, E. Explosive 589
Gréhant and Quinquaud. Respiration of Yeast 686
Grete, A. Phosphoric Acid Determination 771
Griess. Azo-Bodies 562
Griess, J. Peter. Obituary 612
Grimbert, L. *See* Jungfleisch 761
Grimshaw, H., and Kenyon, H. Zinc Residues 388
Gronlund, C. After-taste of Beer 337
Grosfils, P. Lactacidine (Antiseptic) 132
Grosse. Photometer 668
Grosseteste, C. Wild Silk 840
Grossmann, J. Hardness of Water 797
Grote, H. Removing Fusel Oil from Spirits 129
Grote and Pinetta. Defuselisation of Spirit 687
Grouvelle, P. J. Iron Cement 211
Grove. Decomposition of Water 476
Groves, C. E. Discussion on Desulphurising Coal Gas 7
Gruber. Butyric Ferment 513
Grüner. Calorimetry 197
Grunhut, J. Dyeing 207
Grussner. Oxystearic Acid 755
Grussner, A. *See* Hazura 506, 681
Guéret, L. and C. Carbonic Acid Generator 762
Gugenheim, H. Liquors for Brewing 860
Guimet, E. Ultramarines 573
Guimet, J. B. Ultramarine 573
Gumbel, v. Westphalian Coal 556
Gumbinner. Spirit from Dari 447
Gunn, H. H. Sulphide of Zinc 38
Guranville. Boldin 585
Güttler, H. Charcoal for Explosives 521
  Charcoal Powder 588
Guttmann, O. Explosives 588
Gutzkow, F. Magnesia from Sea Water 844

Habermann, J. Methyl Alcohol in Spirits 404
  Testing Ethyl Alcohol 772
Habgood, W. *See* Kynoch 389
Hack. Discussion on Water Gas 101
Häckel, G. T. Citric Acid in Cows' Milk 861
Hackmann, H. Barrel for Clearing 514
Hadfield, R. A. Manganese Iron 211
Haen, de. Antimony Fluoride 566
Haen, E. de. Antimony Fluorides 841
Hagen, v. *See* Zincke 316
Hager. Cod-liver Oil 37
Haines. Conessine 585
Hake, C. N. *See* Duprè, A. 44
Hale, J. Varnishes 392
  Varnish for Wood, &c. 330
Hall. Influence of Pressure on Chemical Change 475
Hall and Hermanus. Lignoceric Acid 391
Hallsworth, S., and Bailes, R. Ferric Sulphate 625, 626
Halske. *See* Siemens 514
Hamberg. Properties of Higher Alcohols 513
Hamburger. *See* Liebermann 382
Hamburger, S. Discussion on Chairman's Address (Liverpool) 725
Hamilton, J. W. Disinfectants 398
Hammer. Estimation of Tannin 593
Hampe. Aluminium 389
  Manganese Determination 234
Hampe, W. Aluminium Bronze 325
Hanak, J. Yeast 510
Hanausek, T. F. Oil of Lallemantia Seed 219
Hance. Preservation of Books from Insects 409

PAGE

- Hanlon, P. Preservative Polish 635
- Hannay, J. B. Lead Pigments 330
- Hansen. Pure Yeast 447
  - Yeast 336
- Hansen, E. C. Brewing 337
  - Examination of Air 858
  - Pure Yeast 515
- Hanson, J. Alkali Waste 626
  - Disinfection 150
  - Treatment of Sewage 749, 763
- Hantke, E. Orthocresulphonic Acid 32
- Harcourt. Pentane Standard 367
- Harcourt, A. G. V. Photometric Standard 741
- Harcourt, V. Oxygen Carriers 122
- Hard, J. R., and Wilson, T. Galvanic Batteries 572
- Hardman. Centrifugal Machine 419
- Hardman and Holdens. Dyes, &c. at Glasgow International Exhibition 482
- Hardmeyer, E., Hatch, H. W., and Jackson, J. C., Steel Manufacture 634
- Hardy, E., and Gallois, N. Anagyrine 765
  - Strophanthine 586
- Harford, J. H., and Reeves, W. W. Herbal Snuff 43
- Hargreaves. Soda Manufacture 721
- Hargreaves, J. Cement 676
  - New Motor 30
- Hargreaves, J. and J., and Robinson, T. Treatment of Pyrites 217
- Harmel, A., M., and F. Wool Dyeing 434
- Harpe, C. de la. *See* Reverdin, F. 593
- Harris, H. G. Antiseptics 43
- Harris, R. Discussion on Standards of Light 372
- Hartland, W. H. Treatment of Sewage 131
- Hartley, W. N., and Blenkinsop, W. E. B. Metallic Sulphates 435, 437
- Hartshorn, G. T., and Jackson, C. L. Aniline-trisulphonic Acid 669
- Hasenclever. Hydrochloric Acid Gas 289
- Haslehurst, G. S. Beverage from Sea Water 862
- Hasslacher, F. *See* Dun, A. 126
- Hatch. *See* Hardmeyer 634
- Hatchett. Caoutchouc Varnish 573
- Hatschek, E. T. Malto-peptine 859
- Hatton, F. Action of Gases on Bacteria 717
- Hauff, J. Basic Aluminium Chlorides 624
  - Basic Sulphocyanide of Aluminium 433
  - Basic Sulphocyanides 207
- Hawliczek, J. *See* Mathieson 323, 387
- Hayden, E. S. Metal Refining 390
- Haydiroth. Fermentation of Galactose 511
- Hayduck. Fermentation of Galactose 578
  - Lactic Ferment 510
  - Lactic Fermentation 513
  - Litmus Paper 514
  - Potable Spirit 687
- Hazura K. Oxidation of Fatty Acids 681
  - Unsaturated Acids in Fats 219
  - *See* Bauer 680, 681
- Hazura, K., and Grüssner, A. Drying Oils 506
  - Drying Oleic Acid 681
- Heaton, C. W. Sulphur Recovery 164
  - Discussion on Desulphurising Coal Gas 7
- Heckel, E. Sodium Sulphibenzoate as an Antiseptic 226
- Heckel, E., and Schlagdenhauffen, F. Vernonine 517
- Hefner-Alteneck. Standard Lamp 368
- Heffter, P. J. E. Clarification of Sugar Solutions 446
- Hefftner. Purification of Sugar 509
- Hehner. Butter Analysis 186
- Hehner, O. Discussion on Standards of Light 372
  - Hardness of Water 797
- Heiden. Nitrogen lost from Manure 508
- Heiden, E. Bone Powder 133
  - Cultivation of Maize 757
  - Farmyard Manure 332
  - Valuation of Ground Bones 779
- Heine, Cimbal, O., and others. Potato Cultivation 331
- Heine, F. *See* Beseler O. 40
- Heinicke, O. Filter for Wort Samples 514
- Heinzelmann. Fermentation 512
  - Filter for Wort Samples 514
  - Wort Purifying 513
- Heinzerling, C. Oxidising Furnace 628
  - Separation of Chlorine from Mixtures 673
- Helbing, H. Schinus Molle 340
  - Strophanthus 227
- Hellot. Theory of Dyeing 816
- Hellriegel. Sterilisation of Soil 758
- Helm, H. J. Discussion on Duty on Spirits 283
- Hempel. Absorption of Carbon Monoxide 133
- Hempel, M. Purification of Gas 380
- Hempel, W. Absorption of Carbonic Oxide 403
  - Ammonium Chloride 387
  - Combination of Carbon and Iron by Pressure 388
  - Evaporation of Liquids (illus.) 379
  - Magnesium Chloride 386
- Henderson, J. F. Unfermented Wine 859
- Henderson, N. M. Purifying Paraffin Wax 116
- Henderson, R, J. Iron Smelting 125
  - Purification of Carbonic Oxide 315
- Henniger and Sanson. Glycol from Fermentation of Sugar 336
- Henry, J. Art of Dyeing 817
- Henwood. Calorific Value of Fuel 198
- Hepp. *See* Fischer, O. 562
- Hepp, E. *See* Fischer 316, 743
- Herberz. Coke Oven 836
- Herles. *See* Degener 349
- Herles, F. Inversion of Sugar 696
- Herman, D. Condensers for Acid Gases (illus.) 845
  - Crystals of Phosphorus 9
  - Glycerin Paper 300
  - Sulphate of Soda Manufacture (illus.) 673
- Hermanns. *See* Hall 391
- Hermite, E. Bleaching 321
  - Disinfection by Electrolysis 764
  - Electric Bleaching 737
  - Electrolytic Bleaching 293
- Hermite, E., Paterson, E. J., and Cooper, C. F. Electrolytic Bleaching 126
- Heron. *See* Brown 267
- Heron, J. Hardness of Water 803
  - Polarimeter for Brewers 713
  - Polariscope applied to Brewing (illus.) 259
- Héroult, P. L. T. Aluminium 441
- Herrmann, A. M and E. Dyeing Furs 747
- Herroun. Estimation of Antimonic Acid 344
- Herz, J. Lichtenhainer Beer 337
- Herzfeld. Carbohydrates 685
  - Estimation of Invert Sugar 236
  - Examination of Brandy 871
  - Fermentation of Galactose 511, 578
  - Hydrosulphite Indigo Vat 321
  - Invert Sugar 222
- Herzfeld, A. Examination of Molasses 695
  - Invert Sugar 696
  - Levulose 445
- Herzfeld and Reischauer. Saccharin 527
- Heselwood, J. Rinsing and Wringing Machine 34
- Hess, P. Fulminating Mercury Fuse 342
- Hesse. Phytosterin 37, 223
- Hesse, A. Attemperators 687
- Hesse, E. Cooler 511
  - Potato Mash for Spirit 447
- Hesse, O. Coca Bases 341
  - Quinine Alkaloids 350
  - Sulphate of Quinine 349
  - *See* Jobst 327
- Hewitt, D. B. Discussion on Recovery of Sulphur 177
  - *See* Mond 122
- Heyden, F. v. *See* Nencki 690
- Heymann, B., and Koenigs, W. Lepidine Derivatives 642
- Hibbert, G. Pulp Strainer for Paper (illus.) 398
- Higbie, M. S., and Frelinghuysen, G. Damp-proof Vessels 846
- Higgins, J. Somersetshire Cider 857
- Hill, D. Alkali Manufacture 807
- Hillman, H. N., and Kleinpass, G. B. Margarine 338
- Hindorf, R. Germination of Plants 575
- Hinshaw. *See* Arthur 483
- Hintz, E. Ammonia Determination 772
  - Estimation of Acetone 459
  - *See* Fresenius, R. 456
- Hirsch, R. α-Naphthylamine-mono-Sulphonic Acid 670
  - Oxalic Acid as By-product of Aniline 498
  - Spontaneous Combustion of Nitrobenzene 563
- Hirschberger, J. *See* Fischer 508
- Hlasiwetz. Guaiacol 227
  - Rutin 382
- Hodge, A. Baryta 731
- Hoff, van t'. Thermodynamics 478
- Hoffmann. Cement Kiln 107
- Hoffmeister, W. Cellulose 620
- Hofman, F. Naunhof Water 397
- Hofmann. Methenylamidophenylmercaptan 203
- Hofmann and Martius. Methylaniline By-product 318
- Hofmann. *See* Graham 16
- Hofmeister. *See* Ellenberger 130
- Holbling, V. *See* Sobieczky 524
  - Examination of Blacking 235
- Holde. Detection of Rosin Oil 526

PAGE

- Holderer. Fermentation 512
- Holdefleiss. Nitrogen lost by Manure 508
- Holliday, R. Insoluble Cotton Colours 180
- Holm. *See* Goldschmidt 672
- Holm, G. E. Cooling Wort 333
- Holm, J. C. Cooling Wort 223
- Holt, H. *See* Macevoy 325
- Holtz, E. Alcohol Manufacture 448
- Holzapfel, W. C. A. Compositon for Ships' Bottoms 683
- Holzmann, E. Thio-Derivatives of Aromatic Amines 672
- Hönig, M., and Jesser, L. Carbo-hydrates 685
- Hönig, M., and Schubert, St. Crystalline Levulose 415
  - Lichenin 129
- Hood, J. J., and Salamon, A. G. Desulphurising Coal Gas 3
  - Desulphurisation of Gases 617
- Hooker. Retene 116
  - Vasicine 866
- Horn, F. M. Benzoic Acid in Milk 225
  - Estimation of Mineral Oils in Fats 696
  - Gold and Tellurium Ores 326
  - Oil from Jatropha Curcas Seed 142
- Hornberger, R. Purification of Waste Water 578
- Horne, W. L. Spirit Still (illus.) 763
- Hotter, E. Phenaceturic Acid 611
- House, H. Artificial Leather 331
- Howard. Coca Leaves 400
  - Vacuum Pan 419
- Howard, D. Discussion on Antiseptics 716
  - Discussion on Coal Distillation 62
  - Discussion on Desulphurising Coal Gas 7
  - Discussion on Duty on Spirits 282
  - Discussion on the Gas Industry 547
  - Discussion on Polarimeter 713
  - Discussion on Recovery of Sulphur 177
  - Discussion on Standards of Light 372
  - Discussion on Water Analysis 802
  - London Chamber of Commerce 794
- Howard and Sons. Chemicals at Glasgow International Exhibition 482
- Howard, J., and Bousfield, E. T. Gas Manufacture 203
- Howard, S. L. *See* Wells 320
- Howatson, A. Treatment of Sewage 43
- Howell, J. C. *See* Crompton 389
- Huber, E. Methyl Alcohol 515
- Hübl. Analysis of Wax 871
  - Examination of Oils 594
  - Testing Oils 135
- Huchard. Quebracho Bark 132
- Hueppe. Well Water 669
- Huggenberg, C. Nitrates, Permanganates, &c. 673
- Hughes. Brittleness of Metals 35
- Hughes, C. Treatment of Vines for Peronospera 39
- Hughes, O. Cement 631
- Hummel, J. J. The Dyeing of Textile Fabrics 773
- Humphrys, F. C. Discussion on L. T. Wright's Address 28
- Humphrys, N. H. Discussion on Coal Distillation 62
- Hundhausen. *See* Langen 835
- Hunt, C. Discussion on Water Gas 100
- Hunt, W. Ammonia Manufacture 736
- Hunter, A. G. Alkali Manufacture 807
- Huntley, A. H. Yeast 688
- Hurter, F. Address to Liverpool Section 719
  - Bleaching 293
  - Chlorine Manufacture 288
  - Discussion on Alkali Process 813
  - Discussion on Chlorine Manufacture 10
  - The Hermite Process of Bleaching 726
- Hutchins. Explosion of Gases by Electric Lamps 557
- Hutchinson, A. H. Antiseptics 715
- Hutchinson, C. C. *See* Johnson 427
- Hutchinson, T. C. Treatment of Slag 677
- Hutton. Theories of Chemical Action 475

- Ihl, A. Coal Tar Colours formed on Fibre 744
  - Colour Reactions of Starches 511
  - Examination of Beet Sugar 238
  - Methylene Blue as Test for Glucose, &c. 347
- Ikuta, M. Paranitrosodiphenylamine 318
- Ilge. Purification of Spirit 687
- Ilges, R. Still (illus.) 514
- Ilinski. Estimation of Iron 236
  - α-nitroso-β-naphthol Derivative 316
- Imai, H. *See* Fesca 759
- Ingham, J. W. *See* Cook 837
- Ingraham. Adulteration of Sherry 637
- Irelan, W., jun. Californian Petroleum 410
- Irvine. Discussion on Manures 195
- Isbert, A., and Stutzer, A. Estimation of Phosphoric Acid 44
- Isbert and Venator. Examination of Lard 527
  - Estimation of Sodium Hydrate 234

- Jackson. *See* Hardmeyer 634
- Jackson, C. Asbestos Filters 833
- Jackson, C. L. *See* Hartshorn 669
- Jackson, H. Hardness of Water 797
- Jackson, J. H. Liquid Enamel 854
- Jacobsen, E., and Julius, P. Product of Cinnamic and Gallic Acids 117
- Jacquemin, G. E. Barley Wine 397
- Jaegermayer, E. Valuation of Wool 620
- Jagenburg, G. Dyeing Cotton 386
- Jameson. Sal-ammoniac from Coal 735
- Jameson, J. Coke Ovens 838
  - Paper protected against Erasure, &c. 864
- Jandrier. Mononitro-acenaphthene 382
- Japp and Klingemann. Benzeneazoacetone 558
  - Mixed Azo-compounds 203
  - Sodium Methylacetoacetic Ether 742
- Jarmain, G. Water Analysis 796
- Jawein, L., and Lamansky, S. Illuminating power of Gas mixed with Air 315
- Jeger, J. Dried Moss as Disinfectant, &c. 333
- Jehn, C. *See* Klein 527
- Jellett. Polarimeter 262
- Jellineck, G. *See* Liebermann 383
  - Flavopurpurin 743
- Jenkin, Fleming. Gaseous Fuel 668
- Jennings, E. P. Titanium in Iron Ores 590
- Jensch, E. Calcium Sulphite 508
  - Manure with Calcium Sulphite 333
  - Manurial Value of Lime in Slag 332
- Jensen, P. C. Fertiliser 508
- Jeremin, F. Action of Sulphuric Acid on Ferrous and Aluminium Sulphates 844
- Jessor, L. *See* Hönig, M. 685
- Jewell, O. H. Filter 398
- Jeyes, O. Anticorrosive Compound 127
- Johst, J. v., and Hesse, O. Kola nuts 397
- Jodelbauer, M. Evolution of Carbonic Acid during Fermentation (illus.) 636
- Joffre, I. Fastness of Colour on Fabrics 671
- Johanson, C. J. *See* Ekstrand 128
- Johansson, C. A. Manufacture of Butter (illus.) 450
- Johnson, D. Nitrocellulose Gunpowder 342
- Johnson, I. C. Cement 105
- Johnson, S. H., and Hutchinson, C. C. Filter Presses 427
- Johnson-Johnson, J. E. Acetic Acid 628
- Johnstone, H. R. *See* Webb 203
- Jolles. Estimation of Glycerol 350
- Jolles, A. Determination of Glycerol 136
  - Estimation of Antimonious Acid 344
  - Examination of Chloroform 135
- Jones. Diacetylacetic Ether 742
- Jones, E. A. and F. F. Oxides of Iron 443
- Jones, R. Preserving Food 338
- Jones (Consul). Indigo in China 444
- Jörgensen. Narcotine 518
- Jörgensen, A. Pressure Gauges for Malt Kilns 858
- Jouanne. Gas Testing 113
- Judassohn, J., and Cahen, F. Cholera Bacteria 131
- Judell, M. W. *See* Singer 499
- Julius, P. Calico Printing in 1887 386
  - *See* Jacobsen, E. 117
- Jungfleisch, E., and Grimbert, L. Levulose 761
- Jungfleisch and Lefranc. Levulose 445
- Juptner. Analysis of Iron 616
- Juranville. Boldoin 866
- Jurisch. Electrolysis 300
  - Force lost in Electrolysis 724
- Jurisch, K. W. Copper Waste Liquors 124
  - Decomposition of Ammonium Chloride 322
  - Electrolysis of Calcium Chloride 327
- Just, L. Action of Sulphurous Acid on Vegetation 220

- De Kalb, Courtenay. Electrical Silver Refining 571
- Kalmann, W. Estimation of Nitrous Acid 870
- Kalmann, W., and Gläser, M. Action of Potash on Realgar 870

PAGE
Karcz, M. Coniferyl Alcohol in Spirit 515
Karpeles, J. Concreting Amber Shavings 38
Karsten. Ammonium Chloride from Coal 735
Karsten, B. Purification of Mercury (illus.) 522
Karth. Exhaled Air 225
Kassner, G. Oil of Millet 341
Kast. Sulphonal 451
Kay, P. Determination of Picric Acid 592
Kayser. Crocose 396
Keates. Standard Lamp 367
Keene, J. Discussion on Duty on Spirits 283
Keep, W. J., and others. Influence of Aluminium on Iron.... 752
Kehrmann. *See* Nietzki 316
Keirby, E. Cement 325
  Mucilage 580
Keith. Oil Gas 199
Kekulé. Azo-Bodies 562
  Water-bath 232
Kellner, C Cellulose 132
Kellner, O. Excrements as Manure 127
  Japanese fodders 860
Kemp, J. F. Lead Smelting in Missouri 503
Kempf. *See* Unger 446
Kennepohl, G. Estimation of Iron and Aluminium 590
Kenyon, H. Water Gas 30
  See Grimshaw 388
Kern. Thioketone 118
Kern, A. Colouring Matters 498
  Purple Derivatives of Gallic Acid 385
Kerner and Weller. Detection of Cinchonine 349
Kertész, A. Primuline 561
Kessler. Oxygen Carriers 122
Kiepert. Manure for Potatoes 391
Kiliani. Fermentation of Galactose 336, 511, 578
King, C. M. *See* Menzies 399
Kingsland, W. Secondary Batteries 328
Kingzett. *See* Deacon 739
Kingzett, C. T. Antiseptics 43, 714
  Camphorogenol 549
  Chlorine Manufacture 286
  Oxidation of Turpentine, &c 67
Kissling. Nicotine Determination 348
Kissling, R. Examination of Caoutchouc Goods 527
Kjeldahl. Brewing 259
Kjeldahl, J. Nitrogen Determination (illus.) 45, 63, 134, 238, 239, 768, 871
Klaning. Distillers' Wash 688
Klason, P. Estimation of Chlorine, &c. in Organic Compounds (illus.) 137
Klaudi, J. Iodometry 344
  See Breinl 320
Kleemann. F. Purification of Juices 335
Klein. Infection 714
Klein, D., and Jehn, C. Reaction for Polyatomic Alcohols 527
Klein, G. Manurial Value of Nitrogen 332
Kleinpass, G. B. *See* Hillman 338
Klic. Heliogravure 400
Klic, S. Molasses as Food-stuff 130
Kliebham, G. Iodo-aldehyde 512
Klingemann. *See* Japp 203, 558
Klobukow, v. Safety Pinch-cock (illus.) 456
Knapp. Colouration of Porcelain 387
Knapp, F. Ultramarine 635
Knapp, L. Santonine 452
Knauer. Improvement of Beet 856
Knauer, F. Enriching Seed Plants 335
Knauss. Hardness of Water 869
Knecht. Theory of Dyeing 819
  Valuation of Picric Acid 592
Knecht, E. Absorption of Acids, &c. by Wool, &c 621
  Chromium Colours on Fabrics 841
  Magenta in Orchil, &c. 458
  Rhodamine 560
  See Rawson 429
Kneiling, P. Earth Nut Oil 391
Knemeyer, L. G. Artificial Stone 439
Kness, V. J. Pigments for Glass, &c 847
Knight, J. W., and Gall, W. D. Carbolic Acid 429
Knoop, A. Evaporator 611
  Receptacles for Liquid Carbonic Acid (illus.) 835
Knorre, G. v. Corrosion of Lead Pipes 123
  Determination of Antimonic Acid 344
Knorre, V. Estimation of Iron 236
Knublauch, O. Cyanogen Compounds from Gas 116
Kobert, Oxynaphthoic Acid 131

PAGE
Koch. Disinfection 716
  Fermentation of Galactose 511
  Xylose 596
Koch, E. Aromatic Nitroso-bases 319
Koch, F. Fermentation of Galactose 336, 578
Koch, R. Estimation of Tannin 452
  Estimation of Tanning Materials 528
  Free Acid in Tannin Liquor 349
Köchlin. Bleaching 841
  Gallocyanine 559
Koechlin, H. Bleaching 221
Koechlin, S. C. Resistance of Resin in Bleaching 321
Koenig. Estimation of Sugar 223
Koenigs, W. *See* Heymann 642
Koepp. Antimony Fluoride 566
Koepp, R., and Co. Chromium Fluoride 566
  Chromium Fluorides 746
Koettstoefer. Butter Analysis 185
Kohlrauser. Sugar from Sorghum 334
Kohn. Discussion on Alkali Process 843
Kohnstein and Simand. Free Acids in Tanning Liquors 528
Kolbe, C. Salols 587
Kollrepp, A. Cholesterin from Beet Juice 856
König. Reduction of Gold Chloride 215
Konig, I. Meat Guano 871
Konig, J. Clover Seed 393
  Fraudulent Manure 220
  Peptone Preparations 449
  See Schleh 394
Koninck, L. de. Carbon Determination in Iron 693
  Chlorine Determination 457
  Estimation of Carbon in Iron 457
  Quantitative Filtration 693
  Separation of Gold from Arsenic, &c 693
Koninck, L. L. de. Cleaning Platinum Crucibles 869
  Hardness of Water 869
  Sulphur Determination 525
Kopp, E., and Bruère, S. Antimony Fluoride 566
Kopp, R., and Co. Antimony Fluorides 841
Kornauth, C. Oil Residues as Fodder 127
Körting. Waterspray (illus.) 614
Kossakoffsky. Santonine 452
Kossanowsky. Santonine 458
Kostanecki. *See* Liebermann 383
Kostanecki, H. v. Styrogallol 117
  Artificial Colouring Matters 179
Kostanecki, S. de. Dinitrosocresorcinol 562
Kostanecki, S. v. Colouring Matters which combine with Mordants 33
  Nitrosoresorcinol Dye Stuffs 838
  Phenyldisazoresorcinol 838
Kozietulski. Waste Water from Sugar Works 395
Krafft, F. Ricinoleic Acid 755
Krajewski, T. F. Treatment of Sugar Cane 41
Krämer, G. Estimation of Acetone 459
Kraemer, G., and Böttcher, W. German Petroleum 202, 320
Krämer, G., and Loewenherz, L. Denaturation of Alcohol.... 135
Krandauer. Cultivation of Barley 576
Kranzfeld, G. Mercury Salicylate 865
Kratschmer and Sztankovanzky. Phosphoric Acid Determination 311
Krauch, C. Impurities in Reagents 645
  Manuring Hops 221
Krauss, J. *See* Claus, A. 32
Kräyebühl, J. C., and others. Ammoniacal Liquors 741
Kremel, A. Detection of Creosote 526
  Determination of Emetin 495
  Extract of Buck Bean 132
  Guarana 347
  Iodoform 405
  Medicinal Extracts 44
  Morphia Determination 45
Kretschmar, M. Antimony Mordant from Whey 623
  Determination of Carbonates in presence of Hydrates..... 403
Kreusler. Nitrogen Determination 134
Kreuzhage, C. *See* Wolff 221
Kreuzpointer, P. Ingot Iron for Boilers 124
Krey. Distillation 202
Krohn, C. W. *See* Möhlau, R. 203
Kronberg, H. Ash Determination 238
Krüger, B. Hydroxylamine Developer 341
Kruss. Grosse's Photometer 698
  Phometry 390
Kruss and Schmidt. Gold Chloride 208
Kruss, G. Germanium 230
Kubin, E., and Siersch, A. Explosives 768
Kühl. Pressure Gauge for Malt Kilns 858
Kuhle. Yeast 447

PAGE
Kuhn and Nilson. Realgar 870
Kühn and Schroeder. Dyes, &c. at Glasgow International Exhibition 482
Kühne. Lipochromes 37
Kühne and Chittenden. Peptone 449
Kuhnt, A., and Deissler, R. Explosives 521
Kulisch, P. Nitrogen Determination 45
Kunath. Lux's Gas Balance 668
Kunz. Prevention of Bumping 524
Kynoch, J., and Habgood, W. Secondary Batteries 389

Labiche, M. Cotton Seed Oil 404
Laborde and Magnan. Poisonous Properties of Higher Alcohols 513
Lacey, F. W. Treatment of Sewage 450
Lacey, T. S. Discussion on Coal Distillation 63
Lack. *See* Degener, P. 421
Lachowiez, B. Piperidine Colouring Matters 689
Lagrange, W. Copying Photographic Negatives 231
Laidler, C. P. Temperature Regulator (illus.) 188
Lainer, A. Hydroxylamine Hydrochloride in Analysis 693
Lamansky, S. *See* Jawein 315
Lambotte. Stripping Tin Scrap 440
Lambotte, A. Stripping Tin Plates 569
Lamm, C. Beltite 589
Lamprecht, H. Magnetic Rotator 379
Landolt. Optically Inactive Substances 154
  Polariscope 264
Landolt, H. Nitrification in Soils 760
Lancaster, R. *See* Stead 554
Lang, J. Water Gas 554
Lang, W. Influence of Pressure on Temperature of Combustion 380
Lange, H. Chromium Fluoride 566
  Wool Dyeing 433
Lange, M. Naphthylenediamines 618
  Thio-substitution Products 341
Langen, E. Fireproof Material 677
Langen. *See* Pfeifer 41, 509
Langen and Hundhausen. Washer for Granular Substances (illus.) 835
Langhans, G. Sulphuring Hops 858
Langstaffe, J., and Peckover, H. D. Purifying Water 554
Lanson. Iso-butylene Glycol 762
Lanvin-Schraen, E. I. Tanning 443
Lanyen, C. J. *See* Steffen 688
Laquai, G. Extraction of Oil from Olive Residues 505
Larkin, H., and White, W. Chlorine Manufacture 288
Larsen, E. Cement 568
  Slag Cement 325
Lasne, H. Fluorine Determination 772
Lassar, O. Sozoiodol 586
Laurent. Polarimeter (illus.) 262
  Sterilisation of Soil 758
Laurent and Cleve. Naphthalidine Sulphonic Acid 670
Lauth. Violet dye 560
Lauth, C., and Dutailly, G. "Crackle" Porcelain 630
  Glazes for Porcelain 750
Laws, J. P. Antiseptics 716
Layton, G. M. R. Cement 850
Lazenby, W. R. Absence of certain Plants on Limy Soils 394
Lea, Carey. Action of Light on Silver Chloride 230
  Latent Photographic Images 230
  Photochromatism 642
Le Bel. Temperature of Fermentation 582
Le Bel, J. A. Mineral Matter in Petroleums 837
Lechartier, G. Effect of Heat and Cold on Cider 129
Le Chatelier, H. Cements 847
  Decomposition of Calcium Carbonate 849
  Decomposition of Calcium Carbonate by Heat 690
Lecremier, A. *See* Koninck, L. de 693
Ledeboer. Bleaching 293
Ledebur, A. Brittleness of Iron after Corrosion 35
  Testing Cast Iron 569
Lee, F. *See* Clegg 624
Lee, F., and Bradshaw, J. Dyeing Wool, &c. 501
Leeds, A. R. Treatment of Sewage 629
Leffmann, H. Carbonic Acid Manufacture 750
Leffmann, H., and Beam, W. Action of Food Preservatives 582
Lefranc. Extraction of Sugar from Molasses 334
  See Jungfleisch 445
Léger, M. E. Reaction of Bismuth 769
Lehmann. Levulose 686
Lehmann, K. B. *See* Pettenkofer 225
Leigh, C. Examination of Water 802
Lellmann, E., and Geller, W. Dyes from Para-amidophenylpiperidine 671
  Piperidine 642
Leme, P., and Dränert, M. Diffusion Sugar Process 856
Lenz, L. Nitrogen Determination 45
Leonhardt, A., and Co. Alphanaphtholdisulpho Acid 672
  Chrysophenin 386
  Tetrazo-Colours 319
Lepetit, R. Detection of Dyestuffs 773
Le Pileur, d'Apligny. Theory of Dyeing 816
Leplay. Salts in Molasses 334
  Use of the Osmometer 779
Leplay, H. Osmosis 509
Le Rivert, V. D'Escalonne. *See* Quarante 764
Letheby. Photometer 373
Leuchtenbeyer, C., and Moiske, B. Molasses 579
Lewin. Erythrophleine 339
Lewis, H. R., and Phillips, C. B. Extraction of Gold 678
Lewis and Sellon. Incandescent Gas Burner 23
Lewkowitsch, J. Laboratory Steam Heater (illus.) 522
Leybold, W. Gas Industry 112
Liebermann. Colours from Nitrosophenols 315
  Estimation of Rosin Oil 135
  Phenyldisazoresorcinol 839
Liebermann, C. Chrysarobin 230
  Hystazarin 669
  Leuco-Compounds of Anthraquinone Derivatives 384
  Leuco-Derivatives of Anthraquinone Dyes 204
  Sericoin 385
  Substitutes for Chrysarobin 205
  Thiophen 30
Liborius. Lime as a Disinfectant 338
Liebermann and Bergami. Sugar in Malder 382
Liebermann and Dittler. Tetrazo Dyes 618
Liebermann and Hamburger. Quercitrin 382
Liebermann, C., and Jellinek, G. 383
Liebermann and Kostanecki 383
Liebmann, A. Pyrodine 765
Liebmann, A., and Studer, A. Naphtholsulphonic Acid 431
Liebmann and Studer. Magenta in Orchil, &c. 458
Liebscher, G. Assimilation of Food by Plants 40
Liechti. Saponification 218
Liechti, L., and Suida, W. Aluminium Sulphocyanide 433
Liechti and Suida. Turkey-red Oil 328
Liepmann, H. Galvanic Batteries 327
  Treatment of Ores 217
  See Mayer 572
Lifschütz. Dipydroxyanthraquinone 669
Limpach, L. Substitution Products 429
  Metaxylidine 430
Linde. Santonine 452
Lindemann. Vanadium 74
Lindenberg, B. Indigo Vat 565
Linder, P. Yeast 336
Lindet, L. Bases in Commercial Alcohol 348
  Influence of Temperature of Fermentation 581
Lindet, M. L. Fermentation 762
Lindler, H. *See* Trassl 502
Lindner. Coloured Yeast Preparations 513
  Lactic Fermentation 513
Lindner, P. The Air of Breweries 858
  Micro-organisms in Breweries 514, 515
  Yeast 857
Lindo, D. Test for Saccharine 772
Lingard. Infection 714
Lintner. Diastase 224
Lintner, C. Ferments 512
  Malt 336
Lintner, C., sen. Thermometer 613
Lintner, C. J. Brewing 514
  Diastase 397
Lintner, P. Yeasts 687
Liotard, E. *See* Nivière 227
Lippmann. Beetroot Fat 223
  Deposit on Sugar Filters 223
  Fermentation of Galactose 336, 511
Lippmann, E. v. Fermentation of Galactose 578
Lippmann, E. v., and Degener, P. Beet Juice 578
Lippmann, E. O. v. Improvement of Beet 856
  Pure Grape Sugar 579
Lippmann, E. O. C. Raw Beet Sugar 128
Lippmann, V. Catechol in Beet Sugar 459
Lissenko, K., and Rosenbladt. Decomposition of Naphtha by Heat 115

PAGE
List, R. *See* Fahlberg 333
Listard, E. Cosso 451
Lister. Exhaled Air 225
Lockwood, K., and Adamson, E. L. Yarn Dyeing 433
Lodge, T. H. Cement (illus.) 438, 440
Loevy. Examination of Chloroform 135
Loew. Formose 396
Loew, O. Enzymes 224
Formose 41
Loewenherz, L. *See* Krämer, G. 135
Loiseau. Raffinose 41
Long, J. H. Refractive Indices of Oils 755
Longmore, J., and Watson, W. L. Treatment of Fibres 206
Lookeren, C. J. v., and Gerlins, H. Examination of Butter 595
Lookeren-Campagne, C. J. v. Bone Dust 222
Lord, J. W. Extraction and Treatment of Oils 756
Lorenz, N. v. Analysis of Substances containing Tartaric Acid 136
Tartaric Acid Determination 239
Lorin. Inosite 129
Losanitsch, S. M. Servian Coal 111
Losh. Soda Manufacture 661
Lovibond, J. W. Chromometer 69
Colorimeter 234
Tintometer (illus.) 424
Invert Sugar 831
Loviton. Separation of Antimony and Tin 403
Lowe. Incandescent Gas Burner 23
Lowe, W. F. Butter Analysis 185, 376
Löwenthal. Determination of Tannin 236
Estimation of Tannin 593, 647
Tannin Determination 238
Löwig. Caustic Alkalis 122
Lübbert, A. Oxynaphthoic Acid 130
Lucien. Barium Hydrate 207
Lucion. Precipitation of Barium Sulphate in presence of Bromine 401
Lucion, R. Stripping Tin Plates 569
Lücke. Pyocyanin 117
Lüders. *See* Wepper 762
Lunge. Nitrometer 647
Soda Manufacture 719
Sulphuric Acid Process 747
Lunge, G. Coal Tar Phenol 809
Correction of Gas Volume 521
Sulphuric Acid Process 208, 209
Three-way Tap (illus.) 232
Water Gas 668
Lunge and Hurter. Sulphur Determination 306
Lunge and Landolt. Action of Chlorine on Magnesia 297
Lunge, G., and Zeckendorf, A. Carbonic Acid in Air (illus.) 639
Lutcke, C., and George, P. Galvanic Batteries 634
Lux. Gas Balance 668
Lyle, J. Liquid Fuel 381

Mabery, C. F. *See* Keep 752
Macadam. Discussion on Manures 195
Macadam, W. J. Candle Value of Gas 199
Manures 79
Macarthur, J. B. Mineral Oil Gases 198
MacArthur, J. S. and Forrest, R. W., and W. Extraction of Gold 678
Treatment of Ores 389
Macevoy, H., and others. Cement 325
Mach, E. Acid in Damaged Grass 591
MacIlwaine, A. W. Extraction of Oils 126
Macindoe, G. D. Discussion on Desulphurising Coal Gas 8
MacIvor, R. W. E. White Lead 846
Mackirdy, G. de M. *See* Simpson 451
See Simpson, H. J. 443, 451
Macnab, W. Discussion on Water Analysis 805
Macqueen, A. Soap 682
Mactear. Sulphur Recovery 163
Maercker. Distillers' Wash for Cattle 687
Spirit Manufacture 447
Magerstein. α-Hydroxynaphthoic Acid as an Antiseptic 762
Magerstein, V. T. Mixed Manures 394
Maggi. Peptone Preparations 130
Magnall, J. Carbonic Acid 110
Magnan. *See* Laborde 513
Maiden, J. H. New South Wales Tan Substances 38, 392
Maizier, F. J., and Reitz, F. J. W. Treatment of Fibrous Stalks 385
Majert, W. Dioxynaphthalene Colours 320
Majert, W., and Richter, G. Production of Hydrogen 341
Mallary, G. H. Paper Pulp (illus.) 639
Mallet, F. R. Gosalpur Manganese Ore 141
Mallock, A. M. *See* Brogan 324
Malmann, F., and Scolik, C. Orthochromatic Collodion 230
Maltzan, M. v., and Tralls, L. Nitrogenous Mixtures 844
Mandleberg, G. C. and S. L., and Rothband, H. L. Ornamental Waterproof Fabrics 33
Mangin. Respiration of Fungi 686
Mann. Hydrogen Peroxide 640
Mann, A. Aluminium Alloys 217
Manning, J. A., and others. Paper Pulp 689
Manoury. Purification of Sugar 509
Mansfield, M. Testing Butter 527
Manzelius, R. Naphthylaminesulphonic Acid 118
Maquenne. Perseït 516
Maquenne, L. Inosol 579
Marcano. *See* Muntz 516
Marcano, V. Peptonic Fermentation 583
Marcien. *See* Danger 386
Märcker. Barley 394
Marguerie, L. C. A. Substitute for Glass 388
Marignac. Specific Heats of Solutions 768
Markownikow. Prevention of Bumping 524
Marks, D. *See* Schanschieff 754
Marshall, G. F. Carbon for Filters 132
Marsilly, Comines de. Flue Gases 615
Martin, J. C. Pigments 443
Martinon, P. Discrimination of Dyes 386
Martmann. Lactic Fermentation 513
Maruhn, R. W. E. Treatment of Slag 125
Marx, J. Soda Manufacture 502, 724
Mason. Burnt Pyrites 306
Mason, H. H. *See* Butterfield 43
Mather. Bleaching Keir 841
Mathëus, T. Azo-Dyes of the Hydroxyquinolines 557
Mathias, E. Specific Heats of Solutions 768
Mathieson, T. T., and Hawliczek J. Soda Manufacture 887
Caustic Ash Manufacture (illus.) 323
Mattheides. Metaxylylenediamine 742
Matthiessen. Sugar Refining 422
Matz P., and Balcke, J. Influence of Temperature of Malting 859
Maude, Son, and Co. Cement 102
Maumené. Inactose 445
Invert Sugar 222
Maximowitsch. Alpha-Naphthol 867
α-Naphthol as an Antiseptic 450
May and Baker. Chemicals at Glasgow International Exhibition 482
Mayer. Malt Kiln 858
See Becke 236
Mayer, A. Exhalation of Oxygen by Plants 393
Mayer, E. Q., and Liepmann, H. Porous Pots for Batteries 572
Mayrhofer. Estimation of Fusel Oil 396
McArthur. Discussion on Petroleum Acid Tars 376
McArthur, J. *See* McGregor 450
McArthur, J. B. Bromine Absorption of Mineral Oils 64
McDougall, I. S. Wood Pulp 451
McGregor, D., and McArthur, J. Treatment of Excreta 450
McKenny, J. *See* Donovan 127
McLea, K., and Punshon, R. Preservation of Timber, &c. 841
Varnish for Iron, &c. 853
Waterproofing 573
McMinn, F. A. Oil Gas 203
McMurray, T. Treatment of Slag 131
McRoberts, G. Explosives 491
Mead, F. Discussion on Desulphurising Coal Gas 7
Medlicott, H. B. Gosalpur Manganese Ore 141
Medleck, H. Magenta 118
Meering. Acetal 866
Meerkatz. Free Acid in Tannin Liquor 349
Meeze, A. G. Gas from Hydrocarbons 115
Mehrlander, H. Menthol 586
Meineke. Analysis of Clays 234
Sulphur in Iron 645
Meineke, C. Iron Determination 525
Materials used in the Iron Industry 236
Meissl. Benzoic Acid in Milk 225
Testing Butter 527
Meissner, C. Stopcock for Burettes (illus.) 343
Meixner, A. *See* Claus 399
Meldola. Naphthol Blue 559

PAGE
Meldola, R., and East, F. J. Azo-Derivatives 617
Meldola, R., and Moritz, E. R. Nitrogen Determinations 63
Meldola, R., and Streatfeild, F. W. Diazo-amido Compounds. 618
Mendelejeff. Hydrates of Alcohol 285
Menges, C. L. R. E. Electrodes for Batteries 218
Mensching. Nitronaphthalene-sulphonic Acid 670
Menzies, R. C., and King, C. M. Safety Paper for Cheques 399
Mercer. Discharge for Indigo 843
Mercier. Organic Developers for Photographs 867
  Saccharin 518
Merck. Cocaine 228
Merck, E. Erythrophleine 339
Meritens, E. and A. de. Treatment of Alcoholic Liquors 860
Merkling, M. Oil of Sesame 45
Merz. *See* Ebert 618
Merz and Weith. Diphenylaminesulphonic Acid 840
Methven, J. Standard of Light 367
Meunier-Dollfus. Calorimetry 197
Meyer. Gases in Coal 729
Meyer, A. Sugars 41
Meyer, J. Gums 578
Meyer, L. Hydriodic Acid 121
  Oxygen Carriers 122
Meyer, R. Diazobenzene Derivatives 558
Meyer, V. Mixed Azo-Compounds 203
  Stability of Antiseptic Sublimate Solutions 131
Meyer-Everloh, A. "Ammonium Phosphate" Manure 683
Meyerstein. Spectrometer 755
Michael. *See* Gabriel 671
Michaud. Cyclamose 512
Micheles V. D. de. Cement 105
Middendorf, W. Osmosis 509
Milburn, R. P. Electrical Batteries 678
Miller. Coal Tar Phenol 808
  Corrosion of Lead 15
Miller, K. Phosphoric Acid Determination 869
Millian, E. Adulteration of Olive Oil 593
Milligan, T. P. Glue, &c. 444
Millon. Reagent for Animal Size 516
Mills, E. J. Bromine Absorption of Oils 64
  Discussion on Corrosion of Pipes 78
  Discussion on Value of Fuel 308
  Photochemical Estimation of Tint 378
Mills, E. J., and Buchanan, J. Photochemical Estimation of Tint 309
Mills and Takamine. Absorption of Wool, &c. 621
Milne. Discussion on Manures 195
Minton, T. *See* Brock 313
Mittenzweg. Mashes 447
Moebius, B. Silver Refining 571
Moerk, F. Linseed Oil 330
Möhlau, R. Constitution of Colours 180
Möhlau, R., and Krohn, C. W. Action of Sulphur on Dimethylaniline 203
Mohler, J. Pyridine Bases from Coal Tar 381
Mohr. Yeast from Rye 510
Mohr, F. Bromine Determination 729
Moiske, B. *See* Leuchtenbeyer 579
Molas, J. Detector for Explosive Gases 837
Molinari, E. *See* Goldschmidt 672
Molisch, H. Nitrogenous Salts in Plants 127
Möller, J. C. J. *See* Barthel 326
Molyneaux, P. Coating for Petroleum Barrels 392
Monari. *See* Giacosa 340
Mond, L. Ammonia 737
  Chlorine Manufacture 626
  Discussion on Chlorine Manufacture 288
  Discussion on Electrolytic Bleaching 298
  Sulphur Recovery 163
  Treatment of Solids by Gases (illus.) 833
Mond, L., and Eschellmann, G. Chlorine 845
Mond, L., and Hewitt, D. B. Caustic Soda 122
Monheim. Estimation of Starch 528
Monnet, P. *See* Gilliard 501
Montgelas, R. de. Aluminium 35
Montlaur, A. de. *See* Gall 327
Morau, A. Dyeing 321
Morawski, T. Detection of Rosin 871
  Grease recovered in the Milling Process 853
  Lubricants for Wool 852
Morawski, T., and Glaser, M. Activity of Malt 687
More, A. F. *See* Offen, C. R. W. 131
Moren, E. C. Bases produced by Fermentation 336
Morewood, E. Tin Plates 36
Morfitt. Phosphatic Manures 195

PAGE
Morgen. Dried Distillers' Wash 688
Morin. Bases formed by Fermentation 450
  See Claudon 513
Morin, E. C. Cognac 224
  Fermentation of Glycerol 129
  See Claudon 233
Moritz, E. R. *See* Meldola 63
Moro, Chev. S. Preserving Meat, &c. 515
Morris. Brewing 259
Morris, N. K. White Lead 846
Morrison, J. Fluorine Scrubber (illus.) 89
Morse, H. N., and Burton, W. M. Analysis of Butter 697
  Estimation of Boric Acid 525
  Iodide of Potassium 690
Moszczensky, A. Crucibles 631
Mourgues, L. *See* Gautier 585
Mower, H. Secondary Batteries 634
Muchall. Gas Governor 668
Muck. Corrosion of Iron 833
Muck, F. Westphalian Coal 556
Muencke, R. Suction and Pressure Apparatus (illus.) 312
Mühlhäuser, O. Magenta Manufacture (illus.) 118
Mulder. Absorption of Carbonic Acid 616
  Drying Oils 680, 681
  Silk 385
Muller. Silk 385
  Sugar in Potatoes 447
  Wort Purifying 513
Muller, E. Potato Mash 447
Müller, E. D. Explosives 643
Müller, F. C. G. Theory of Steel 503
Müller, H. Azo-Colours for Cotton 204
  The Mildew of Grapes 580
Müller L. Experiments with Manures 576
Müller, M. Action of Water on Lead Pipes 226
  Corrosion of Zinc Pipes 689
  Estimation of Ammonia 403
Muller, R. Nitrogen in Soil 393
Müller, T. *See* Donath 344
Müller-Jacobs. Saponification 218
  Turkey-red Oil 329
Müllner, F. *See* Donath 215
Mumford and Moodie. Separator 420
Munier, F., and Salvaire, N. Staining Wood 121
Munktell. Separation of Gold 850
Müntz. Mineral Matter in Natural Petroleums 837
Müntz, A., and Girard, C. Farmyard Manure 577
Muntz and Marcano. Perseit 516
Murrie. Pyrometer 59
Mushet, R. Manganese Iron 212
Muspratt. Sulphites 522
Muspratt, E. K. Copper Waste Liquors 812
  Discussion on Chairman's Address (Liverpool) 725
  Discussion on Chlorine Manufacture 11
Muspratt and Eschellmann. Chlorates 291
Muspratt, J., and Sons. Chemicals at Glasgow International Exhibition 481
Muter and De Koningh. Carbolic Acid 826
Myers, J. Treatment of Hides 683
Mylius F. Blue Iodine of Starch 397
  Deterioration of Levels 752

Nafziger. Spirit from Jerusalem Artichokes 447
Nahnsen. Purification of Waste Water 578
Naudin. Cultivation of Ramie in Provence 575
Naumann. Thermometer 554
Neilson, A. *See* Craig, A. 126
Nelson, T. Filters 427
Nencki. Thermifugine 866
Nencki, M. v., and Heyden, F. v. Salol 690
Nessler. Ammonia Test 829
  Manuring Tobacco 684
Nettlefold F. Discussion on Antiseptics 717
Netto. Aluminium 568
Netto, C. Extraction of Aluminum 217
  Sodium Manufacture 851
Neuhaus. Spirit Measuring Clock 514
Neumann, G. Analysis of Sodium Acetate (illus.) 645
  Estimation of Thallium (illus.) 343
  Funnels with Fittings (illus.) 643
  Flash with Fittings (illus.) 644
  Gas Burette (illus.) 644
Nĕvolé. Isobutolene Glycol 336
Newall, F. S. Discussion on Recovery of Sulphur 177
Newbery, J. C., and Vautin, C. T. J. Extraction of Gold 850
Newbury, S. B., and Cutter, W. P. Safety of Kerosene Oils 740

PAGE

Newell, J. W. *See* Rowell 36
Newlands, B. E. R. Discussion on Desulphurising Coal Gas .. 8
  Discussion on Polariscope applied to Brewing 275
  Discussion on Water Analysis 804
Newlands, B. E. R. and J. S. R. Method of Using Char in Sugar Refining 119
Newton. Theory of Chemical Action 476
Nicholson. Hydrometer 278
Nicholson B. *See* Collin 635
Nicholson, E. C. Magenta 118
Nickels, B. Funnels 596
Nicol. Prism (illus.) 259
Nicolle, A. Phosphorus 438
Niessen. Purification of Beet Juice 129
Nietzki, R., and Diesterweg, T. Disazo-Compounds 557
  Metanitranaline Colours 839
Nietzki and Kehrmann. Quinonedioxime 316
Nietzki, R., and Otto R. Indamines and Indophenols 559
  Safranines 497
Nietzki, R., and Schmidt, A. W. Benzenetriphenazine 384
Nietzki and Schmidt. Dihydroxyquinone 858
Nilson. *See* Kühn 870
Nipper, J. Distemper Colours 330
Nitzsch. Sugar Industry in Pernambuco 578
Nivière, G., and Liotard, E. Fabiana Imbricata 227
Noad, J. Galvanic Batteries 441
  See Trickett 629
Nobbe. Nutritive Solution for Plants 757
Nobel. Explosives and Detonators 490
Nobel, A. Detonators and Explosives 867
Noelting. Rosaniline Derivatives 744
Noelting, E. Hydroxyazobenzene 562
Noelting, E., and Abt, A. Azimido-Derivatives 562
Noelting, E., and Stricker, T. Iodophenols 562
North British Chemical Co. Specimens at Glasgow International Exhibition 482
Northwood, J. Treatment of Glass Cullet 324
Nowacki. Cultivation of Potatoes 576
Nylander. Test for Sugar in Urine 134

Odling. *See* Crookes 16
Oehler, K. Azo-colours 120
  Benzoflavines 746
Oehlrich, A., and Co. Specimens at Glasgow International Exhibition 482
Oettel, F. German Silver 133
Offen, C. R. W., and Moore, A. F. Antiseptic for Yeast, &c. 131
Ogier. Saccharin 856
Opificius, L. Determination of Gold and Silver 403
Ordonneau. Butyl Alcohol in Spirit 513
Orr, A. White Lead 635
Orth. Distillers' Wash for Cattle 687
Osmond and Werth. Carbides of Iron 503
Ostachiewicz, V. d', and Gerlicz. L. de. Fermentation 638
Ostermayer, E. Iodised Sulpho-Acids 745
Ostersetzer, O. Estimation of Carbonic Acid (illus.) 134
O'Sullivan, C. Brewing and Saccharimetry 259
O'Sullivan, C., and Valentine, W. G. Dextrin-maltose 446
Otto. Coke Oven (illus.) 836
  Crucible Furnace 380
Otto, R. *See* Nietzki 497, 559
Outerbridge, A. E. Carbonising Fabrics for Casting 677

Page. Temperature Regulator 188
Palm, R. Peptones 526
Palmer, T. *See* Collin 635
Pampe, F. Defuselisation of Spirit 513
Panther Lead Co. Condensing Lead Fume 504
Parcus, E. Testing for Invert Sugar 591
Park, J. Chromium Manufacture 754
Parker, T. *See* Salomons 126
Parnell. Discussion on Chairman's Address (Liverpool) 725
Parnell. E. W., and Simpson, J. Ammonia Soda Liquors 438
  Treatment of Ammonia Sulphide 629
  Utilisation of Sulphate of Lime 323
Parry, W. J., and Welch, J. T. Utilisation of Slate Waste 631
Pasley, C. Cement 102
Passburg, E. Vacuum Drying Apparatus (illus.) 667
Pasteur. Fermentation of Galactose 336, 511, 578
Paterson, E. J. *See* Hermite, E. 126, 764

PAGE

Paton. Discussion on L. T. Wright's Address 29
Patrick. Treatment of Char 423
Patterson, T. L. *See* Walker, H. W. 41
Pattinson, H. L., jun. Barium Hydrate 122
Pattinson, J. Available Chlorine lost by Bleach 188
  Discussion on Colliery Waters 13
  Discussion on Tees Salt 667
Pauksch. Refrigerator 514
Paul, H. W. *See* Webb 203
Paul, L. Tetrazodiphenyldicarbonic Acid and Tetrazo-colours 432
Paul and Cownley. Amount of Caffeïne in Coffee 44
Pawlowski, H. K. de. Bleaching 207
Payne, J. H. Discussion on Shotley Spa Water 70
Pearson, A. N. Treatment of Gums 856
Pearson, S., and others. Aluminium Alloys 753
Peasgood, J. F. Tomato Vinegar 130
Pechiney. Chlorine Manufacture 287
Pechiney, A. R. Magnesium Oxychloride 749
  Regenerative Furnace 837
Péchmann. Refrigerator 514
Peckham, W. M. *See* Manning 689
Peckolt, T. Lucuma 339
Peckover, H. D. *See* Langstaffe 554
Peclet. Flue Gases 615
Peile, H. Shotley Bridge Spa Water 14
Pellet. Action of Lime on Beet Juice 856
  Estimation of Sugar 595
Pellet, H. Examination of Beetroot 528
Pelletier. Cinchona Tannin 865
Pelouze. Determination of Sulphur in Pyrites 305
Pensky, B. Colouring Metals 753
Pentecost. Discussion on L. T. Wright's Address 28
Percival, W. H. Matches 768
Percy. Calorimetry 196
Pereira. Corrosion of Leaden Pipes 15
Perillon. Manganese Determination 235
Perino, J. Extraction of Zinc 678
  Treatment of Copper Pyrites 389
Perkin. Pseudomauveine 743
Perrett, E. Filters 30
  See Bolton, M. P. W. 423
Perrot, E. Phosphoric Acid Determination 311
Persoz. Art of Dyeing 817
Pesier, P. E. E. Treatment of Vegetable Fibre 640
Petermann, A. Cacao Husks 583
  Estimation of Sugar in Beet 595
  Peat Manure 576
  Pods of Hop Clover 574
  Retrograde Phosphoric Acid 345
  Sugar Beet 575
Petersen, A. S. F. Oil from Asarum Europaeum 391
Petersen, H. C. *See* Kräyenbühl 741
Petrie, E. B., and Wild, R. Treatment of Fibres 121
Petschow, G. *See* Döbner 312
Pettenkofer, M. v., and Lehmann, K. B. Noxious Vapours 225
Pfandler, C. Treatment of Beer, &c. 859
Pfeiffer, J. Dry Calcium Hydroxide (illus.) 323
Pfeiffer and Langen. Raffinose 41, 509
Pfitzinger, W. αγ-Dimethyl-*p*-toluquinoline 642
Phillips. Revivification of Char 424
Phillips, C. B. *See* Lewis 678
Phillips, F. C. Natural Gas 738
Phillips, W. B. *See* Venable 239
Piatkowski, J. J. *See* Tinlin 313
Pichot, J., and Grangier, P. Ultramarine 573
Pick, S. Evaporator 426
Pictet, Raoul. Refrigerator 614
Pietrowicz and Siegert. Silesite 342
Piffard, B. Artificial Manure 761
Pinetta. *See* Grote 687
Pinkey. Aniline Colours with use of Nickel Salt 31
Pintsch. Oil Gas 199
Piria. Naphthionic Acid 670
Pitt, S. Refining Hydrocarbons 126
Pitt, W. H., and Van Vleck, G. H. Petroleum Refining 429
Planchon, V. Determination of Glycerol 779
Plath, H. Nitrification 760
Plattner. Separation of Gold 850
  Treatment of Gold Ore 215
Platts, J. C. *See* Cleeves 729
Platz, B. Formation of Warts in Pig Iron 124
Playfair, Lyon. Letter to Mr. Young 612
Plom and Retinne. Boring Tools 589
Plugge. Andromedotoxin 866
Plumacher (U.S. Consul). Petroleum in Venezuela 739

PAGE
Podakowsky. Fermentation of Galactose 511
Poehl. Peptone and Albumen 526
Pohl, P. R. Carbonic Acid Generator (illus.) 582
Poirrier, A. F., and Rosenstiehl, D. A. Azo-Colours 499, 563
Poirrier, A. F., and others. Azo-Colours 432
Poirrier, A. F., and Roussin, Z. Nitrodiazobenzene Compounds 564
Pol, R. Filter 835
Pollak, E. Nitric Acid in Wine 134
Pollak and Wilde. Hydrogen Generator (illus.) 523
Pollok, J. H. Extraction of Gold 678
Pomeranz, C. Cubebin 517
Pöpel, M. Condensation of Steam 387
Popow, M. Wheat and Rye Bread 638
Porter, J. H., G., and J. Filters (illus.) 862
Pouchet. Saccharin 856
Prangey, L. E. A. Sugar Manufacture 579
Preuss. Estimation of Sugar 761
Preussner, L. Artificial Stone 324
Pribram, R. Polaristrobometric Determination of Grape Sugar 594
Prillieux. Black Rot in Vines 758
  Potato Disease 758
Prinsep. Gold Alloy 114
Prinz, A., and Quellmalz, E. Treatment of Vegetable Fibres. 843
Proctor, B. S. Discussion on Shotley Spa Water 70
Proskowitz, E. v. Slag as Manure for Beet 220
Prost, E. Colloid Cadmium Sulphide 34
Prudhomme. Fixing Aniline Colours 565
Pudrin, P., and Strecker. Action of Manure on Mustard 332
Pujos, J. Leather from Rabbit Skins 574
Pumpherston Oil Co. Specimens at Glasgow International Exhibition 482
Punsheon, R. K. Explosive 589
Punshon, R. *See* McLea 573, 841, 853

Quaglio. Coke Oven 835
Quarante, P. L., and Le River V. D'Escalonne. Preservation of Wood 764
Quarterman, W. H. Galvanic Batteries 389
Quellmalz, E. *See* Prinz 843
Quimby. Sugar Refining 422
Quincke, F. Acenapthene 382
Quinquaud, *See* Gréhant 686

Rabe, H. Laboratory Turbine (illus.) 379
Rabillot, E. *See* Chastaing 319
Ragosine, V., and Dvorkovitch, P. Utilisation of Acid Tars... 628
Raikow, P. Filtration with exclusion of Air (illus.) 524
  Fractional Distillation in Vacuo (illus.) 523
Rainbow, F. Soap Manufacture 442
Rammelsberg. Sulphites 322
Ranger, R. Draw-off Tube for Wort 42
Rankine. Thermo-dynamics 477
Ransome, F. Cement 850
Rappaport, L. Utilisation of Flour Waste 508
Raschig. Sulphuric Acid Process 208
Raschig, F. Hydroxylamine 210
  Sulphuric Acid Process 747
Raspe. Mineral Waters 803
Rathgen, F. Cane Sugar Determination 694
Raulin, J. Action of Micro-organisms on Colouring Matters.. 745
Raupp. Ammonium Phosphate from Gas Liquor 114
Rave. Petroleum Residues 377
  Utilisation of Acid Tar Residues 303
Rawson, C. Magenta in Orchil, &c. 458
  Tinctorial Value of Dyes 592
Rawson, C., and Knecht, E. Examination of Indigo 459
  West African Indigo 429
Rawson, S. G. Discussion on Chairman's Address (Liverpool) 725
Rayman, B. Rhamnose 578
Raymann. Cholesteryl Acetate 584
  Iodometry 344
Redgrave, G. R. Cement 102
Reese, L. Ash Determination (illus.) 454
Reeves, W. W. *See* Harford 43
Regnault. Thermo-dynamics 477
Reichardt, E. Copper in Jam 348
Reichart. Use of Gas for Heating 668
Reichert. Butter Analysis 185
Reichert and Meissel. Butter Analysis 37
  Testing Butter 238

PAGE
Reichl. Detection of Glycerin 236
Reid, R. Straining Colour 121
Reid, W. F. Preservation of Fruit 583
Reinhardt, C. Injurious Action of Methylated Spirits in Lamps 869
  Manganese in Pig Iron 234
  Preservative for Solutions of Tartaric Acid 871
  "Thomas" Pig Iron 215
  Titanium Cyano-nitride 326
Reinitzer, F. Cholesterin 584
Reinke. Sarcinate in Beer 857
  Vanillin in Spirit 223, 513
Reinke, O. Brewing in Warm Climates 858
  Preservation of Yeast 858
  Decolouration of Beer 449
  Starch Determination 448
Reinsch. *See* Warrington 320
Reisebauer. *See* Herzfeld 527
Reissmann, A. Prevention of Bumping 524
Reissner. *See* Erlenmeyer 866
Reitmair. Estimation of Fusel Oil 396
Reitz, F. J. W. *See* Maizier 385
Remmey, R. C. *See* Weidig 322
Renard, A. Hydrocarbons in Resin Oil 507
Renard, A., and Berthelot. Di-Terebene 115
Reschert, M. Camphoric Acid 865
Retinne. *See* Plom 589
Retter. Mashing Apparatus 514
Reverdin, F., and Harpe, C. de la. Paranitrotoluene 593
Reymann. Orcinol-dichrome 670
Reynier, A. Bichromate Batteries 851
Reynolds, W. J. Electrotyped Compass Cards, &c. 634
Riban, J. Estimation of Zinc 771
Richard, P. Wool 841
Richards. Detection of Hydrogen Peroxide 344
Richardson and Grey. Chlorine Manufacture 724
Richter, G. *See* Majert 841
Richter, L. Oil of Lallemantia Seed 219
Richter, V. v. Chromogens 742
Rickard, T. Desilverisation of Speiss 570
Rickmann, A. *See* White 845
Rickmann and Thomson. Ammonia from Air 736
Ridsdale, C. H. Chromometer (illus.) 70
  Determination of Vanadium 73
Riebeck. Distillation 202
Riedel, G. D. Sulphonal 585
Riedel, O. Iodine Trichloride 866
Riedlin, G. Antiseptics 226
Rigby, J. S. Cement 439
  Cement from Lime Mud 301
  Whiting and Cement 568
Rillieux. Evaporator 426
Rimmer, H. Magnetic Carbide of Iron 450
Rissmüller, L. *See* Wiesinger 756
Ritsert. Detection of Sulfonal 772
  Sulphonal 641
Ritsert, E. Sulphonal 694
Riviere, V. Treatment of Hides 444
Rix, W. P. *See* Doulton 324
Robert, G. Treatment of Iron 504
Roberts. Brittleness of Metals 35
Roberts, F. Adair. Discussion on Antiseptics 718
Roberts, F. G. A. *See* Boake 862
  See Boake, A. 764
Robertshaw, J. Dyeing Hanks 504
Robeson, C. Scouring Wool 206
Robet, E. J. P. India-rubber Manufacture 330
Robins, Aspdin, and Co. Cement 102
Robinson, L. S. Strength of Cast Iron 201
Robinson, T. *See* Hargreaves 217
Robson. Lithia 731
Roche, C. T. Uranium Nitrate for Photographs 231
Rochleder. Isoalizarin 669
  Rutin 382
Röchling. Coke Oven 836
Rodger. Photochemical Estimation of Tint 378
Roessler, H. Silver Assay 457
Roessler, S. Purifying Alcoholic Liquids 515
Rogers. Oil Gas 199
Röhrig, A. Sulphites 322
Rominier. Fermentation of Fruit 511
Roscoe. Coal Tar Cresols 808
Roscoe and Schorlemmer. Vanadium 73
Rose. Coke Oven 836
  Vanadium 73

PAGE
Röse. Estimation of Fusel Oil 396
  Examination of Brandy 871
Röse, B. Milk Analysis 350
Rose, P. B. Tank Water from Fat Rendering 40
Rosenbladt. *See* Lissenko 115
Rosenstiehl, D. A. *See* Poirrier, A. F. 432, 499, 563
Roser, W. Narcotine 518
Rössler, H. Occurrence of Cobalt 503
  Silver Assay 869
Roth. Roburite 589
Rothband, H. L. *See* Mandleberg 33
Rotten, M. M. Extraction of Precious Metals 571
Rouff, V. and E. Chromium Alloys 753
Roussin, Z. *See* Poirrier, A. F. 432, 564
Rowan, F. J. Calorific Value of Fuels 195, 308
Rowell, S. C., and Newell, J. W. Litharge 36
Royle, T. Treatment of Wood 35
Rubay, F. Bleaching 501
Rücker. Calorific Value of Hydrogen 196
Ruffin, M. C. A. *See* Bang 224
Ruscoe, J. Retort Lids 381
Russell, E. H. Treatment of Ores 504
Russell, W. Determination of Sulphur in Pyrites 305
Rust, J. Red Paint 507
Rutgers, F. Food Value of Albuminoids 450
Rytel, C. Sugar Solutions for Polarisation 349

Saare. Mashes 447
  Pneumatical Malting 336
Sachsenröder and Gottfried. Invert Sugar 222
Sadler and Co. Specimens at Glasgow International Exhibition 482
Sagumenny. Dinitrobenzil 432
Sahli. Guaiacol 227
Saint-Edme, E. Passive State of Iron and Nickel 521
Saladin. Malting 687
Saladin, J. Pneumatical Malting 336
Salamon, A. G. Discussion on Polariscope applied to Brewing 275
  Saccharine 452
  See Hood, J. J. 3, 617
Salkowski. Oxynaphthioe Acid 131
  Phenaceturic Acid 641
Salkowski, E. Antiseptics 716
  Examination of Mixed Oils 37
Salomons, D. L., Parker, T., and Elwell, P. B. Secondary Batteries 126
Salvaire, N. *See* Munier 121
Salvat, J. Preservation of Wood 388
Salzer. Vanillin in Spirit 223, 513
Salzer, H. Preservation of Food 763
Samuel, M. W. Plastic Compound 631
Samuelson. Adulteration of Cocoa Powder 593
Sanderson, Burdon. Prophylactics 714
Sanson. *See* Henniger 336
Sawrey, J. S., and Collet, H. Settling Tanks 834
Saytzeff. Oxidation of Oleic Acid 506
Saytzeff, A. *See* Const 442
Saytzeff, M. C. and S. Oxystearic Acid 755
Scabanjew. Turkey-red Oil 329
Schäfer, L. Cinchona Bark from Bolivia 451
Schäffer. Naphtholmonosulphonic Acid 839
Schaffner. Sulphur Recovery 163
Schall, C., and Dralle, C. Brasilin Derivative 117
Schall, C., and Dralle, G. Brasilin 838
Schanschieff, A., and Marks, D. Gold Extraction 754
Scheen. *See* Gössmann 391
Scheibener, J. Rectifying Still 514
Scheibner. Purification of Spirit 687
Scheibler. Beet Juice 578
  Beetroot Fat 223
  Calcimeter 104
  Dextrane 761
  Saccharimeter (illus.) 263
Scheithauer. *See* Bunte, A. 390
Schenk, J. Peppermint 552
Scherff, E., and Drenckhau, C. Condensed Milk 43
Scheurer, A. Bleaching 841, 843
Scheurer, O. Iron Mordant 121
Scheurer-Kestner. Calorimetry 197
  Combustion of Coal 615
  Thompson's Calorimeter (illus.) 868
  Value of Fuels 690
Schilling, N. H. Connecting Lightning Conductors with Gas Mains 668
Schilling. Limed Coal 113
Schimmel. Eucalyptol 585
Schimper, A. F. W. Calcium Oxalate in Leaves 575
Schindler, C. Estimation of Molybdic Acid and Lead 456
  Estimation of Phosphoric Acid 455
Schlagdenhauffen, F. *See* Heckel 517
Schlamm, A., and Brassard, F. à. Treatment of Wool 206
Schleber, G. A. Bleaching, &c. 843
Schleh and Konig, J. Cultivation of Maize and Sorghum 394
Schloesing. Chlorine Manufacture 291
Schloesing, T. Chlorine from Magnesium Chloride (illus.) 626
Schloesing and Grandeau. Nitrogen Determination 647
Schlösing. Action of Magnesia on Ammonia Salts 772
  Estimation of Sugar 223
  Nitric Acid Determination 692
Schlösing, T., and others. Nitrogen in Arable Soils 757
Schlott. Optical Glass 846
Schmid, W. Estimation of Fat in Milk 695
Schmidt. Vanillin in Spirit 513
  See Krüs 208
  See Nietzki 838
Schmidt, A. W. *See* Nietzki, R. 384
Schmidt, E. Atropyne from Hyoscyamine 518
Schmidt, H. Cultivation of Potatoes 221
Schmidt, O. Aluminium Bronze 389
Schmidt, T. *See* Fischer 559
Schmidt, W. Dowson Gas 496
Schmidt and Schaal. Naphthionic Acid 670
Schmitz. *See* Tollens 265
Schneider, A. Denaturation of Alcohol 223
  Mercury Albuminate 866
Schneider, E. A. Toluidine-sulphonic Acids 498
Schneider, L. Manganese Determination 525, 693
  Phosphorus in Iron 125
Schneider, R. Hydrate of Baryta 436
Schnirch. Corrosion in Steam Boilers 202
Schoeckh. Treating Frozen Potatoes 687
Schoeller, A. Hystazarin 669
Schoen, G. A. Paratoluidine 594
Schoeneweg, F. Securite 589
Schoeneweg, H. Explosives 643
  Flameless Powder 519
Scholvien. Sulphonal 585
Scholvien, L. Testing Chloroform 237
Schön, L. Oleic Acid in Earth Nut Oil 391
Schönherr, O. Nitrogen Determination 238
Schönn. Reaction of Titanic Acid 344
Schraube. *See* Caro 557
Schreib, H. Ammonia-Soda Process 434
  Milk Analysis 350
Schreivogel, F. Expresstype 588
Schrobe. Fermentation 447
Schröder. Earth Nut Oil 391
  Free Acids in Tanning Liquors 529
Schroeder, v. Estimation of Tannin 647
Schroeder, C. A. J. H. Carbons for Arc Lamps 572
Schrohe. Pneumatic Malting 687
Schrohe, J. Fermentation 512, 513
Schrohe, R. Storage of Yeast 509
Schrötter, H. Action of Acids on Saccharic Acid 579
Schubert, St. *See* Honig, M. 129, 445
Schuchardt. Tinted Colour Scale 404
Schückher, W. Meganite 588
Schüller. Specific Heats of Solutions 768
Schultz. Naphthylamine-sulphonic Acid 670
Schultz, G. Naphthylamine-sulphonic Acids 33, 118
Schultze. Gunpowder 401
Schultze, C. B. Recovery of Tin from Scrap 388
Schulz, H. Blue Dyes 319
Schulze. Cholesteryl Benzoate 585
  Nitrogen in Plants 127
Schulze and Barbieri. Malt Peptone 238
Schulze, C., and Seliwanoff, T. Sugar from Potatoes 686
Schulze, E. Cane Sugar in Vegetables 347
  Soja Hispida 854
Schulze, H. Colloid Metallic Sulphides 34
Schulze, R. E. Titration of Pyridine Bases 136, 349
Schumacher-Kopp. Saccharine Cocoa 225
Schumacher-Kopp, E. Peptone Preparations 130
Schumann, A. Starch Gum 334, 335
Schunck, E. Quercetin and Rutin 404
  Rutin and Quercitrin 382, 404
  Theory of Dyeing 815

PAGE
Schütt, F. Germination of Malt 129
  Polarimetric Analysis of Mixed Chlorides 770
  Respiration of Malt 512
Schütze, R. Drying Apparatus (illus.) 589
  Graduated Flask with Burette (illus.) 589
  Solubility of Type Metal 217
Schützenberger. Silk 499
Schwab, M. *See* Estcourt 203
Schwackhoefer. Heating Power of Coal 617
Schwartz, Y. Estimation of Lead 237
Schwarz. Tints on Glass 123
Schwarz, C. Antifebrine in Phenacetine 694
  Detection of Chloral 773
  Determination of Phosphoric and Boric Acids 45
  Medicinal Use for Hydroxylamine 865
  Sulphonal 641
Schwarz, H. Analysis of Liqueurs 459
  Temperature of Fermentation 582
Schweizer. Cellulose 818
  Reagent for Fibroin 385
Scolik, E. *See* Malmann 230
Scott, H. B., and Gentles, W. Copper Furnaces 754
Scott, J. Rewards for Inventions 782
Scott, W. *See* Garratt 501
Scott, W., and others. Cement 325
Scrieb, H. Purification of Water 862
Scurfield, F. Determination of Sulphur in Pyrites 305
Seger. Determination of High Temperatures 846
Seger, H. Colouring Porcelain 324
  Colouration of Porcelain 387
Seliwanoff, T. Potato Buds 686
Selkirk, A. Paper Pulp (illus.) 864
Sellon, J. S. Secondary Batteries 125
Selwyn. Calorific Value of Fuel 198
Sendey, W. E. *See* Bull and Co. 437
Sendtner. Thermometer 613
Sengel, E. A., and Dobler, L. F. Gelatinised Cloth 516
Senier, H. Crystalline Zinc Hydrate 845
Senstad, O. *See* Evenstad 499
Sershall, G. J. Photographic Skies 132
Seyberlich. Invert Sugar 222
Seyfert. Estimation of Starch 528
Seyfert, F. Phosphoric Acid Determination 869
  Starch Determination 350
Seyffart, J. The Elution Process 578
Seymour, F. J. Aluminium 504
Shannon, A. J. Extraction of Antimony 36
Shaw, E. J. Ornamenting Glass 847
Shearer, A. Discussion on Polariscope applied to Brewing 274
  Discussion on Water Analysis 804
  See Giles 34, 764
  See Boake, A. 764
Shimoyama, Y. Buko Leaves 585
Siebert, H. Gatta-percha Substitute 635
Siegert. *See* Pietrowicz 342
Siemens. Regenerative Furnaces 25
Siemens and Halske. Electro Deposition of Copper 723
  Spirit-Measuring Clock 514
Siersch, A. *See* Kubin 768
Sikes. Hydrometer 276
Silber, P. *See* Ciamician 399, 583
Simand, F. Acidity of Tanning Liquors 528
Simian, A. *See* Danger 386
Simond, F. Estimation of Tannin 459
Simpson. Discussion on Chairman's Address (Liverpool) 725
Simpson, H. J., and others. Cellulose from Sequoia 451
  Tannin from Sequoia 443
  Wood Pulp 451
Simpson, J. Discussion on Alkali Process 813
  See Parnell 323, 438 629
Singer, I., and Judell, M. W. Cleansing Wool 499
Sjöberg. Romite (an Explosive) 690
  Romite 589
Skrivanow, P. Galvanic Batteries 754
Small. Discussion on L. T. Wright's Address 28
Smetham, A. Waterproof Leather 39
Smith. Discussion on Water Gas 101
Smith, E. F. Electrolytic Determination of Iron 693
Smith, H. Cement from Slag 677
  See Scott 325
  See Snelus 631
Smith, J. H. Nitrogen Determination 13, 307
Smith, M. H. Extraction of Particles of Iron 505
Smith, Watson. Blast-Furnace Phenols 808
  Discussion on Carbolic Powders 828
  Discussion on Electrolytic Bleaching 300

PAGE
Smith, W. J. Sulphur Compounds of the Cruciferæ 854
  See Thorpe 382
Snelus, G. J. Cement from Slag 677
Snelus, G. J., Swan, J. C., and Smith, H. Cement 631
Snelus, G. J., Whamond, W., and Gibb, T. Cement 631
Snodgrass. *See* Fraser 429
Snodgrass, J. *See* Craig, A. 126
Sobrero. Nitro-glycerin 491
Sobieczky, J., and Hölbling, V. Wash-bottle Jet (illus.) 524
Soc. Anon. le Ferro Nickel. Alloys 504
Society of Chemical Industry of Basle. Dyes, &c. at Glasgow International Exhibition 482
Soc. A. Cruto & Cie. Carbon Filaments 37
Soc. Indlle. d. Glycerin et Acides Gras. Saponification 756
Soc. Jeannolle et Cie. Fast Black Colour 747
Société Oléo Graisse. Petroleum Residues 304
Sohst. Saccharic Acid 579
Sohst, O., and Tollens, B. Saccharolactonic Acid 508
Soldaini. Test for Sugar 591
Soldenhoff, R. de. Treatment of Sewage Sludge 43
Söllscher. Wash-bottle Valve 643
Solvay, E. Bicarbonate of Soda Furnace (illus.) 628
  Hydrochloric Acid Gas 289
  Ammonia Manufacture 736
  Lime Kilns (illus.) 676
  Treatment of Phosphates 508
Sommer, A. Sulphur Chloride Compounds with Fats 853
Soxhlet, F. Citric Acid in Cows' Milk 861
Soyka, J. Peat as a Disinfectant 39
Spackman, C. Portland Cement 162
Spence, J. B. Treatment of Ores 571
Spence, J. N. Estimation of Starch 77
Spence, P., and Sons. Chemicals at Glasgow International Exhibition 482
Spica. Diosphenol 585
Spice. Limed Coal 113
Spiegel, A. Insoluble Cotton Colours 180
Spring, W. Colloid Metallic Sulphides 34
  Reactions between Solids under Pressure 567, 568
  Resistance of Iron Rails to Rust 753
Squire. Discussion on Desulphurising Coal Gas 8
Squire, W. S. Discussion on Polariscope applied to Brewing. 274
Staats, G. Photochromatism 642
Staedeler. Fibroin 499
  Silk 385
Stammer. Filtration of Sugar Juice 509
Stanford. Discussion on Manures 195
Stanford, E. C. C. Discussion on Corrosion of Pipes 78
Stark, A. C. Pharmaceutical Preparations 516
Staub, L. A. Ammonia-Soda Process (illus.) 436, 437
Staveley, W. New Alkali Process 807
St. Denis Dyestuff and Chemical Co. Dyes, &c. at Glasgow International Exhibition 482
Stead, G. E., and Lancaster, R. Purifying Water 554
Stead, W. H. Treatment of Cotton Seed 433
Steenberg, J. F. V. Preservation of Food. 451
Steffen. Lixiviating Raw Sugar 41
Steffen, C., and Lanyen, C. J. Sugar Refining 688
Stein. Morindin 382
  Rutin 382
Stein, G. Antimony-Sodium Fluoride 133
  Fluorchrome 385
Steinach, H. Electro-metallurgy 754
Steinthal, H. M. Elastic Substance 853
Steitz. Syphon for Lead 503
Stellden. Mercury Cyanide 867
  Mercuric Cyanide 866
Stenhouse. Morindon 382
  Wrightine 585
Stenhouse and Duncan. Treatment of Char 423
Stephens, J. W. T., and Clark, R. Cement 850
Stevenson, J. C. Discussion on Recovery of Sulphur 175
  Discussion on Tees Salt 667
Stevenson, J. C. and Tatters, J. G. Disinfectant 43
Stevenson, J. S. Secondary Batteries 572
Stevenson, T. Discussion on Duty on Spirits 284
Stevenson, Carlile, and Co. Chemicals at Glasgow International Exhibition 481
Stewart, J., and Charlton, T. Storage of Inflammable Liquids. 495
Stiebel, A. *See* Claus, A. 32
Stock, W. F. K. Solubility of Calcium Sulphate 801
Stocker, C. Non-inflammable Celluloid 853
Stohmann. Calorimetry 197
Stokes, F. W. S. Cement 568
Stoklasa, J. Geochemical Studies 338

PAGE

Stolba, F. Combustion of Graphite with Silver Dust ... 235
  Decomposing Bone Earth with Sulphuric Acid ... 333
  Sulphur Determination in Coal ... 524
Stollwerck, L. and C. Preserving Food ... 43
Stolze. Gelatin Emulsion ... 452
  Pigment Photographic Prints ... 400
Stone. Fermentation of Galactose ... 578
Stone, W. E. *See* Gans ... 595
  See Tollens ... 511
Storch, L. Detection of Rosin Oil ... 526, 871
  Estimation of Rosin Oil ... 135, 136
  Indicators in Alkalimetry ... 591
Storer, J. Packing Fresh Fruit, &c. ... 338
Straiton, J. Treatment of Hides ... 39
Straus, J., and Dubreuilh, W. Absence of Microbes from Expired Air ... 225
Streatfeild, F. W. *See* Meldola ... 618
Strecker. *See* Pudrin, P. ... 332
Stricker, T. *See* Noelting ... 562
Strohmer. Carbonic Acid Apparatus ... 646
  Influence of Alkali in Raw Sugar ... 334
Stromeyer. Cosine ... 451
Stuart, E. B. Substitute for Gum Arabic ... 509
Stuart, T. W. The Tees Salt Industry (illus.) ... 660
Stuchly, J. Filtration of Sugar Juice ... 509
Studer. *See* Liebmann ... 458
Studer, A. *See* Liebmann ... 431
Stutzer. Distillers' Wash ... 688
  Estimation of Fusel Oil ... 396
Stutzer, A. *See* Isbert, A. ... 44
Suchomel, J. Influence of Lime on Beet Juice ... 856
Sugden, S. S. Treatment of Fats, &c. ... 126
Sugg, W. Ten-candle Standard ... 367
Suida. Saponification ... 218
Suida, W. *See* Liechti ... 483
Sulman, H. L. *See* Claus ... 435
Swan, J. C. Cement from Slag ... 677
  See Scott ... 325
  See Snelus ... 631
Swan, J. W. Explosive Gases in Mines ... 125
  Fire-damp Indicator ... 753
Swinborne, G. P. Gelatin Manufacture ... 574
Sykes. Hydrometer ... 819
Sztankovanzky. *See* Kratschmer ... 311

Tabary, C. P. Cement ... 568
Tack, A., and Girard, F. Block Fuel ... 428
Tafel, J. *See* Fischer, E. ... 128, 636
Tait. Thermo-dynamics ... 477
Takamine. *See* Mills ... 621
Takamine, J. Alcoholic Liquids ... 397
Tall, G. Cotton-seed Oil ... 634
Tall, G., and Thompson, W. P. Dye from Cotton-seed Oil ... 756
Tallmadge, J. W. Fluid Ink Eraser ... 34
Tapp, W. Water Softening ... 451
Targioni-Tozzetti, A., and Berlese, A. Insecticides ... 684
Tate, A. N. Discussion on Cement from Lime Mud ... 302
Tate, N. Discussion on Petroleum Acid Tars ... 376
Tatlock. Phosphoric Acid Determination ... 311
Tatlock, R. R. Discussion on Estimation of Caustic Alkali ... 830
Tatters, J. G. *See* Stevenson ... 43
Tauber, G. Precipitation of Barium Sulphate in presence of Bromine ... 401
Taylor. Filters for Sugar ... 419
Taylor, A. *See* Simpson, H. J. ... 443, 451
Taylor, J. Nitric Acid ... 210
Taylor, L. Hardness of Water ... 798
Taylor, S. Corrosion of Leaden Pipes ... 15
Teed, F. L. Purification of Sulphuric Acid ... 816
Tennant, C., and Co. Chemicals at Glasgow International Exhibition ... 481
Tennant, C., and Partners. Tees Salt Bed ... 661
Terrill, W. Electro-deposition of Metals ... 679
Thausing. Action of Malt Flour on Attenuation ... 687
  Fermentation ... 513
Theisen, E. Condensation Apparatus ... 511
Thomas, A. Strainer for Tar ... 115
Thomas, T. C. J. Glass Manufacture ... 35
Thomas, W. J. Gases in Coal ... 729
Thompson, J. B., and White, W. Aluminium Alloys ... 440
  Sodium Manufacture ... 440
Thompson, J. B. Soda Manufacture ... 626
Thompson, L. Calorimeter (illus.) ... 868

PAGE

Thompson, S. P. Electro-deposition of Cobalt ... 328
Thompson, T. Medicinal Iron Preparations ... 452
Thompson, W. P. Discussion on Application of Oxygen ... 184
  Discussion on Electrolytic Bleaching ... 299
  Filtering Material for Sugar ... 580
  Utilisation of Acid Tar Residues ... 303
  See Tall ... 756
Thoms, H. Calamus Roots ... 641
Thomsen, J. Gold Chloride ... 208
Thomson. Discussion on Carbolic Powders ... 828
Thomson, G. Extraction of Silver ... 36
Thomson, J. Antiseptic Soap ... 192
  Discussion on Antiseptics ... 718
  Effect of Pressure on Chemical Changes ... 477
  Mercurial Soaps ... 507
Thomson, R. D. Corrosion of Lead ... 20
Thomson, R. T. Phosphoric Acid Determination ... 311
Thorawski, T., and Gläser, M. Activity of Malt ... 448
Thörner, W. Decomposition and Absorption Apparatus (illus.) ... 769
Thornton, J. E. Flexible Photographic Films ... 768
Thorp, W. Discussion on Water Analysis ... 804
  Liquid Fuel ... 309
Thorpe, T. E., and Smith, W. J. Morindon ... 382
Thwaite, B. H. Cement Kiln (illus.) ... 439
  Hydrocarbon Gas ... 116
Tidy. Hardness of Water ... 799
  See Crookes ... 16
Tidy, M. Discussion on Coal Distillation ... 62
Tiedemann. Malt ... 447
Tilden, W. A. Discussion on Water Gas ... 109
Tilley, W. Secondary Batteries ... 572
Tinlin, J., and others. Press for Drugs, &c. ... 313
Todd, A. M. Peppermint ... 550
Toft, C. Decorated Glass ... 502
Töhl, A. Tetramethylbenzene ... 381
Tollens. Fermentation of Galactose ... 336, 578
  Rotatory Power of Cane Sugar ... 595
  Saccharic Acid ... 579
  See Wehmer ... 517
Tollens and Schmitz. Rotation Constant of Sugar ... 265
Tollens, B. *See* Gans ... 595
  See Sohst, O. ... 508
  See Wehmer ... 334
Tollens, B., and Stone, W. E. Fermentation of Galactose ... 511
Tomkins, A. S. *See* Death, J. ... 337
Tompkins, H. K. *See* Farmer ... 767
Tompson. Inversion of Sugar ... 831
Torrey, H. G. Silver Refining ... 571
Towlson, F., and Weldon, E. Aniline Black ... 121
Townsend, J. Chlorine Manufacture ... 288
Tralls, L. *See* Maltzan ... 844
Trassl, J., and Lindler, H. Sheet Glass ... 502
Traube. Capillarimeter ... 871
  Estimation of Fusel Oil ... 396
Traube, I., and Bodländer, G. Separation of Fusel Oil ... 449
Traube, J. *See* Bodländer ... 513
  Purification of Spirits ... 762
  Stalagmometer ... 42
Trenemen, W. Coloured Photographs ... 400
Trew, W. *See* Carnelly ... 15
Trickett, F., and Noad, J. Soda Crystals ... 629
Trimble, H. *See* Abbott ... 757
Tripler, C. E. Extraction of Precious Metals ... 326
Trojanowsky. Substitute for Gum Arabic ... 334
Trommsdorf, H. Sozoiodol ... 227
Trommsdorff. Vanillin in Spirit ... 513
Trottier and Fuchs. Stripping Tin Scrap ... 440
Truchelut, T. M. J. and J. U. Treatment of Sewage ... 862
Tscherikowski, N. Sugar Refining ... 335
Tucker. Ammonia from Air ... 736
Tucker, A. E. Curiosities of Iron Manufacture ... 568
  Discussion on Water Gas ... 100
  Valuation of Pig Iron ... 212
Taffee, W. Cement Kiln ... 325
Turner. Discussion on Water Gas ... 101
Turner, A. W. *See* Pearson ... 753
Turner, T. Cast Iron ... 569
  Filter for Oil ... 442
  Strong Cast Iron ... 200
Turpin, E. Panclastite (illus.) ... 519
Tuson, R. V. Disinfectants ... 43
  Disinfecting Liquid ... 863
Tuteur, E., and Goulborne, J. Artificial Leather ... 220
Tuthill, E. Hides treated with Birch Bark Oil ... 574
Twining, W. J. *See* Burghardt ... 441, 634
Tyne Alkali Co. Hydrate of Baryta ... 675
Typke. Diamidoresorcinol ... 839

PAGE

Typke, P. G. W. Hypophosphites ... 387
Tyrer, T. Discussion on the Gas Industry ... 548
Tzchucke, H. Estimation of Phosphoric Acid ... 646

Ulrici, C. Parthenicine ... 867
Ulzer, F. *See* Benedikt ... 594, 682
    Turkey-red Oil ... 329
Unger, H., and Kempf. Amrad Gum ... 416
Unwin. Strength of Cast Iron ... 201
Utescher, E. Ethyl Nitrite ... 405
    Phenacetin ... 227

Valenta, E. Bone Fat ... 219
Valentin. Dextrin-Maltose ... 269
Valentin, W. G. *See* O'Sullivan ... 446
Van Vleck, G. H. *See* Pitt ... 429
Vaughn, V. C. Tyrotoxicin ... 714
Vaughan-Sherrin, J. Galvanic Batteries ... 126
Vautin, C. T. J. Extraction of Gold ... 125, 851
    Filter Pump ... 109
    See Newbery ... 850
Veevers, H. *See* Estcourt ... 203
Venable, J. P., and Phillips, W. B. North Carolina Wines ... 239
Venator. *See* Isbert ... 234, 527
Ventzke. Saccharimeter (illus.) ... 263
Vergara. Gelatin Film ... 341
Vessel, H. V. Dynamite ... 342
Vicat. Cement ... 102
Vickers. Manure Mixture ... 88
    See Buchanan ... 422
Vignon, L. Acid Sulphates of Aromatic Bases ... 744
    See Barbier, P. ... 31, 116
    See Dubois ... 765
Vilcin. Santonin ... 870
Villard. *See* de Forcrand ... 516
Villiers, A. Detection of Sulphites ... 525
Violle. Platinum Standard of Light ... 368
Vivian, A. P. Alloys ... 388
Vivien. Purification of Sugar ... 509
Vivien, H. Slab Sugar ... 41
Vogel. Optical Sensitisers ... 767
    Phosphoric Acid Determination ... 869
Vogel, H. W. Sensitive Isochromatic Plates ... 518
    Spectra of Dye-stuffs ... 134
    Spectroscopic Examination of Wine ... 526
Vogelmann, A. Treatment of Ores ... 217
Voiry, R. Essence of Eucalyptus ... 764
    Essence of Cajeput ... 765
    Eucalyptol ... 516, 585
    See Bouchardat ... 516
Voit, E. Standard Candles ... 114
Volhard. Titration of Silver ... 311
Vollert. Mercury Imidosuccinate ... 867
Von Hauer. Calorimetry ... 197
    Vanadium ... 73
Voree, L. D. *See* Keep ... 752
Vortmann, G. Application of Sodium Pyrophosphate ... 401
Vry, J. E. de. Cinchona Bark ... 865
Vulpius. Sulphonal ... 641, 694
Vulpius, G. Testing Chloroform ... 237
    Sulphonal ... 457

Wachendorff, C. Antimonic Fluoride ... 624
Wacker, L. Aromatic Nitroso-bases ... 318
Waddington, H. H. Vulcanised Rubber ... 330
Wagner. Azotometer ... 238
Wagner, E. Tannin in Plants ... 759
Wagner, P. Manurial Value of Slag ... 758
    Sugar Beet in 1885, 1886, and 1887 ... 395
Walder, H. J. Phenol Derivatives ... 32
    Anthraquinone Derivatives ... 32
Walder, W. Colours from Anthraquinonedisulphonic Acid ... 116
Walferdin. Thermometer ... 616
Walfiscz, A. *See* Gniewosz ... 772
Walker, A. Sulphate of Soda Manufacture (illus.) ... 625
    Yeast ... 224
Walker, W. T. Still (illus.) ... 834
Walker, H. W., and Patterson, T. L. Refining Sugar ... 41
Walker, J. Dyeing ... 121
Walker, J., and Co. Specimens at Glasgow International Exhibition ... 482
Wallace. Candle Value of Gas ... 199
    Phosphoric Acid Determination ... 312
Wallace, J. O., and Ward, W. Anti-fouling Composition ... 443
Wallace, W. Obituary ... 737
Wallach. Azo-Compounds ... 557
    Phenyldisazoresorcinol ... 838
Wallach, O. Terpenes ... 517
Wallach, O., and Gildemeister, E. Terpenes ... 586, 587
Walls, W., and Co. Specimens at Glasgow International Exhibition ... 482
Waltenberger. Fibroin ... 499
Walter, H. Galvanic Batteries ... 441
Walters. Voltameter (illus.) ... 402
Walton, J. A. Laundry Blue ... 507
Waltz. Propylsuccinic Acid ... 586
Wängler, W. Alizarin Discharge on Blue ... 843
Wanklyn. Water Analysis ... 796
    See Fox ... 779
Ward, W. *See* Wallace ... 443
Warden, C. J. H. India Coca Leaves ... 400
Wardle, J. Wild Silk ... 841
Warnecke, H. Coloured Reactions of Cell Membrane ... 870
    Wrightine ... 585
Warren, H. N. Estimation of Tin in Slags ... 457
Warren, T. P. B. Action of Sulphur Chloride on Oils ... 552
Warrington and Reinsch. Bistre Colour ... 320
Wass, A. G. Varnish, &c. ... 683
Watkins, W. Cement for Joints ... 850
Watson, J. Estimation of Sulphur in Burnt Pyrites ... 305
Watson, J. D. Enamelling Metals ... 392
Watson, W. L. *See* Longmore ... 206
Watson and Spoor. Cement ... 105
Watt, A. Electrolytic Treatment of Zinc Ore ... 328
Waugh. Jaborandi ... 867
Webb, A. E., Johnstone, H. R., and Paul, H. W. Incombustible Wicks ... 203
Weber, C. O. Colouration of Glass ... 502
Weber, R. Zero Point of Thermometers ... 438
Webster, T. *See* Goodall ... 359
Webster, W., jun. Treatment of Sewage ... 441, 764
Wehmer, C. Formose ... 41
Wehmer, C., and Tollens, B. Levulinic Acid ... 334
Wehmer and Tollens. Tannin ... 517
Weidel, H., and Bamberger, M. Quinoline ... 384
Weidig, H. P., and Remmey, R. C. Absorption Towers (illus.) ... 322
Weil. Estimation of Antimonic Acid ... 344
Wein, E. Berlin Weissbier ... 857
    Munich White Beer ... 336
Weinberg. Naphthylamine-sulphonic Acid ... 33
Weinberg, A. Azo-Colours ... 672
    Naphthylamine-sulphonic Acids ... 118
Weingärtner. Discrimination of Dyes ... 386
Weingärtner, E. Benzidine-azo Dyes ... 382
    Rhodamine ... 386
Weinstein, L. Density of Paraffin (illus.) ... 679
Weirich, J. Treatment of Gold Ore ... 326
Weisberg, J. Metapectic Acid from Beet Juice ... 856
Weiss. Rutin ... 382
Weissmann, G. Manganese Determination ... 235
    Carbon in Iron ... 646
Weith. *See* Merz ... 840
Welch, J. C. Nitrogen Determination ... 64
Welch, J. T. *See* Perry, W. J. ... 631
Weld, L. B. Hydrochlorate of Quinine ... 452
Weldon. Chlorine ... 740
    Chlorine Manufacture ... 287
Weldon, E. *See* Towlson ... 121
Weldon, U. Dyeing ... 321
Weldon, W. Soda Manufacture ... 720
    Sulphur Recovery ... 164
Wellcome, H. S. *See* Tinlin ... 313
Weller. Estimation of Antimonic Acid ... 344
Wells, G. I. J., and Howard, S. L. Treatment of Fibre ... 320
Wells, W. T. Coating Iron or Steel ... 633
Welsbach, C. A. v. Bunsen Burners ... 837
    Incandescence Bodies for Lamps ... 617
    Incandescent Gas Burner ... 23
    Mantle for Incandescence Burner ... 315
Wendriner, M. Wash-bottle Valve (illus.) ... 643
Weppen and Lüders. Pyridine Bases ... 345
    Test for Pyridine Bases ... 762
Werens, F. *See* Dirks ... 345
Werth. *See* Osmond ... 503
Weselsky. Diazoresorcinol ... 315
West-Knight and Gall. Phenolate of Sodium ... 808

PAGE
Westphal, C. Water Gas ... 499
Weyl, T. Poisonous Properties of Saffron Surrogate ... 449
  Silk ... 385, 499
Weyl, Th. Saffron Surrogate ... 130
Whamond, N. Cement from Slag ... 677
Whamond, W. *See* Scott ... 325
  See Snelus ... 631
White, J. and J. Chemicals at Glasgow International Exhibition ... 481
White, L. *See* Macevoy ... 325
White, W. *See* Larkin ... 288
  See Thompson ... 410
White, W., and Rickmann, A. Packing Acids ... 845
Whitten, J. O. Galvanic Batteries ... 218
Whittier, T. P. Galvanic Batteries ... 573
Wiborgh, J. Volumetric Determination of Carbon ... 235
Widnes Alkali Co. Chemicals at Glasgow International Exhibition ... 481
Wiesinger, H., and Rissmüller, L. Dry Soap ... 756
Wiesnegg. Laboratory Apparatus (illus.) ... 234
Wiesner, J. Ancient Paper ... 515
  Influence of Light on Wood-made Papers ... 44
Wigg, C. Ammonia Soda ... 502
  Ammonia-Soda Process ... 626
  Treatment of Copper Liquors ... 125
  Waste Liquors ... 812
Wigg and Steele. Waste Liquors ... 812
Wild, R. *See* Ashworth ... 746
  See Petrie ... 121
Wilde. *See* Pollak ... 523
Wilders, W. *See* Macevoy ... 325
Wildt. Oil of Lallemantia Seed ... 219
Wiley. Sugar from Sorghum ... 334
Wiley, T. F. Waterproof Fabrics ... 853
Wilfarth, H. Nitric Acid Determination (illus.) ... 692
Wilhöft, F. Vulcanised Rubber ... 330
Wilkinson. Sugar Manufacture in Louisiana ... 446
Wilkinson, A. Treatment of Fibre ... 339
Will. Estimation of Grape Sugar ... 397
Will, W. Atropine ... 584
Williams. Cocaine ... 400
Williams, C. Compound for Washing ... 634
Williams, E. T. *See* Wright, W. B. ... 30
Williams, Rowland. Adulteration of Tallow with Cotton-Seed Oil ... 186
Williams, R. Carbolic Powders ... 826
Willis, R. W. and A. J. Enamelled Earthenware ... 503
Willis, W. Photo-chemical Printing ... 132
Wilson. Gas Producer ... 114
  Water Gas ... 100
Wilson, A. Water Gas ... 20
Wilson, D. *See* Thwaite ... 439
Wilson, E. S. Treatment of Cotton Seed ... 126
Wilson, G. F. Waterproofing Composition ... 320
Wilson, T. *See* Hard ... 572
Wilson, T. B. Treatment of Sewage ... 43
Windisch. Action of Carbon Dioxide on Diastase ... 514
  Lactic Acid ... 513
Windisch, O. Effect of the Water on Beer ... 396
Windisch, W. Lactic Acid ... 511
Winkler. Correction of Gas Volume ... 521
  Germanium ... 230
Winkler, C. Examination of Alloys ... 772
  Explosions in Mines ... 325
  Sulphuretted Hydrogen ... 121
Winter. Carbohydrates ... 685
  Sugar-cane ... 761
Winter, H. Levulose ... 445
Witt. Azophenine ... 562
  Decomposition of Ammonium Chloride ... 322
  Discrimination of Dyes ... 386
  Eurhodines ... 742
  Naphthionic Acid ... 670
  Naphthylamine-sulphonic Acid ... 118
  Naphthalene Derivatives, &c. ... 317
  Textile Fabrics ... 841
  Toluylene Blue ... 559
Witt, O. N. α-Acetonaphthol ... 204
  Azo-Colours ... 180
Witting, F. Borax Manufacture ... 748
Wittmack. Discriminating certain Seeds ... 39
Witz. Oxycellulose ... 818
Wohanka and Co. Explosives ... 401
Wohl. Detection of Invert Sugar ... 527
Wohl, A. Influence of Catechol on Fehling's Solution ... 459
Wolf, F., Inversion of Sugar ... 696
Wolf, S. Cellulose ... 640
Wolff, C. H. Electrolytic Detection of Mercury (illus.) ... 454
  Voltameter (illus.) ... 440
Wolff, E., and Kreuzhage, C. Experimental Cultivations ... 221
Wollny. Testing Butter ... 238, 348, 527
Wollny, E. Growth of Potatoes ... 127
Wood, A. M. India-rubber Substitute ... 443
  Rubber Composition ... 330
Wood, M. R. Ammonia-Soda Process ... 438
  Bicarbonate of Soda (illus.) ... 629
Woodhead. Antiseptic Soap ... 192
Woodhouse, A. Amalgamation of Gold ... 327
Woods, J. E. T. Recovery of Tin ... 327
Woolford, J. Extraction of Gold ... 851
Worm-Müller. Grape Sugar in Urine ... 595
Worms. Benzopurpurin Colours ... 839
  Saccharine ... 688
Worms and Balé. Tanning ... 507
Worms, E., and Balé, J. Electric Tanning ... 441, 443
Worthington, R. H. Waste Liquor from Tin Scraps ... 36
Wrampelmeyer. Measure for Small quantities of Mercury ... 869
Wright, A. Paper Pulp ... 640
Wright, C. R. A. Discussion on Recovery of Sulphur ... 177
Wright, L. T. Address to Nottingham Section ... 24
  The Gas Industry ... 542
  Studies in Coal Distillation ... 59
Wright, W. B., and Williams, E. T. Hydrocarbon Furnace ... 30
Wulff, L. Crystallisation of Sugar ... 577
Wurster. Red Dye ... 559
Wurster, C. Active Oxygen ... 404
  Colours with Hydrogen Dioxide ... 117
  Hydrogen Peroxide in Vegetables, &c. ... 394
  Paper Testing ... 338
Wurtz. Enzymes ... 224
  Phosphites ... 501
Wurtz, R. Poisonous Bases formed by Fermentation ... 450
Wyatt, J. W. Rosin Size ... 132
Wylde, J. R. *See* Bolton ... 437
Wyllie, R. Ammoniacal Liquors ... 614
Wyss, O. Toxic Action of Water Gas ... 688

Yaryan, H. T. Vacuum Evaporator ... 313
  Purification of Boiler Water ... 614
Yoshida, Hikorokurò. Camphorogenol ... 424
Yoshida, H. Camphorogenol ... 549
  Camphor Oil ... 67
Young. Letter from Lyon Playfair ... 612
Young, A. Sugar Manufacture ... 447
Young and Beilby. Ammonia ... 737
Young Paraffin Light Co. Specimens at Glasgow International Exhibition ... 482

Zahn, W. Tanning ... 444
Zalinski. Dynamite Gun ... 492
Zaloziecki, R. Determination of Paraffin (illus.) ... 349
  Paraffin in Petroleum ... 428
Zander, A. Santaline ... 32
Zeckendorf, A. *See* Lunge ... 639
Zeisel, S. Colchicine ... 228
Zeiss. Polarimeter ... 831
Zeiss, C. and R. Optical Glass ... 846
Zetter, G. Denaturation of Alcohol ... 858
  Discrimination of Dyes ... 386
Zeuner. Thermodynamics ... 721
Zimmer, G. C. Colours from Tetrazodiphenyl ... 673
  Diphenylaminesulphonic Acid ... 840
Zincke and Hagen v. Anilidoethoxybenzoquinone-anil ... 316
Zinin. Naphthylenediamine ... 619
Zipperer. Starch Determination ... 348
Zipperer, P. Nitrogen Determination ... 647
  Starch in Chocolate ... 233
Zirnité, G. Solution of Iron in Caustic Soda ... 322
Zohrab, E. Treatment of Peat ... 381
Zsigmondy. Estimation of Glycerol ... 696
Zsigmondy, R. Tints on Glass ... 122
Zulkowski, K. Determination of High Temperature ... 846
Zulkowsky, K. Mineral Mill (illus.) ... 109

INDEX OF SUBJECTS.

PAGE

Absorption Apparatus (illus.) 769
    Towers (illus.) 322
Acacia Abaica, Gum from 446
    Barks, Various 38
    Tan Substances from 392
Accumulators 328, 389, 390, 442, 505
    Electrical 125, 126, 572, 634, 678
    Plates for 754, 755
Acenaphthene Derivatives 382
Acetal 866
Acetanilide 518
    And Phenacetine 772
Acetic Acid Manufacture 628
Acetonaphthol (α) 204
Acetone Determination 459
Acid Gases, Condensers for (illus.) 845
Acids, Packing 845
Acorin 641
Acorn Coffee 397
Acridine 482
Adapter for Fractional Distillation in Vacuo (illus.) 523
Address at Glasgow, President's 474
    At Nottingham, Chairman's 24
Aethylium Bromatum 701
Agalith for weighting Paper 226
Agriculture, Calcium Sulphite in 508
    U. S. Department of 395
Air, Carbonic Acid in (illus.) 639
    Sterilisation of 763
    Zymo-chemical Examination of 858
Alanine 499
Albo-Carbon Lamp 113
Albumen and Tannic Acid Compounds 331
Albuminoids, Nutritive Value of 450
Alcohol, Aldehyde in 238
    From Brewers' Sediments 42
    Denaturation of 135, 335, 396, 397, 858
    Determination of Bases in 348
    Eugenol and Vanillin in 336
    Fusel Oil in 42
    German 637
    Higher 581
    Impurities in Commercial 457
    Manufacture 418, 449
    For Manufacturing Purposes 78
    Methylated 223
    Purification of 130
    Still (illus.) 763
    Methyl-, Specific Gravity of 581
Alcoholic Fermentation, Bases formed in 450
    Liquids (Japan) 397
Alcohols, Reaction for Polyatomic 527
Aldehyde in Commercial Alcohol 238
Algae of Arable Soil, Nitrogenous 759
Alizarin 382
    Black 386
Alkali Act, Notes on 785
    Estimation of Caustic 829
    Manufacture 323
    Process, a new 807
    In Raw Sugar 334
    Trade in France 875
    Waste, Sulphur Recovery from (illus.) 162
    Treatment of (illus.) 210
    Utilisation of 626
    Works, Registered 783
Alkaline Earths, Determination of Carbonates 403
    Hydrates at High Temperature 730
Alloys 388, 389, 504, 753
Alphanaphthol 867
Alphanaphtholdisulpho-Acid 672
Alpha-oxynaphthoic Acid 130
Alstonine 866
Alumina 437
    Compounds, Pure 625
    Reduction of 124

PAGE

Aluminates, Alkaline 748
    Of Lime 567
Aluminium 389
    Alloys 36, 140, 441, 503, 504, 633, 634, 851, 852
    Basic Sulphocyanide 433
    Bronze 325
    Chlorides, Basic 624
    Determination 590
    Extraction 35, 36, 328
    Extraction and Alloys 217
    Fluoride 675
    Influence on Iron 752
    Manufacture 568, 633, 634, 753, 851
    Plating 441
    Sulphate, Basic 322
    Sulphate, Purification of 844
    Sulphocyanides 207
    Vanadium Determination in presence of 73
Amalgamation of Ores 217, 326, 327
Amber shavings, Concreting 38
Amidoazobenzidines, Derivatives of 432
Amidoparahydroxyquinoline 55
Amidophenaceturic Acid 641
Amidophenylpiperidine 671
Amines, Substitution of 429
Ammonia Carbonate, Lump 387
    Determination 772
    Determination in Water 403
    Influence in the "Elution" Process 578
    Manufacture 35, 629, 675
    Salts, Manurial Value of 332, 333
    Soda Process (illus.) 323, 434, 435, 436, 437, 438, 626, 629
    Introduction of 479
    Sulphate 35, 96, 437
    Sulphate Manufacture 387
    Sulphate Statistics 247, 248
    Sulphites 629
    Yield from Coal 62
    Chloride from Coke, etc. 735
    Decomposition of 522
    Lump 387
    Phosphate from Gas Liquor 114
    Phosphate as Manure for Beet 683
    Sulphide 438
    Sulphide, Treatment of 629
Ammoniacal Liquor 741
    Treatment of 502, 557, 614, 629
Ampères, Effective Value of 723
Amyl Acetate Lump 202, 668, 368
Amyl Alcohol formed from Glycerol 129
Anagyrine 765
Analysis, Arrangement of Results of 800
    By Electrolysis (illus.) 344, 401
    Indicators in Volumetric 591
    Nitrosulphonic Acid Employed in 234
    Quantitative 693
Andromedotoxin 866
Aniline Black 31, 747
    Black Dyeing 121, 207
    Colours 498
    Dyes for Canton 409
    Steam Colours, Fixing 565
    Trisulphonic Acid 669
Animal Substances, Preservation of 331
Anthracene, Percentage in Tar 60
Anthracin 386
Anthraflavinic Acid Derivative 384
Anthraflavic Acid, Reduction of 205
Anthragallol Diethylether 383
    Reduction of 205
Anthranol Derivatives 671
Anthrapurpurin, Reduction of 205
Anthraquinone Colours 32
    Derivatives, Leuco Compounds of 384
    Disulphonic Acid, Colours from 116
    Dyes, Leuco-derivatives of 204
Anthrarobin 205
Anthrarobinum 701

PAGE
Anticorrosive Compound 127
  Composition 443
  Paint for Iron 683
Antifebrine 482
  In Phenacetine 694
  Test for 772
Antimonious Sulphide, Decomposition of 322
Antimony Determination 344
  Determined in Slag 457
  Extraction 36
  Fluoride 566
  Fluoride with Ammonium Sulphate 206, 207
  Fluorides 624
  Mordant for Whey 623
  Mordants 841
  Sodium Fluoride, Analysis of 133
  And Tin, Separation of 403
  In Turkey 245
Antipyretic 227, 765
Antipyrine, Test for 772
Antiseptic.... 130, 131, 132, 225, 226, 331, 398, 582, 583, 635, 639, 762, 764
  Powder from Saponin 863
  Properties of α-Naphthol 450
  Soap 192
  Treatment of Wood 35
  Value of β-Naphthol 225
  Values of various Substances 714
Antiseptics, etc., Application of 43
Apatite 92
Apiol 399, 583
Apiolaldehyde 584
Apiolaldoxim 584
Apiolic Acid 584
Apione 584
Aqua Regia, Action on Phenols 670
Arabinose, Reaction for 595
Arable Soil, Nitrogenous Algae of 759
Arachidic Acid 391
Aromatic Bases, Acid Sulphates of 744
Aromatic Amines, Colours from Secondary 120
  Reactions for 744
  Hydroxy-Compounds, Thio-products of 341
Arsenates, Manufacture of 673
Arsenic Determination in Fabrics 456
  Separation of Gold and Platinum from 693
  Statistics 649
  Sulphuretted Hydrogen free from 121
Arsenious Acid Determination 344
Asarone 391
Asarum Europaeum, Oil of 391
Asbestos Paint 443
  Sheets of 833
Ascension Pipes, Stoppage prevented in 741
Aselline 586
Ash Determination (illus.) 238, 454
Asparagin in Potato Buds 686
  In Soja Hispida 854
Asphalte Paving, Cement for 325
Asphaltene 837
Asphaltum in California 410
Aspidospermin 132
Aspirator (illus.) 312
  With Constant Overflow (illus.) 691
Atropine 584
  From Hyoscyamine 518
Attenuation of Worts 687
Auramines 30, 117, 205
Azimido-Derivatives 562
Azo-Colours 120, 319, 386, 499,, 563, 669, 672, 673
  For Cotton 204, 430, 431, 432
Azo-compounds, Mixed 203, 558
Azo-derivatives 617, 618, 619
Azo-dyes 31, 839
Azo-eosin 561
Azophenine 316, 572, 743
Azotometer 238

Bacillus hutylicus, Action on Glycerol 129
Bacteria, Test for Cholera 131
Bacterio-purpurin 338
Balance, Lux's Gas 668
Baldingera, Carbohydrate from 128
Banksia, Tan Substances from 392
Bar Photometer 363

PAGE
Barium Cements 676
  Fluoride 122
  Hydrate 122, 207
  Method of Starch Determination 350
  Solutions, Treatment of 675
  Sulphate, Precipitation of 401
  Sulphate, Treatment of 443
Barley Cultivation 576
  Experiments on 394
  Wine 397
Baryta Hydrate 436
  Manufacture 675
Bases in Alcohol determined 348
  Formed in Alcoholic Fermentation 450
  From Fermentation 336
Batiatior 517
Batjentjor, African 517
Batteries, Bichromate 851
  Electric 218
  Electrical 678, 679
  Galvanic 126, 327, 389, 390, 441, 572, 573, 634, 754
  Secondary 125, 126, 328, 442, 505, 634, 678, 754, 755
Battery Elements, Lead Peroxide 37
Beer, Analysis of 273
  Berlin and Munich 857
  Bitter After-Taste of 337
  Etc., Carbonic Acid Generator for 762
  Decolourised by Sarcina 449
  Effect of the Water on the 396
  Lichtenhainer 337
  Munich and Berlin White 336
  Etc., Treatment of 859, 860
Beet, Development of 334
  Improvement of 856
Beet Juice, Constituents in 223
  Constituents of 578
  Filtration of 857
  Metapectic Acid from 856
  Treatment of 129
Beet Leaves as Fodder, Sour 337
  Manures for 333, 683, 684
  Sugar in 595
Beetroot, Examination of 528
Beet Sugar, Catechol in 128
Beltite 589
Benzene, Disazo- 557
  Works, Fires in 312
Benzenetriphenazine 384
Benzhydrylaceticcarboxylic Acid 671
Benzidine-azo Dyes 382
  Derivatives 31, 563, 619
Benzoflavines 746
Benzoic Acid in Milk 225
Benzopurpurine 386, 563
  As an Indicator 591
Benzoylsulphimide 452
Benzoylsulphonic-imide 333
Berlin Beer 857
Betol 866
Beverage, Sea Water as a 862
Bibromapione 583
Bicarbonate Column (illus.) 110
Bilberry, Colouring Matter of (illus.) 526
Birch Bark, Oil of 574
Bird Excreta 80
Bismuth, Reaction of 769
  Tetroxide, Preparation of 694
Bistre Colours 320
Bitumen from Petroleum 377
  Varnish from Petroleum Residues 304
Bitumens, Treatment of 573
Black Colour 747
  Dye 431
  Varnish 434
Blacking, Examination of 235
Blacks (Glass Cullet) 324
Bleaching (illus.) 33, 321, 501, 624, 746, 844
  Electrolytic 292
  Hermite Process 726, 737
  Powder, Analysis of 189
  Powder, Chlorine lost from 188
  Powder Manufacture 10
  Solution, Electrolysing 126
  Theory of 841, 843
Blood 94
Blowers, Hydraulic (illus.) 29
Blue for Laundries 507
  Meldola's 560
  Nile 561
  Paraphenylene 561
  Positive Photographic Process 766

PAGE

- Boehmeria nivea, Cultivation of 575
- Boilers, Corrosion of 805, 833
  - Incrustation Preventive 313
  - Purifying Water for 313
  - Scum Separator for 614
- Boldin 585
- Boldoin 866
- Bone Charcoal 636
  - Phosphoric Acid in 311
- Bone Earth, Treatment with Sulphuric Acid 333
  - Fat 219
  - Manures 81, 195
  - Meal, Chloroform Test for 779
  - Powder 133
- Bones, Ratio between Lime and Phosphosic Acid in 222
- Books protected from Insects 409
- Borax, Chilian 462
  - Manufacture 748
  - Statistics 153
  - Trade 245
- Boric Acid Determination 45, 525
  - Treatment of Packing for Fruit, &c. 338
- Boring, Well (illus.) 662
- Borneo Tallow 391
- Bouillie Bordelaise for Vines 758
- Brandy (?) 637
  - Examination of 871
  - Mashes, Yeast for 223
  - Purification of 762
- Brasilin 838
  - Tetramethyl- 117
- Bread, Constituents of 638
- Breweries, Air of 858
- Brewers, Polarimeter for 713, 831
  - Sediments, Alcohol from 42
  - Wort, Cooling 223
- Brewing 42, 336, 447, 514, 857, 858
  - Polariscope applied to (illus.) 259
  - Saccharine Liquors for 860
- Bridges, Destruction of 589
- Brilliant Congo 386
- Brimstone Statistics 169
- "Bromidine" Disinfectant 482
- Bromine, Absorption of Mineral Oils 64
  - Determination 729
  - Determination in Organic Compounds (illus.) 137
  - Statistics 151
- Buck Bean, Extract of 132
- Buko Leaves, Chemistry of 585
- Bulbs, Liebig's (illus.) 734
- Bumping, Prevention of, during Distillation 524
- Burette, Exclusion of Air from (illus.) 232
  - Flask with (illus.) 589
  - For Gas Analysis (illus.) 644
  - Nozzle (illus.) 456
- Burettes, Stop-Cock for (illus.) 343
- Butter 350
  - Analysis 185, 376, 697
  - Examination 527
  - Examination of 348, 595
  - Manufacture (illus.) 450
  - Testing 238
- Butyl Acetate employed in Varnish 443

- Cacao Husks 583
- Cadmium Sulphide, Colloid 34
  - Test for Pyridine Bases 762
- Caffeine 702
  - From Damaged Tea 531
  - In Guarana, Determined 347
  - Manufacture 781
- Cajeput, Essence of 765
  - Oil 587
- Calamus Roots, Constituents of 641
- Calcium Carbonate, Decomposition by Heat 690, 849
  - Chloride, Chlorine from 437
  - Chloride, Electrolysis of 327
  - Chloride, Influence on Germination 575
  - Oxalate in Leaves 575
  - Salts in Cements 567
  - Sulphite in Agriculture 508
  - Sulphite with Farmyard Manure 333
- Californian Petroleum and Asphaltum 410
  - Red Wood Tree, Cellulose from 451
- Calorific Value of Coal 615
  - Of Fuels 195, 308
- Calorimeter (illus.) 196, 691, 868

PAGE

- Calorimetry 476
- Camphor Exports from Japan 783
  - Oil, Oxidation of 67
- Camphoric Acid as a Therapeutic 865
- Camphorogenol 67, 424, 549
- Canada, Imports of Drugs, &c. 409
  - Mineral Production of 358
- Candle Power, comparative Cost of 544
- Candles, Effect of Temperature on 368
  - Foreign Trade in 599
  - Photometric Value of 390
  - Reports from Gibraltar and Turkey 139
  - Standard 114
- Cane Sugar, Determination of 694, 695
- Cannel Coal 556
- Canton, Aniline Dyes for 409
  - Imports and Exports of Chemicals in 699
- Caoutchouc, Bitumen 304
  - Goods, Examination of 527
  - Varnish, Wax of 573
- Cape Colony, Trade in Candles and Soap 47
- Carbines, Chromogenous 742
- Carbo-Dynamite 588, 690
- Carbohydrates 128, 685
  - Estimation of 695
  - Specific Rotatory Powers of 266
- Carbolate of Mercury Soap 193
- Carbolic Acid, Commercial 826
  - Derivatives 32
  - Manufacture 429
  - Trade in 701
  - Gauze 131
- Carbon, Action of Oxygen on 555
  - Asbestos for Filters 132
  - Determination in Iron 235, 457
  - Determined in Iron 646
  - Estimated in Iron 693
  - Disulphide, Emulsions for 684
  - Electrodes 327
  - Filaments for Electric Lamps 37
  - Monoxide, Absorption by Cuprous Chloride 133
- Carbons, Electric 572
- Carbonate of Soda Deposits in India 874
- Carbonic Acid in Air (illus.) 339
  - Apparatus (illus.) 134
  - In Coal Gas 427
  - Evolved during Fermentation (illus.) 636
  - Gas, Compressed 605
  - Gas Manufacture 626, 749, 750
  - Generator (illus.) 110, 582
  - Generator for Beer, &c. 762
  - Receptacle for Liquid (illus.) 835
  - Oxide, Absorption of 403
  - Oxide Manufacture 315
- Carbonite 342
- Carburetter for Gas 367
- Carpets, Smyrna 781
- Carrère Powder for Vines 758
- Carthagena Drug Exports 409
- Carvoximes 587
- *Cascara Sagrada*, Treatment of 339
- Cassia Lignea Trade of Kwangsi 409
- Casurina, Tan Substances from 392
- Catalpin 689
- Catechol in Beet Sugar 128
  - Reaction of 459
- Cattle Food, Distillers' Wash as 687
- Celadon Porcelain 324
- Cell Membrane, Reactions of Lignified 870
- Celluloid Substances, Non-inflammable 853
- Cellulose 620
  - Manufacture 132, 640
  - From Sequoia Bark 451
- Cement 325, 568, 631, 676, 677
  - Iron 211
  - For Joints 850
  - From Lime Mud 301
  - Lining for Spirit Reservoirs 514
  - Manufacture (illus.) 438, 439, 440, 850
  - Portland 102
- Cements, Calcium Salts in 567
  - Hydraulic 847
- Centrifugal Machine for separation of Liquids 834
- Cereals, Sugar in 223, 685
- Ceresine 428
- Cerise 119
- Chairman's Address to Liverpool Section 719
  - Address at Nottingham 24
- Char 636
  - For Sugar Refining 419

PAGE

- Charcoal for Explosives ... 521
  - Peat ... 837
  - Powder ... 588
  - Revivification of ... 422
  - Retorts ... 837
  - Wood ... 497
- Cheese Manufacture ... 42
- Chemical Industry, German ... 650
  - Syndicate ... 700
  - Trade at Rouen ... 410
  - Works Registered and Inspected ... 784
- Chemicals, Customs Tariffs for ... 241
  - Exhibited at Glasgow ... 482
  - Foreign Trade in ... 49
  - Imports and Exports in Canton ... 699
- Cheques, &c., Safety Paper for ... 864
- Chili Saltpetre, Manurial Value of ... 332
- Chilian Nitrate of Soda Production ... 407
  - Trade ... 781
- China, Customs Tariff of ... 107
  - Drug Trade at Wenchow ... 409
  - Grass, Treatment of ... 399
- Chloragenine ... 866
- Chloral, Detection of ... 773
- Chlorate of Potash ... 437
- Chlorates ... 327
- Chlorides, Antiseptic Values of ... 715
- Chlorindigo ... 482
- Chlorine lost from Bleaching Powder ... 188
  - Determination ... 457
  - Determination in Organic Compounds (illus.) ... 137
  - From Gas Mixtures ... 673
  - Hermite Process ... 726, 737
  - Manufacture (illus.) 10, 286, 322, 437, 626, 628, 629, 720 845
- Chloroform, Detection of ... 773
  - Examination of ... 135
  - Testing ... 237
  - Trade in ... 702
- Chlorozone (illus.) ... 33
- Chocolate, Detection of Starch in ... 233
- Cholera Bacteria, Test for ... 131
- Cholesterin ... 584
  - In Beet Juice ... 223
- Cholesteryl Acetate ... 584
- Chromates, Manufacture of ... 673
  - Statistics ... 150
- Chrome Alum Photographic Bath ... 342
  - Alum in Photographic Emulsion ... 690
- Chromium Fluoride ... 385, 566, 746
  - Fluoride for Wool Dyeing ... 433
  - Manufacture ... 753, 754
  - Mordants ... 841
  - Sulphocyanides ... 207
  - Vanadium Determination in presence of ... 73
- Chromogens ... 742, 815
- Chromometer (illus.) ... 70, 234
- Chrysarobin, Substitutes for ... 205, 230
- Chrysoidine Compounds ... 619
- Chrysophanehydranthrone ... 204
- Chrysophanic Acid, Reduction of ... 204
- Chrysophenin ... 386
- Cider, Effect of Heat and Cold on ... 129
  - Somersetshire ... 857
- Cinchona Bark ... 451, 865
  - Duty on South American ... 246
- Cinchonidine ... 350
- Cineolic Acid ... 586
- Cinnamic and Gallic Acids, Product of ... 117
- Citric Acid in Cows' Milk ... 861
  - Solution, Preservative for ... 871
- Clay, Analysis of ... 234
- Cleansing Compound ... 634
- Climates, Brewing in Warm ... 858
- Clock for Measuring Spirit from Stills ... 514
- Cloth, Gelatinised ... 516
  - Treatment of ... 843, 844
- Clover Pods ... 574
  - Seeds, Inferior ... 393
- Coal, Analyses of ... 59, 61
  - Calorific Value of ... 739
  - Combustion of ... 615
  - Deposits in the Don Territory ... 781
  - Distillation, Studies in ... 59
  - Gases occluded in ... 729
- Coal Gas ... 741
  - Action on Malt ... 223
  - Cyanogen Compounds from ... 116
  - Desulphurising ... 3
  - Enrichment of ... 741
  - Generator ... 203
  - Industry, Prospects of ... 542
  - Purification ... 203

PAGE

- Coal Gas, Purification of ... 427
  - Value lost in Purification ... 427
- Coal Mines, Explosions in (illus.) ... 215
  - Firedamp, Detector for ... 753
  - Water from ... 457
- Coal, Production in the United States ... 532
  - Servian ... 111
  - In Turkey ... 245
  - Westphalian Cannel ... 556
  - Yield of Gas per Ton of ... 547
- Coal Smoke, Inspector's Report on ... 785
- Coal as a substitute for Lamp Black ... 127
- Coal, Sulphur Determination ... 524
- Coal Tar Colours, Paper Pulp dyed with ... 843
- Coal Tar, Composition of ... 59
  - Effect of Temperature of Carbonisation on ... 59
  - Phenols ... 808
  - Pyridine Bases from ... 381
- Cobalt, occurrence of ... 503
  - Plating ... 328
  - Statistics ... 149
  - Sulphate ... 437
- Coca Leaves, Indian ... 400
- Cocaïdine ... 341
- Cocaine ... 228, 516
- Cochineal Trade ... 530
- Cocoa ... 397
  - Powder, Adulteration of ... 593
  - Saccharine ... 225
- Cod Liver Oil ... 585
  - Examination of ... 37
- Coffee, Caffeine in ... 44
- Cognac, Composition of ... 224
- Coke, etc., Ammonium Chloride from ... 735
  - By-products from ... 838
  - Combustion with Silver-dust ... 235
  - Manufacture ... 428
  - Ovens (illus.) ... 835
  - From Tar ... 428
- Colchic Acid ... 228
- Colchiceïne, Amide of ... 228
- Colchicine ... 228
- Colliery Water, Analysis of ... 729
  - Waters ... 13, 796
- Collodion, Orthochromatic ... 230
  - Orthochromatic Emulsion ... 690
- Colorimeter ... 69, 70
- Colour Printing ... 123
- Coloured Glazes ... 750
- Colouring Matters ... 498
  - Acted on by Micro-organisms ... 745
  - Discrimination of ... 345
  - Fastness of ... 671
  - Permitted ... 130
  - From Piperidine ... 689
  - Theory of Formation ... 384
- Colours from Alphanaphtholdisulpho-Acid ... 672
  - Which combine with Mordants ... 33
  - For Cotton, New (illus.) ... 179
  - Discrimination of ... 386
  - Distemper ... 330
  - For Glass Painting ... 847
  - Produced by means of Hydrogen Dioxide ... 117
  - Standardising ... 592
- Combustion in making Nitrobenzene ... 563
  - Temperature of ... 380
- Compression, Action of ... 477
- Condensation of Steam emitted ... 387
- Condensers for Acid Gases (illus.) ... 845
- Condurango (illus.) ... 228
- Conessa Bark and Seeds ... 227
- Conessine ... 585
- Congo ... 386
- Congo-red. Reactions of ... 237
- Coniferyl Alcohol in Spirits of Wine ... 515
- Consular Reports ... 47, 139, 462
- Cooler for Vapours, etc. (illus.) ... 554
- Copper, Drawback from United States ... 46
  - Electro-deposition of Sheet ... 572
  - Extraction of Agordo ... 503
  - In Jam ... 348
  - Liquors, Treatment of ... 677
  - Method of Estimating Sugar ... 761
  - Ores, Furnaces for ... 754
  - Pyrites, Treatment of ... 389
  - Salts, Reagent for ... 525
  - Statistics ... 144
  - Works, Utilisation of Waste Liquor ... 124, 125
- Copperas Manufacture ... 625
- Coprolite ... 92
- Cork, Substitute for ... 677
- Cosine ... 451

PAGE

- Cosso 451
- Cotton, Absorption by 621
  - Azo-Colours for 204, 430, 431, 432
  - Bleaching 841, 843
  - Dead 818
  - Dyeing 623, 624
  - New Colours for (illus.) 179
  - Seed Husks, Ash of 591
  - Seed Oil, Reaction of 404
  - Seed Oil mixed with Olive Oil 135
  - Seed Oil, Treatment of 756
  - Seed Oil, Tallow adulterated with 186
  - Seed, Treatment of 126, 433
- Cow Dung 80
  - Manure 577
- Creosote, Detection of 526
- Cresol as a Therapeutic 866
- Cresolsulphonic Acid (*m*-) and (ortho-) 32
- Cresorcinol, Dinitroso- 562
- Crocose 396
- Crucibles 631
- Cruciferæ, Sulphur Compounds in the 854
- Cubebin 517
- Cudbear, Adulterations in 345
  - Magenta in 458
- Cultivation, Experimental 221
- Cupels (illus.) 631
- Cuprous Chloride, Absorption of Carbon Monoxide 133
  - As Photographic Developer 231
- Current Reducer, Electric (illus.) 401
- Customs Regulations 138, 351, 460, 529, 648
  - Tariff of China 407
- Cutch, Production of 245
- Cyanides, Oxidation of 308
- Cyanogen Compounds from Coal Gas 116
- Cyanotype 766
- Cyclamose 512

- Dambose 579
- Dari, Spirit from 447
- Decoloriser for Sugar Liquor 41
- Decomposition Apparatus (illus.) 769
- Denaturation of Alcohol 135, 223
  - Of Spirit 355
- Deodoriser 131
- Detonators 867
- Developers, Photographic 341, 342, 767, 867
- Dextrin 335
- Dextrose, Honey adulterated with 136
  - From Lichenin 512
  - Reaction for 595
- Diacetoxanthranol 384
- Dialyser 231
- Diamido Compounds 672
- Diamidoethoxydiphenyl-sulphonic Acid 839
- Diamidostilbene, Colours from 669
- Diamidostilbenedisulphonic Acid 319
- Diamine Red 386
- Dianilidoquinone-anil 562
- Diastase 224, 397
- Diazo-amido Compounds 618, 672
- Diazo-Derivatives 617, 618, 619
- Diazo-urea 672
- Dibromamidophenol 316
- Dibromonitrosophenol 316
- Dichloro-α-naphthoquinone Sulphonic Acid 319
- Dichroïnes 315
  - From Phenols 670
- Diethylsulphodimethylmethane 451
- Dihydroxyquinonephenazine 384
- Dimethylaniline, Acid Sulphate of 744
- Dimethylparatoluquinoline ($\alpha\ \gamma$) 612
- Dinitrobenzil Derivatives 432
- Dinitrocresol (Saffron substitute) 130
  - Poisonous Properties of 449
- Dinitrosocresorcinol 562
- Diolic Acid 585
- Diosphenol 585
- Dioxynaphthalene Derivatives 320
- Dioxynaphthaquinone 431
- Dipentene 542
  - Nitrolpiperidine 517
- Diphenylamine-sulphonic Acids 840
- Disazo-Compounds 557
- Disincrustant for Boilers 313

PAGE

- Disinfectants 43, 44, 398, 639, 716, 863
  - Lime as a 388
  - Moss as a 333
  - Peat as a 39
  - Powders, Carbolic 826
- Disinfecting with use of Spray 862
- Disinfection 450
  - Of Liquids 764
- Dissociation of Gases 615
  - Theory of 477
- Distillation, Prevention of Bumping during 524
  - In Vacuo, Fractional (illus.) 522, 523
- Distillers' Mash, Treatment of 859
  - Wash for Cattle Food 687
  - Wash, Treatment of 688
- Distilleries, Temperature of Fermentation 223
- Distilling Apparatus (illus.) 768
- Di-terebene 115
- Dominica, Drugs in 875
- Dracaena, Carbohydrate from 128
- Drainage Water 331
- Drawback on Exported Tinctures, &c. 875
- Drug Trade, Brazilian 245
- Drugs, Foreign Trade in 49
- Dryer for Gases (illus.) 589
- Drying Apparatus, Vacuum (illus.) 667
- Duration Test for Gas 374
- Dyeing 121, 321, 385, 386, 433, 434, 501
  - Cotton, etc. 623, 624, 625
  - And Printing 746, 747
  - Theory of 815
  - Yarns, etc. 207
- Dyes, Azo- 31, 618, 619
  - Detection of 458
  - Tinctorial Value of 592
- Dyestuffs, Discrimination of 773
  - From Nitrosoresorcinol 838
  - Spectra of 134
- Dye Woods, Colours from 82
- Dynamite 342, 452, 491, 588
  - Experiments with 488

- Earth Nut Oil, Acids in 391
- Earthenware, Fire Resisting Powers of 846
- Eau Céleste for Vines 758
- Ebonite Substitute 304
- Elastic Material 677
  - Substance 853
- Electric Lamps, Carbon Filaments for 37
  - Light, Action on Plants 40
  - Tanning 441, 443, 507
- Electro-deposition 328
  - Of Metals 631, 679
- Electrodes for Batteries 218
- Electrolysing Bleaching Solution 126
- Electrolysis of Calcium Chloride 327
- Electrolytic Analysis (illus.) 344, 401
  - Bleaching 292, 726, 737, 844
  - Detection of Mercury (illus.) 454
  - Disinfection of Liquids 764
  - Manufacture of Soda 502
  - Treatment of Ores 217, 328
  - Treatment of Sewage 441
- Electro-metallurgy 572, 754
- Electromotive Force of Bichromate Batteries 851
- "Elution" Process, Influence of Ammonia in the 578
- Emetin Determination 405
- Employers' Liability 248
- Emulsion Plates, Isochromatic 518
  - Photographic 699
- Enamel, Black 573
- Enamelling Composition 854
  - Glass and Earthenware 503
  - Metals 392
- Enzymes 224
- Erythrophleine 339
- Esparto Grass, Treatment of (illus.) 639
- Estramadurite 92
- Etching Glass 847
- Ethyl Alcohol, Test for 772
- Ethylanthranoethyl Ether 671
- Ethylnitrite 405
- Eucalyptene 587
- Eucalyptol 516, 764
- Eucalyptus Gum 38
  - Oil 516, 585, 587
  - Tan Substances from 392, 393

PAGE
Eugenol in Alcohol 336
  In Spirit 515
Eurhodines 317, 742
Evaporation of Liquids by Inverted Burner (illus.) 379
Evaporator (illus.) 426, 614, 834
  For Sugar Juice 686
  For Sugar Syrup 395
  Vacuum 313
Excrement, Value as Manure 127
Excreta, Collection of 333
  Treatment of 43
Exhaled Air, Microbes absent from 225
Exhaust Hood for Fumes (illus.) 614
Exhibition, Glasgow International 481
Explosibility of Mixtures of Gas and Air 315
Explosions in Coal Mines (illus.) 215
Explosive Gases 325
  In Mines, Detection of 125
Explosives 342, 401, 519, 521, 588, 589, 643, 690, 768, 867, 868
  Manufacture of 490
  Report on 452
  Testing 488
  Trade in France 244
Expresstype 588

Fabiana Imbricata 227
Fabrics Carbonised for Ornamental Castings 677
  Destruction of Vegetable Fibre in (illus.) 620
  Arsenic Determination in 456
  Etc. rendered Non-inflammable 841
Farmyard Manure 19
Fat Determination 695
  Extraction (illus.) 137
  Extractor (illus.) 455
Fats, Analysis of 185
  Estimation of Paraffin in 696
  Examination of 494
  Glycerol determined in 136
  And Oils, Acids in 219
  Proportion of Di-glycerides in 696
  Saponification of 756
  Treatment of 126
  Rendering, Tank Water from 40
Fatty Acids, Oxidation of 681
  Compounds with Sulphur Chloride 853
Fermentation (illus.) 336, 511, 512, 581, 636, 638, 687
  Apparatus 224
  Temperature of 223, 726
Ferric Sulphate 625, 626
Fertiliser 40
Fertilisers 222, 508
  United States Statistics 152
  Values of 576
Fibre from Wood 841
Fibres, Dyeing 501
  Treatment of 339, 385
  For Yarns 501
Fibroïn 385
Films, Flexible Photographic 768
  Etc., Material for 127
  Photographic 642
Filter (illus.) 109, 131, 132, 398, 427, 833, 834, 835, 862
  Cleansing 30
  Mats, Asbestos 833
  For Oils 442
  Presses (illus.) 313, 427, 834
  Stand (illus.) 830
Filtering Medium 639
Filtration in Atmosphere of Carbonic Acid 638
  Without Contact with Air (illus.) 524
Fires in Benzene Works 312
Fire Bricks 631
Fire-damp 325
  Detector 753
Fire-places, Calorific Effect of 739
Fireworks 452
Fish Guano 82
  Phosphoric Acid in 311
  Poisoning 873
  Preservation of 451
Flame, Theory of 476
Flashing Point of Petroleum 740
Flask with Burette (illus.) 589
  With Fittings (illus.) 644
Flavopurpurin Diethylether 384
  Pure 743
  Reduction of 205
Flax Fibre 501
  Scutching 320

PAGE
Floor Cloth, etc., Cement for 325
Flour Waste, Utilisation of 508
Fluorchrome 385
Fluorescent Blue 482
Fluoride of Antimony and Sodium 133
Fluorides 122
Fluorine Determination 772
  Scrubber (illus.) 88
Fodder 394
  For Cattle 510
  Sour Beet-leaves as 337
  Value of Oil-cake as 127
Fodders, Japanese 860
Food Preparation 859
  Preserved 43
  Preservation of 238, 515
  Preservatives, Effects of 582
  Stuff, Molasses as a 130
Formose 41, 396
Fractionating Still for Laboratory use (illus.) 233
France, Importation of Saccharine into 406
French Tares on Heavy Oils 779
Fruit, Preservation of 338, 583
Fuel, Gaseous 668
  Heating Power of 721
  Liquid 381
  Value of Natural Gas 738
Fuels, Calorific Values of 195, 308
  Value of (illus.) 690
Fuller's Earth 324
Fulminating Mercury Fuse 342
Funnel, Dropping (illus.) 643
  Measuring (illus.) 345
  For Washing Precipitates (illus.) 643
Funnels 596
Fur Dyeing 747
Furnace, Decomposing 728
  With Forced Draught 380
  For Liquid Fuel 381
  For Soda Bicarbonate, Revolving (illus.) 628
Furnaces, Hydrocarbon 30
  For Laboratory use 182
  Regenerative Gas 836
  Revolving 837
Fusel Oil Determination 42, 396, 405
  Removed from Spirits 129
  Separated from Alcohol 449
Fusion produced by Pressure 475
Fustic, Dyes from 619

Galactose, Fermentation of 336, 511, 578
Gallic Acid Methylether 385
Gallocyanine 559
Gas Analysis 668
  Balance, Lux's 668
  Burette (illus.) 216, 235, 644
  Burners 428
  Burners, Bunsen 837
  Burner, Clamond's (illus.) 115
  Burners, Incandescent 23
  Burners, Incandescence Bodies for 617
  Burners, Photometric Values of 113, 114
  Dowson (illus.) 495
  Effect of Admixture with Air 315
  Generator 203
  Light, Action on Wood-made Papers 44
  Liquor, Ammonium Phosphate from 114
  Liquor, Treatment of 557
  Mains, Lightning Conductors connected to 668
  Manufacture 30
  Measurement in Flues 556
  Natural 738
  Oil 556
  From Oil 203
  Producers 315, 836
  Purification of 380
  Retort Lids 381
  From Tar 112, 115, 428
  Tar, Strainer for 115
  Thermometer (illus.) 521, 631
  Volumes, Correction of 521
  Water- 100, 114, 554, 668
  Water, for Heating and Illuminating 20
Gaseous Fuel 668
Gases Absorbed by Petroleum 772
  Comparisons between 112
  Constant Supply (illus.) 523
  Desulphurisation of 617
  Detector for Explosive 837
  Exploded by Incandescent Lamps 557

PAGE

- Gases, Interaction of ... 554
  - Liquefaction of ... 477
  - Noxious ... 225
  - Occluded in Coal ... 729
  - Regulations respecting Liquefied ... 650
  - Rule for Correcting Volumes of ... 806
  - Toxic Action of Water- and Generator- ... 688
  - Treatment of Solids by (illus.) ... 833
- Gauze, Gelatinised ... 388
- Gelatin, Antiseptic ... 226
  - Emulsion ... 452
  - Film, Photographic ... 341
  - Manufacture ... 444, 574
- Gelatinous Explosives ... 492
- Generator for Gas ... 203
  - Gas, Toxic Action of ... 688
- Geochemical Studies ... 338
- German Silver ... 133
- Germanium, Source of ... 230
- Germany, Slag Exported to ... 650
- Germination, Influence of Chlorides on ... 575
- Glass, Colouration produced by Iron ... 502
  - Crystalline Surface on ... 438
  - Gold Lustre on ... 122
  - Influence of Composition on Thermometers ... 438
  - Manufacture ... 35, 502, 503, 631
  - For Optical Purposes ... 846
  - Painting ... 847
  - Rippled or Chequered ... 324
  - Substitute for ... 388
  - Treatment of "Blacks" ... 324
  - Works, Belgian ... 597
- Glazes for Porcelain ... 750
- Glucose, etc., Methylene Blue as a Test for ... 347
  - Manufacture ... 41
- Glue Manufacture ... 444
  - Nitrogen in ... 331
- Glycerides in Fat ... 696
- Glycerine applied to Paper ... 300
- Glycerol Determination ... 397, 696, 779
  - Determined in Fats, etc. ... 136
  - Estimation ... 350
  - Fermentation of ... 129
- Glycerin Manufacture ... 126, 756
- Glycol, Isobutylene, formed by Fermentation ... 336
- Gold, Action of Chlorine on ... 208
  - Amalgamation ... 326, 327, 852
  - Chloride, Reduction by Wood Charcoal ... 215
  - Determination in Cyanide Solutions ... 403
  - Extraction ... 125, 126, 217, 678, 754, 851
  - Extraction of ... 571
  - Lustre on Glas ... 122
  - Ore of Siebenburg ... 326
  - Separation of ... 693
  - Separation by Wet Methods ... 850
  - And Silver Production in the United States ... 877
- Graduation of Tubes ... 645
- Grain, Gelatinised ... 337
  - Nutritive Constituents of ... 638
- Graminin ... 128
- Grandiflorin ... 227
- Granular Substances, Washer for (illus.) ... 835
- Grape, Colouring Matter of (illus.) ... 526
  - Sugar Determination ... 397
  - Sugar, Pure ... 579
- Grapes, Mildew of ... 580
- Graphite, Combustion with Silver-dust ... 235
- Grasses, Sulphuric Acid in Injured ... 591
- Grease, Analysis of ... 494
  - Recovered from Wool Milling ... 853
- Greece, Tobacco Disease in ... 699
  - Trade in Drugs and Chemicals ... 47
- Grevillea, Tan Substances from ... 392
- Grinder (illus.) ... 427
- Guaiacol ... 227
- Guarana, Determination of Caffeine in ... 347
- Guano ... 82, 84, 91
- Gum Amrad ... 446
  - Arabic, Prices of ... 649
  - Arabic, Substitute for ... 334, 509
  - Benjamin, Exports from Padang ... 409
  - Indian ... 578
  - From Starch ... 334, 335
- Gums, Artificial ... 578
  - Colour Reactions of ... 511
  - Treatment of ... 573, 856
- Gun-cotton Material ... 127
  - Testing ... 588
- Gunpowder, Nitrocellulose ... 342
- Gutta-percha ... 330
  - Substitute ... 635
- Gypsum ... 675

PAGE

- Hakea, Tan Substances from ... 392
- Hank Dyeing ... 501
- Heat of Chemical Operations ... 739
  - And Mixture, Effects of ... 475
- Heater for Liquids or Gases (illus.) ... 554
- Hedwigia Balsamifera ... 765
- Heliogravure ... 400
- Heliotrope ... 386
- Hessian Violet ... 386
- Hides, Stripping ... 121
  - Treatment of ... 39, 331, 444, 574, 683
- Holland, India-rubber Manufacture in ... 47
- Homapocinchene ... 642
- Honey adulterated with Dextrose ... 136
- Hop Stalks, Linen from ... 320
- Hops, Manuring ... 221
  - Sulphuring ... 858
- Horse-dung ... 80
- Human Excreta ... 80
- Humus, Potash in ... 393
  - Sulphur and Phosphorus in ... 222
- Hydrargyrum Salicylicum ... 399
- Hydraulic Blast (illus.) ... 312
  - Blowers (illus.) ... 29
- Hydrazinesulphonic Acids ... 431
- Hydrazones ... 404
- Hydriodic Acid ... 121
- Hydrocarbon Furnaces ... 30
  - Gas ... 115, 116
  - Motor ... 30
  - Oils, Refining ... 126
- Hydrocarbons in Coal ... 729
  - In Kerosene ... 740
  - In Plants ... 757
  - In Resin Oil ... 507
- Hydrochloric Acid, Absorption Towers for (illus.) ... 322
  - Manufacture ... 437, 626, 628
- Hydrogen Apparatus (illus.) ... 523
  - Dioxide, Colours produced by means of ... 117
  - Manufacture ... 341
  - Peroxide, Bleaching with ... 841
  - Peroxide, Bleaching Wool by ... 120
  - Peroxide in Organic Juices ... 394
  - Peroxide, Pure ... 640
  - Peroxide, Wool bleached by ... 207
- Hydrometers, Sykes' ... 819
  - For Spirit ... 277
- Hydroquinone Photographic Developer ... 342, 767
- Hydroxyanthraquinones ... 669
  - Ethers of the ... 383
- Hydroxyazobenzene, Nitro- ... 562
- Hydroxylamine Hydrochloride ... 341, 342
  - Employed in Analysis ... 693
  - Medicinal Use for ... 865
  - Production of ... 210
- Hydroxynaphthoic Acid ... 762
- Hydroxynaphthylmethylketone (α) ... 204
- Hydroxypropylenedi-iso-amylamine ... 867
- Hydroxyquinolines, Azo-dyes of the ... 557
- Hydroxystearic Acid ... 442
- Hygrine ... 341
- Hyoscyamine ... 584
  - Converted into Abropine ... 518
- Hyponitric Anhydride ... 519
- Hystazarin ... 669

- Illuminating Oils ... 682
- "Imperial Standard" Photometer ... 368
- Imports and Exports ... 533, 534
- Inactose ... 445
- Incandescent Gas Burners ... 617
  - Lamps, Mantles for ... 315
- Incrustation in Boilers, Prevention of ... 554
- Indamines ... 559, 671
- India-rubber ... 330
  - Fabrics, Ornamental ... 33
  - Substitutes ... 443
- Indian Carbonate of Soda ... 874
- Indicators ... 591

PAGE
Indigo 386
  Analysis of 459
  Production in China 444
  Red Discharge on 843
  Vat, Hydrosulphite 321
  Vat for Wool Dyeing 565
  West African 429
Indophenols 559
Indulines 743
Ingrain Colours (illus.) 180
Ink Eraser, Fluid 34
Inosite 129
Inosol 579
Insecticide for Books 409
Insecticides 684
Insulating Material from Petroleum Acid Residues 304
Iodine, Tincture of 227
  Trichloride 209, 866
Iodised Sulpho-acids 745
Iodoaldehyde 512
Iodoform 405
  Antiseptic Action of 226
  Gauze 131
Iodometry 344
Iodophenols 562
Ipecacuanha Cultivation in India 516
  Emetin Determined in 405
Iron, Anticorrosive Paint for 683
  Brittleness after Corrosion 35
  Carbon Determination in 235
  Carbon Determination 457
  And Carbon, Combination by Pressure 388
  Carbon Estimated in 646
  Casting 568, 569
  Cement 211
  Detected in Oil 591
  Determination 590
  Determination of Carbon in 693
  Determination, Electrolytic 693
  Determination of Manganese in 234
  Determination by Nitroso-β-Naphthol 236
  Determination in Presence of Alumina 525
  "Gas Oxide" of 677
  Ingot for Steam Boilers 124
  Impurities in 568, 569
  Influence of Aluminium on 752
  Influence of Phosphorus in 125
  Magnetic Carbide 450
  Malleable (illus.) 633
  With Manganese 211
  Mordants 121
  Nitrate, Commercial 625, 626
  Non-homogenous Nature of Thomas Pig- 285
  Ore, Metal direct from 125
  Ore, Treatment of 633
  Ores, Analysis of 456
  Oxides, Manufacture 443
  Etc., Paint for 853, 854
  Passivity of 521
  Preparations, Medicinal 452
  Pig, Valuation of 212
  Production in United States 601
  Production in the World 850
  Protection of 633
  Rails, Oxidation of 753
  Separation of Particles of 505
  Separation of Titanium from 344
  Soluble in Caustic Soda 322
  Spongy 131
  Strong Last 200
  Sulphocyanides 207
  Sulphur Determination 525
  Sulphur estimated in 645
  Testing Cast 569
  Etc., Tin Coating on 36
  Treatment of 504, 505
  Warts and Globules in 124
  Wire, Corrosion of 388
Isapiol 583
Iso-anthraflavinic Acid Derivative 384
Isobutyleneglycol produced by Fermentation 762
Isochromatic Emulsion Plates 518
Isodulcite 578, 636
Iso-oleic Acid 755
Italian Customs Tariff 352
  Trade Statistics 648
  Wines 688
Italy, Tariff Changes 529
  Trade in Chemicals, &c 47

PAGE
Jaborandi 867
Jam, Copper in 318
Japan, Taxation on Drug Trade 410
Japanese Camphor Exports 783
Jatropha Curcas, Oil from Seeds of 442
Jerusalem Artichokes, Spirit from 447
Joints, Cement for 850
Jurumbeba (illus.) 229
Jurumbeba (illus.) a Drug 340
Jute Bleaching 624

Kainit 97
Kainite as Protection against Wire-worm 220
  Syndicate 782
Kati magnesia (a Manure) 684
Kanaff (Russian Textile Fibre) 873
Kerosene Oils, Commercial 740
  Russian Duty on 246
Ketonaphthol 430
Ketone Compounds 318
Kid Leather 444
Kieselguhr 491
Kiln for Sulphuretted Hydrogen (illus.) 173
Kilns for Char 422
  For Drying Slurry (illus.) 438, 439, 440
Kinos, Australian 38
Kola Nuts 397

Labiata Lallemantia Seeds, Oil from 219
Lactacidine 132
Lactic Fermentation 510
Laevo-maltose 638
Lakes from Wool, Coloured 622
Lamp, Amyl-acetate 668
  For burning Panclastite (illus.) 521
  For Microscopes (illus.) 719
  Standard 202
  Standard Oil 367
Lamps, Gases exploded by Incandescent 557
  Kerosene 112
  Naphthalene for 741
Lanolin 340
Lantern Transparencies, Photographic 342
Lard from Cotton-Seed Oil 244
  Examination of 527
Latent Images, Photographic 230
Laundry Blue 567
Lavender Oil, Examination of 637
Lead Carbonate, Manufacture of 846
  Consumption in Russia 874
  Determination 237, 456
  Fumes, Condensation of 594
  Ores, Furnaces for 754
  Peroxide Battery Elements 37
  Pigments 126, 330
  Smelting in Missouri 503
  In Tin Alloys determined 772
  White 635
  Pipes, Action of Water on 226
  Pipes, Corrosion by Mortar 123
Leaden Pipes, Corrosion of (illus.) 15
  Water Pipes 669
  Corrosion of 78
Leather, Artificial 331
  Composition 220
  Manufacture 574
  Soluble Polish for 39
  Treatment of 220
  Waterproof 39
Leaves, Calcium Oxalate in 575
Leipzig, New Water Supply for 397
Lepidine Derivatives 642
Leucauramine 30
Levels, Deterioration of 752
Levulinic Acid 334
Levulose 445
  Rotatory and Reducing Power of 685
Lichenin 129
Light, Standards of 367
Lightning Conductors connected to Gas Mains 668
Ligneous Fibre 620
Lignite as a Filtering Material 335
Lignoceric Acid 391
Lime Carbonate, Analyses of 170
  Fusion of 475

PAGE

- Lime as a Disinfectant 338
  - Dry Hydrate of (illus.) 323
  - Juice, Montserrat 875
  - Kiln (illus.) 676
  - Kiln Gases, Sulphur Recovery by means of (illus.) 162
  - Mud for Cement 301
  - Mud, Treatment of 568
  - In Raw Sugar 334
  - In Slag, Manurial Value of 332
  - Sulphate, Utilisation of 323
- Limestone, Asphaltic 837
- Limey Soils, Absence of certain Plants 394
- Limonene 587
  - Nitrosochloride 517
- Linen from Hop-stalks 320
  - Rags, Ancient Paper from 515
- Linography 588
- Linolenic Acid 507
- Linoxyn 680
- Linseed Oil 330
  - Roumanian Customs Regulations 699
- Linseed as substitute for Gum Arabic 334
- Linusic Acid 506
- Liqueurs, Analysis of 459
  - Cane Sugar determined in 694
- Liquids, Storage of Inflammable 495
- Litharge Manufacture 36
- Lithia Hydrate 731
- Litmus, Decolourisation of 646
  - Paper 514
- Liverpool Chemical Manufacturers, Meeting of 781
- Lubricants for Wool 852
- Lubricating Oils 682
  - Estimation of Rosin Oil in 135, 136
- Lucifer Matches 231
- Lucuma, Fruit, etc. of 339
- Lumps for Furnaces 631

- Magenta Manufacture (illus.) 118
  - In Orchil and Cudbear 458
- Magnesia 750
  - Commercial 529
  - Process of Chlorine Manufacture 10, 286
  - From Sea Water 844
- Magnesium Chloride 386
  - Chlorine from (illus.) 626
  - Electrolysis of 294, 726, 737
  - Influence on Germination 575
  - Fluoride 122
  - Oxychloride 749
  - Salicylicum 399
- Magnet, Rotating 379
- Mahogany, Dyes from 619
- Maize, Experimental Cultivation of 757
  - Grown for Fodder 394
  - Malt 637
- Malt 336
  - Action of Coal Gas on 223
  - Activity of 448, 687
  - Air-dried 447
  - Germination of 129
  - Houses, Pneumatic Arrangements in 637
  - Kilns 858
  - Substitute for 446
- Malting 687
  - Temperature, Influence of 859
- Malto-peptine 859
- Manganates, Manufacture of 673
- Manganese in Chili 246
  - Determination 234, 236, 525, 693
  - Iron and Steel 211
  - Ore from Gosalpur 141
- Manganous Salts, Precipitation of 320
- Manila, Drug Business in 410
- Manna 222
- Mannose 508
- Mantles for Incandescence Burners 315
- Manure, Artificial 761
  - Farmyard 577
  - Fraudulent 220
  - For Oats 683
  - Trade, Foreign 143
  - Treatment of Stable 127
  - Urine as a 40
  - Value of Excrement as 127
- Manures 332, 333
  - Natural and Artificial 79, 195
  - Phosphatic 222
  - For Potatoes 394
- Manurial Experiments 574, 576
  - Value of Slag 758
- Manuring, Experimental 854
  - Hops 221
- Margarin 338, 348
- Market Prices of Manures 190
- Maroon 119
- Mash, Potable Spirit direct from 687
- Mashes, Concentrated 447
- Massarandubin (Resin of Lucuma) 339
- Matches 768
- Material impervious to Moisture 846
- Mauve, Perkin's 743
- Meadows, Moss in 220
- Measure for Small Quantities 869
- Meat Guano, Analysis of 871
  - Peptonic Fermentation of 583
  - Etc., Preservation of 451, 763
- Medicago Lupulina 574
- Medicinal Preparations 452
- Meeting, Proceedings of Seventh Annual 472
- Meganite 588
- Menthol, Pimelic Acid from 586
- Menyanthin 132
- Mercaptan with Water Gas 668
- Mercurial Soaps 507
- Mercuric Cyanide 866
  - Iodidide as an Antiseptic 331, 635
- Mercury Albuminate 866
  - Biniodide Soap 192
  - Compounds, Antiseptic Properties of 583
  - Cyanide and Hydroxycyanide 857
  - Electrolytic Detection of (illus.) 454
  - Fulminate 493
  - Imidosuccinate 867
  - Phenate 865
  - Prices of 649
  - Purification (illus.) 522
  - Salicylate 865
- Meta-amidoquinoline 32
- Metacresol, Sulphonic Acids of 32
- Metal Castings, Ornamental 677
  - Coating 328
  - Sheets for Decorative purposes 634
  - Etc. Varnish for 330
- Metals, Enamelling 302
  - Extraction of 504, 570, 571, 572, 678
  - Produced in Prussia 651
  - Separation of 401
  - Solutions for Colouring 753
  - Treatment of 390
- Metanitraniline Derivatives 499
- Metanitroquinoline 32
- Metapectic Acid from Beet Juice 856
- Metaxylidine 429, 430
- Methana, Waters from Peninsula of 133
- Methenylamidophenylmercaptan 203
- Methyl Alcohol, Acetone in 459
  - Detection of 404
  - Properties of 510
  - Purification of 515
  - Soda Compounds with 453
- Methyl Chloride, Hydrate of 516
- Methylene Blue for Detection of Invert Sugar 527
  - As Test for Glucose, etc 347
  - Reaction for Sugar 238
  - Test for Sugar 591
  - For Printing 206
- Methylhydroxanthranol 384
- Microbes absent from Exhaled Air 225
- Micro-organisms, Action on Colouring Matters 745
  - In the Soil 854
  - In Water 337
- Microscope Lamp (illus.) 719
- Milk, Aërated 130
  - Analysis 350
  - Benzoic Acid in 225
  - Citric Acid in Cows' 861
  - Condensed 43
  - Determination of Fat in 695
  - Separator 834
  - Sugar 222
- Mill for Minerals (illus.) 109
- Millet, Oil of 341
- Mine Gases, Explosive 837
- Mines, Detection of Explosive Gases in 125
- Mineral Mill (illus.) 109
  - Production of Canada 358
  - Statistics 599
- Minjak Tengkawang (a Fat from Borneo) 391

PAGE
Mint, Report of United States 877
Molasses 334
  As a Food-stuff 130
  Purification 579
Molybdic Acid Determination 456
Mordant 385
  Antimony 206, 207
Mordants 841
  Analysis of Oils for 594
  Colours which combine with 33
Morindin 382
Morindon 382
Morphia Estimation 45
Morphine-blue 319
Morrhuine 586
Mortar 676
  Corrosion of Lead Pipes by 123
Moss as Litter for Stables, etc. 333
  In Meadows 220
Motor worked with Oils 30
Mucilage, Adhesive 580
Munich Beer 857
Museums, Commercial 597
Mushrooms, Cellulose from 620
Mustard, Action of Manures on 332

Naphtha, Decomposition by Heat 115
  English Mineral 612
Naphthalene Derivatives 317
  For Lamps 741
  β-Series 617
Naphthalic Acid 400
Naphthalidine-sulphonic Acid 670
Naphthazarine 431
Naphthionic Acid 670
Naphtbol-β- 226
  Aceto-α- 430
  -α-, Antiseptic Properties of 450
  Antiseptic Value of β- 225
  α- Colours 563
  β-, Oxidation of 671
  Sulpho-Acids of 430, 431
Napthoquinoneanilide 317
Naphthosalol 866
Naphthylenediamines 618
Naphthylaminesulphonic Acids 33, 118, 670, 840
Naphthylamine Sulpho-Acids 430
Narceine 399, 866
Narcotine 518
New South Wales Tan Substances 38
New Zealand Customs Tariff 780
Nickel, Passivity of 521
  Plating 327
  Salts, Aniline Black made with 31
  Statistics 149
Nicotine Determination 348
Night Blue 592
Nitrate of Soda Production in Chili 407
Nitrates, Antiseptic Values of 715
  Manufacture of 673
  As Manure 221
  In Soil 577
Nitre 97
Nitric Acid, Detection of 590
  Determination (illus.) 692
  Manufacture 210
  In Plants, Source of 444
  In Wines 134, 457
Nitric Ether, Examination of 405
Nitrification of Ammonia Salts 760
Nitrobenzene, Oxalic Acid as By-product 498
  Spontaneous Combustion in Making 563
Nitrodiazobenzene Derivatives 564
Nitrogen, Absorption by Soil 332
  Ammonia from Atmospheric 35
  In Arable Soil 757
Nitrogen Determination (illus.) 45, 63, 134, 238, 239, 307, 528 869
  Sources of Error in 697
  In Superphosphates 647
  In Drainage Water 331
  Fixation of Atmospheric 758
  Obtained from the Air 845
  Peroxide 519
  In Plants 221
  In Soil 393
  Sources 94

PAGE
Nitrogenous Salts, Relation to Plants 127
  Substances, Treatment of 844
Nitro-glycerin 491
Nitro-hydrobromic Acid, Action on Phenols 670
Nitrometer Tap (illus.) 232
Nitronaphthalic Acid 382
Nitrophenaceturic Acid 641
Nitroso-aniline 316
  Bases, Aromatic 318, 319
  Colours 319
  Derivatives 120
  β-naphthol as precipitant for Iron 525
Nitrosophenols 33
Nitrosoresorcinol, Dyestuffs from 838
Nitrosulphonic Acid employed in Analysis 234
Nitrotartaric Acid Derivatives 432
Nitrotoluidine Derivatives 499
Nitrous Acid Determination 870
Noxious Gases and Vapours 225
Nutrition 450

Oats, Cultivation of 40
  Manure for 683
Obituary, J. J. Colman, F.R.S.E. 831
  J. Peter Griess, F.R.S. 612
  William Wallace, Ph.D., F.R.S.E. 737
Oil, Adulterated Olive 135
  Adulteration of Olive 593
  Cake 126
  Cake, Examination of 127
  Cement 631
  Cotton Seed 634
  Detection of Iron in 591
  Extraction of 505, 507
  Filter for 442
  Gas, Mineral 199
  Gas 203, 556
  German Mineral 505
  Linseed 330
  From Labiata Lallemantia Seeds 219
  Press 756
  Trade at Marseilles 410
  From Seeds of Jatropha Curcas 442
  Separator 126
  Of Sesame, Detection of 45
Oils 682
  Action of Sulphur Chloride on 552
  Analysis of 594
  Bromine Absorption of Mineral 64
  Densities and Refractive Indices of 755
  Drying 506, 680, 681
  Ethereal, Antiseptic Action of 226
  Examination of 37, 135, 136
  Extraction of 126, 499
  Oxidation of Essential 67
  Refining Mineral 126
  Rosin Oil detected in 526
  From Singapore, Essential 245
  Treatment of 507, 756
  Turkey-red 871
  Okahero (a Drug) 340
Oleic Acid, Action of Sulphuric Acid on 218
  Drying 681
  In Earth Nut Oil 391
  Solid 442
Oleomargarine, Analysis of 697
Olive Oil, Adulteration of 593
  Cotton-Seed Oil mixed with 135
  In Petroleum Casks 782
  Seed Oil in 457
  Trade 530
Olive Residues, Extraction of Oil from 505
  Seed Husk in Pepper 763
Ophioxylin 340
Opium, Extract of 44
  Trade of Wenchow 409
  Valuation of 45
Optically Inactive Substances, Determination of 454
Orchil, Adulterations in 315
  Magenta in 458
Orcinol Derivatives 670
Ores, Amalgamation of 217
  Calcination of Sulphurous 504
  Electrolytic Treatment of 217
  Treatment of 389, 570, 571, 572
Orthocinnamiccarboxylic Acid 671
Orthocresolsulphonic Acid 32
Orthosulphamine Carboxylic Acids 333
Osazones 396
Osmometer used in Sugar Refineries 779
Osmosis 509

PAGE

Ouabaioe........ 586
  Toxic Action of........ 765
Oxalic Acid as By-product of Nitrobenzene........ 498
Oxybenzyl-lepidine........ 642
Oxygen Carriers........ 122
  Constant Supply of........ 523
  Exhaled by Plants........ 393
  Obtained from the Air........ 845
  Used with Laboratory Furnaces........ 182
Oxylinoleic Acid........ 680, 681
Oxystearic Acid........ 755
Oxywrightine........ 585
Ozokerit........ 428
Ozone Determination........ 404

Paint, Incombustible........ 443
  For Iron, etc........ 853, 854
  For Petroleum Barrels........ 392
Paints, Red Colour for........ 507
  United States Statistics........ 154
Panclastite (illus.)........ 519
Pancreas Ferment........ 224
Panicol........ 341
Paper, Ancient........ 515
  Application of Glycerin to........ 300
  Changes produced by Storage........ 689
  For Cheques, etc........ 399
  For Cheques, etc., Safety........ 864
  Manufacture........ 226
  Pulp (illus.)........ 639. 640
  Pulp Bleaching (illus.)........ 33
  Pulp dyed with Coal Tar Colours........ 843
  Pulp Manufacture (illus.)........ 864
  Pulp Strainer (illus.)........ 398
  Pulp, Treatment of........ 451
  Sizing........ 132
  Stock Manufacture........ 689
  Testing........ 338
  Wood Shavings estimated in........ 863
Paraffin, Density of (illus.)........ 679
  Determination (illus.)........ 349
  Determination in Waxes........ 696
  In Petroleum........ 428
  Wax, Purification of........ 116
Parchment, Artificial........ 516
Paranitraniline, Diazotised........ 433
Paranitrosoaniline........ 316
Paranitrosodiphenylamine........ 318
Paranitrotoluene, Estimation of........ 593
Parsley Camphor........ 399
Parthenicine........ 867
Patents in Switzerland........ 244, 531
Peas, Cultivation in Nutritive Solutions........ 757
  Inoculated with Lucerne Grass........ 758
Peat Charcoal........ 837
  As a Disinfectant........ 39, 333
  Litter........ 80
  Manure........ 576
  Moss Litter........ 855
  Treatment of........ 381
Pentane Lamp........ 368
  Standard........ 367
Pepper, Olive Seed Husk in........ 763
Peppermint Plants, Treatment of........ 550
Peptone........ 337
  And Maltose........ 766
  Preparations........ 130, 449
  Reaction........ 238
Peptones........ 526, 583
Percolators for Extraction of Oil........ 507
Permanganate of Potash........ 437
Peronospera, Vines treated for........ 39
Perseït........ 516
Petroleum Acid Residues........ 376
  Acid Residues, Utilisation of........ 628
  Acid Tar, Utilisation of........ 303
  Barrels, Paint for........ 392
  In California........ 410
  Decomposition by Heat........ 115
  Deposits in Venezuela........ 739
  In the East........ 699
  Gases absorbed by........ 772
  German........ 202, 380, 428
  Greek Restrictions on........ 462
  Illuminating Power of........ 544
  New occurrence of........ 202
  At Northwich........ 701
  Refining........ 116, 429
  Russian........ 355
  Trade, Belgian........ 409
Petroleums, Mineral matter in........ 837
Pharmaceutical Preparations........ 516
  Preparations in Japan........ 246
Phellandrene........ 587
Phenacetine and Acetanilide........ 772
  Antifebrine in........ 694
Phenacetin an Antipyretic........ 227
Phenaceturic Acid........ 641
Phenol Dyes........ 32
  Process of Alkali Manufacture........ 808
Phenolic Colouring Matters........ 33
Phenoloxychroine........ 315
Phenols, Dichroïnes from........ 670
Phenolsulphonic Acid, Iodised........ 745
Phenosafranine........ 497
Phenosafranines........ 31
Phenylazoacetylacetone........ 558
Phenyldiazoresorcinols........ 838
Phenylenediamines, Physiological Action of........ 765
Phenylhydrazine Compounds with Sugars........ 396
  Derivatives........ 432
Phenylindole Pr. 3........ 559
Philadelphia, Sugar Refinery at........ 407
Phlenm, Carbohydrate from........ 128
Phlorose........ 396
Phosgene Colours........ 30
Phosphates, Treatment of........ 508, 684
Phosphatic Manures........ 87, 222
Phosphites, Acid........ 501
Phosphoric Acid, Action on Ammonium Chloride........ 322
  Acid Determination........ 44, 45, 311, 455, 646, 771, 869
  Acid and Lime, Ratio in Bones........ 222
  Acid Manufacture........ 34
  Acid Retrograde........ 345
  Acid, in Superphosphate, Soluble........ 343
Phosphorite........ 92
  From Capo di Leuca........ 684
Phosphorous Acid with Iron Mordants........ 121
  Compounds, By-products of........ 387
Phosphorus, Crystals of........ 9
  Estimation in Iron Ores........ 590
  In Iron, Influence of........ 125
  In Plants and Soil........ 222
  Trichloride........ 675
  Vanadium Determination in presence of........ 73
Photochemical Estimation of Tint........ 309, 378
Photographic Copies........ 518, 519
  Films........ 642
  Pigment Process........ 400
  Plate developed in Water........ 401
  Prints........ 231
Photographs, Developer for Instantaneous........ 231
  Fixing and Clearing........ 231
Photography........ 132, 230, 341, 342, 452, 588
  Orthochromatic........ 767
Photometer (illus.)........ 425, 668
Photometric Bacteria........ 338
  Standard........ 202
  Standard Lamp........ 741
  Values........ 112, 113, 114, 115
  Values of Gases........ 199
Photometry........ 367
  Of Candles........ 390
Phthaleins........ 745
Physical Chemistry........ 479
Phytosterin........ 37, 223
Picric Acid........ 48
  Determination of........ 592
  Explosiveness of........ 342, 642
  Restrictions on........ 452
Pigment, Black........ 127
  Process, Photographic........ 400
Pigments, Manufacture........ 443
Pimelic Acid from Menthol........ 586
Pinch-cock, Safety (illus.)........ 456
Pine Wood, Distillation of........ 497
Pinene........ 587
  Nitrosochloride........ 517
Piperidine........ 642
  Colouring Matters........ 689
Piperylene-nitrogen Chloride........ 642
Plants, Action of Electric Light on........ 40
  Ashes of........ 81
  Assimilation of Food by........ 40
  Hydrocarbons in........ 757
  Nitric Acid in........ 444
  Oxygen Exhaled by........ 393
  Potash in........ 393
  Relation between Nitrogenous Salts and........ 127
  Sulphur and Phosphorus in........ 222
Plaster of Paris........ 675

PAGE

- Platinum Bath, Photographic 132
  - Chloride, Toning 588
  - Crucibles, Cleaning 869
  - Prints, Photographic 230
  - Separation of 693
  - Transparent Deposit of 215
- Plumbic Oxide Manufacture 36
- Pneumatical System of Malting 336
- Polarimeter (illus.) 262
  - For Brewers 713, 831
- Polarimetric-Analysis of Mixed Alkaline Chlorides 770
- Polarisation, Laws of Circular 264
- Polariscope, Application of 454
  - Applied to Brewing (illus.) 259
  - Purification of Sugar for 349
- Polaristrobometric Estimation of Sugar 594
- Police Manure 80
- Polish, Preservative 635
- Polygonum, Tan Substances from 392
- Porcelain Colouration during Heating 387
  - Colouring 210, 324
  - "Crackle" 630
  - Glazes for 750
- Portugal, Prohibition against Saccharin 648
- Potash Manufacturers' Syndicate 700
  - Muriate 97
  - In Plants, Humus and Soil 393
- Potassium Chloride Industry 141, 605
  - Chloride for Sugar Beet 575
  - Cyanide Solutions, Gold, &c. Determined in 403
  - Determination in Presence of Sulphates 237
  - Iodide, Removal of Iodate from 690
  - Manufacture 440
  - Metabisulphide 867
  - Salts from Sea Water 479
  - And Sodium Chlorides, Analysis of 770
- Potato Buds, Asparagin in 686
  - Cultivation 331
  - Disease 758
  - Growth of 127
- Potatoes, Cultivation of 221, 576
  - Manures for 394
  - Spirit from 447
  - Sugar from 686
  - Treatment of Frozen 687
- Pots for Batteries 572
- Pottery, Decoration of 502, 503
  - Etc., Decoration of 324
- Powder, Flameless 519
- Precipitates collected and washed in Vacuo (illus.) 524
  - Treatment of Quantitative 693
- Prehnidine 381
- Press for Cupels (illus.) 632
  - For Oil 756
- Presses for Drugs, etc. 313
- Pressure, Action of Heat and 475
  - Gauges for Malt Kilns 858
- Primuline (illus.) 180, 386, 561
- Printers' Varnish 330
- Printing, Photographic 518, 519
- Prism, Nicol's (illus.) 259
- Producer Gas 20
- Propyl Acetate employed in Varnish 443
- Prussia, Metals produced in 651
- Pseudoflavaniline 384
- Pseudo-flavenol 384
- Pulp, Strainer for (illus.) 339
  - Strainer for Paper (illus.) 398
- Puneeria coagulans (illus.) 229
- Punica Bark, Extract of 44
- Purifier for Water, etc. 450, 451
- Purple Colour 385
- Purpurogallol 31
- Pycnometer (illus.) 680
- Pyridine Bases added to Alcohol 135
  - Cadmium Test for 762
  - From Coal Tar 381
  - Examination of 345
  - Titration of 136, 349
- Pyrites, Auriferous 326
  - Statistics 147, 152, 169
  - Sulphur Estimation in Burnt 305
  - Treatment of 440
  - Treatment of Cupreous 217
- Pyrodine 765
- Pyrosulphates 210
- Pyroxyline Compounds 443

PAGE

- Quartz, Rotation produced by 261
- Quebracho Bark 132
- Queensland Customs Tariff 780
- Quercetin, Reactions of 404
- Quercitrin 382
- Quercitron Sugar 578
- Quicksilver in Cuba 245
  - Mines at Idria 531
  - Statistics 144, 534, 703, 785, 874
- Quinine 516
  - Alkaloids 350
  - Bark, Stock of 649
  - Hydrochlorate 452
  - Sulphate 349
- Quinizarin mono-ethylether 383
- Quinoline Derivatives 32
  - Reactions 384
- Quinoneanilides 316
- Quinoneimides 117
- Quinone-oxims 33

- Rabbit Skins. Treatment of 574
- Radiation from Boilers 617
- Raffinose 41, 334, 509
  - Dextrose in 595
- Rails, Oxidation of Iron 753
- Rain, Nitrogen in 331
- Ramie, Cultivation of 575
- Rape Dust 96
- Ratany, Extract of 44
- Reagents, Impurities in 645
- Realgar, Decomposition by Caustic Potash 870
- Receiver for Fractional Distillation in Vacuo (illus.) 522
- Red Discharge on Indigo 843
- Red, Ingrain 561
- Refractive Indices of certain Oils 755
- Refrigerator (illus.) 313, 314, 614
- Regenerative Burner for Evaporation (illus.) 379
- Registration of Firms 249
- Regulator, Gas (illus.) 188
  - Temperature (illus.) 636
  - For Water-Bath (illus.) 231
- Resin Oil 507
  - Oil, Retene from 635
  - Solubility of 321
- Resins, Treatment of 573
- Resorcinol Derivatives 670, 838
- Retene 116
  - From Resin Oil 635
- Retort Lids and Fastenings 381
  - For Shale 429
- Retorts for Charcoal 837
- Revenue Duty on Spirits 276
- Rhamnose 578
- *Rhamnus Purshiana*, Bark of 339
- Rhea Bark, Treatment of 320
  - Fibre, Treatment of 399
  - Fibres, Treatment of 120
- Rheostat 344
- Rhodamine 386, 560
- Rhodamines 745
- Rhubarb, Extract of 44
- Ricinic Acid 755
- Ricinisoleic Acid 681
- Ricinoleic Acid 755
- *Ricinus Communis*, Examination of 405
- Roburite 342, 589
- Rock Boring (illus.) 662
- Romite 589, 690
- Rosaniline Base 119
  - Salts, Constitution of 743, 744
- Rosazurin 386
- Rosemary Oil, Examination of 637
- Rosin, Detection of 871
  - Sizing Paper with 132
  - Oil, Detection of 526
  - Oil, Estimation of 135, 136
- Rotation produced by Quartz 261
- Ruberythric Acid 382
- Rubidium Carbonate 734
- Rufigallic Acid, Reduction of 205
  - Triethylether 384
- Rule, Fuller's Slide 806

PAGE

- Russian Chemical Trade 245
  - Petroleum 699
  - Textile Fibre, New 873
  - Trade in Drugs, etc. 597
- Rutin 382
  - Reactions of 404
- Rye Flour 638

- Saccharates 508
- Saccharic Acid, Influence of Acids on 579
- Saccharimeter (illus.) 263
- Saccharin 688
- Saccharine 452, 458, 518
  - Detection of 527
  - French Importation of 406
  - French Prohibition of 873
  - French Report on 856
  - Prohibition against 648
  - Test for 772
  - Cocoa 225
  - Liquors for Brewing 860
- Saccharolactonic Acid 508
- Saccharum for Brewers 638
- Saffron Substitute (Dinitrocresol) 130
  - Surrogate 449
- Safranines 317, 497, 742
  - Substituted 116
- Safranol 498
- Salicylates 399
- Salicylic Acid, Brazilian Prohibition of 873
- Salol 690
- Salols 587
- Salt Deposits in the Don Territory 781
  - Industry on the Tees (illus.) 660
  - Syndicate 652
- Saltpetre Deposits in Tarapacá 844
- Sanderswood, Dye from Red 32
- Santaline 32
  - Sulphonic Acid 561
- Santonine 452, 458
  - Reactions of 870
- Sapindus Bark 747
- Saponification 842
- Saponin, Antiseptic Powder from 863
- Sarcina in Beer 449
- Sativic Acid 506
- *Schinus molle* 340
- Schools, German Polytechnic 479
- Scum Separator for Boilers 614
- Sea Water as a Beverage 862
  - Magnesia from 844
- Seaweed, Composition of 79
- Securite 589
- Seed Plants, Enrichment of Beet 335
- Seedlac 682
- Seeds, Discrimination of Cabbage, etc. 39
- Sensitisers, Photographic 767
- Separator for Oils, etc. 126
- Sequoia Bark 451
- Sequoia Sempervirens, Bark of 443
- Seréh Cane Sugar Disease 685
- Sericoïn 385
- Sesame Oil, Test for 593
- Sewage Disposal 763
  - Purification 125
  - Sludge, Ammonium Chloride from 736
  - Sludge, Treatment of 43
  - Treatment of 43, 131, 338, 441, 450, 629, 639, 749, 763, 764, 862
- Shale, Ammonium Chloride from Spent 736
  - Retort for 429
- Sheep Manure 577
- Shellac 391, 682
- Sherry, Adulteration of 637
- Shoddy Manure 95
- Silesite (an Explosive) 342
- Silicon in Cast Iron 569
- Silk 385, 499
  - Absorption by 621
  - Artificial 206
  - Etc. separated from Vegetable Fibre 33
  - Wild 840

PAGE

- Silver Assay 457
  - Carbonate with Gelatin Emulsion 452
  - Chloride, Photochromatic Properties of 642
  - Dry Assay of 869
  - Dust, Combustion with 235
  - Extraction 36
  - Extraction from Speiss 570
  - German 133
  - Price of 877
  - Photochloride 230
  - Refining 571
  - Separation of Gold from 850
- Skies, Photographic 132
- Skins, Treatment of 683
- Slabs, Moulded 631
- Slag, Cement 568
  - Cement from 677
  - Exported to Germany 650
  - Manure for Oats 683
  - As Manure for Sugar Beet 220
  - Manurial Value of 332, 758
  - Mixed with Manure 220
  - Phosphates 94
  - Recovery of Metal from 125
  - Treatment of 131, 325
- Slags, Tin and Antimony determined in 457
- Slate Waste, Utilisation of 631
- Slot Standard, Methven's 367
- Slurry for Cement, Dryer for (illus.) 438, 439, 440
- Smoke, Analysis of 615
  - Gases, Measurement of 556
- Smyrna Carpets 781
- Soap, Action of Water on 797
  - Antiseptic 192
  - Dried 756
  - Exports 410
  - Manufacture 126, 442
  - Recovered from Dye-baths 841
  - Test for Water 795
  - Trade 598, 599
  - Trade in Bulgaria 356
- Soaps 682
  - Mercurial 507
- Soap-berry Tree 747
- Soaping Machine 34
- Soda Ammonia Process (illus.) 434, 435, 436, 437, 438
  - Bicarbonate 502
  - Bicarbonate, Decomposition of (illus.) 628
  - Bicarbonate, Purification of (illus.) 629
  - Carbonate 733
  - Compounds with Methyl Alcohol 453
  - Hydrate, Volatility of 733
  - Manufacture (illus.) 323, 387, 502, 626, 627, 629, 720
  - Manufacture of Caustic 122
  - Nitrate 96
  - Nitrate Prices 248
  - Permanganate 437
  - Phenolate 808
  - Sesquicarbonate 814
  - Solubility of Iron in 322
  - Sulphate Manufacture (illus.) 625, 673
  - Syndicate 700
- Sodium Acetate, Analysis of (illus.) 645
  - Bicarbonate, Testing 133
  - Carbonate, Hydrate estimated in 234
  - Chloride, Solubility of 434
  - Hydrate estimated in presence of Carbonates 234
  - Manufacture 440, 568, 851
  - Pyrophosphate employed in Analysis 401
  - Sulphibenzoate as an Antiseptic 226
- Soil. Absorption of Nitrogen by 332
  - Micro-organisms in the 854
  - Nitrates in 577
  - Nitrogen in 393
  - Nitrogen in Arable 757
  - Potash in 393
  - Sterilisation of 758
  - Sulphur and Phosphorus in 222
- Soils, Composition of 81
  - Experiments on 574, 575
- Soja Hispida, Constituents of 854
- Solanum Grandiflora 227
- Solanum Manimosum and Paniculatum (illus.) 229
- Solids under Pressure, Reactions between 567, 568
- Soot 96
- Sorghum Canes, Storage of 395
  - Grown for Fodder 394
  - Glucose in 395
  - Sugar from 222, 334
- South Australia Customs Tariff 46
- Sozoiodol 227
  - Compounds 586
- Spain, British Trade with 530
  - Trade with 242
  - Trade with United Kingdom 47
  - And the United Kingdom, Trade between 406, 702

PAGE

- Sparteine 399
- Specific Gravity Tables 521
  - Heats of Solutions 768
- Spectra of Organic Dye-stuffs 134
- Speiss, Desilverisation of 570
- Spermaceti 372
- Spirit, Denaturation of 637
  - Direct from Mash 687
  - Duties in Sweden 406
  - Eugenol in 515
  - Fusel Oil removed from 129, 687
  - Manufacture 396, 447, 449, 509, 511, 512, 513, 514, 686, 762
  - Manufacture in Bond 782
  - Methylated 78, 135
  - Proof 821
  - Purification of 224, 515
  - Tables, Sykes' 819
  - For Trade Purposes in Germany 355
  - Vanillin in 223
- Spirits, Action on Metals of Methylated 869
  - Duty on 276
  - Estimation of Fusel Oil in 405
  - Methyl Alcohol detected in 404
- Stalagmometer 42
- Standard Lamp, Amyl-acetate 668
  - Lamp, Photometric 741
  - Solutions, Preservation of 771
- Starch Determination 348, 350
  - Estimation of 77, 448, 528
  - Gum 334, 335
  - Iodide 397
  - Manufacture 41
  - Microscopic Detection of 233
  - Saccharification of 514
  - Sugar 335
  - Transformations 267
  - Treatment for Brewing 446
- Starches, Colour Reactions of 511
- Stassfurt Industry, Development of 649
- Statistics of Imports and Exports 357, 408, 464, 652, 702
  - Mineral 599, 602
  - Trade 246
- Steam Boilers, Corrosion in 202
  - Boilers, Ingot Iron for 124
  - Condensation of 387
  - Superheated (illus.) 522
- Stearin, Distilled 755
  - In Lard 527
- Steel 504, 505
  - From Crude Iron (illus.) 633, 634
  - Theory of 503
  - Wire, Corrosion of 388
- Stems, Treatment of Fibrous 385
- Sterilisation of Soil 758
- Still (illus.) 834
  - Fractionating for Laboratories (illus.) 233
  - For Spirits (illus.) 763
  - Vacuum (illus.) 313, 314
- Stone, Artificial 324, 325, 439
- Stop-cock for Burettes (illus.) 343
- Strain, Action on Steel Rod 388
- Strainer for Gas Tar 115
  - For Pulp (illus.) 339
- Straining Colours, etc. 121
- Strontium Fluoride 122
  - Hydrate 122
  - Solutions, Treatment of 675
- Strophanthine 586
  - Toxic Action of 765
- Strophanthus 227
- Stuttgart Commercial Museum 699
- Styrogallol 117
- Sublimate Solutions, Stability of 131
- Suction and Pressure Apparatus (illus.) 312
- Sugar, Ash Determination 348
  - Beet, Percentage of Sugar in 395
  - Beet, Potassium Chloride for 575
  - Beet, Slag as Manure for 220
  - Bounty in the United States 395
  - Cane, Constituents of 761
  - In Cereals 685
  - Crystallisation of 577
  - Decolourisation of 636
  - Detection of 347
  - Detection of Invert 591
  - Determination of 594, 595
  - Disease in Java 685
  - Examination of 238
  - Extraction by Diffusion 856
  - Extraction and Treatment 41, 42
  - At Fort Scott, United States, Report on 395
  - Industry in Brazil and Pernambuco 578
  - Invert 222, 527, 696, 831
  - Juice, Evaporator for 686
  - Lime in Raw 334
  - Liquors, Deposit from 223
  - Liquors, Filtration of 580
  - Manufacture 446, 447, 509, 578, 579, 580
  - From Molasses 334
  - Refinery at Philadelphia 407
  - Refining 335, 419, 688
  - Solutions, Purification of 349
  - From Sorghum 334
  - From Starch 335
  - Statistics 247
  - Tested by the Osmometer 779
  - In Urine 134
  - Works, Waste Water from 395
- Sugars, Action of Lime on 856
  - Estimation 761
  - Phenylhydrazine, Compounds with 396
  - Synthesis of 128
- Suint, Acids in 219
- Sulphates, Antiseptic Values of 715
  - Metallic 435
- Sulphides, Colloid Metallic 34
- Sulphites 322
  - Detection of 525
- Sulphocyanide of Aluminium 433
- Sulphocyanides, Basic 207
- Sulphonal 451, 585
  - Detection of 457, 694, 772
  - Italian Tariff 873
  - Reactions of 641
- Sulphonic Acids 498
- Sulphur, Black 635
  - In Cast Iron 569
  - In Coal Gas 3
  - Chloride, Action on Oils 552
  - Chloride with Fats, Compounds of 853
  - Compounds, Utilisation of 388
  - Determination in Coal 524
  - Determination in Iron 525
  - Determination in Organic Compounds (illus.) 137
  - Estimation in Burnt Pyrites 305
  - Industry, Andalusian 245
  - In Iron, Estimation 645
  - New Occurrence of 202
  - In Plants and Soil 222
  - From Pyrites, etc. 440
  - Recovery (illus.) 162, 203, 720
  - Recovery from Pyrites 217
  - Report from Sicily 139
- Sulphuretted Hydrogen 438
  - Hydrogen from Alkali Waste (illus.) 210
  - Hydrogen free from Arsenic 121
  - Hydrogen in Coal Gas 668
  - Hydrogen Manufacture 629
  - Hydrogen, Sulphur from (illus.) 164
- Sulphuric Acid Determination 455
  - Acid in injured Grasses 591
  - Acid Manufacture 566, 626, 628
  - Acid, Monohydrated 209
  - Acid Process 208
  - Acid Process, Theory of 747
  - Acid, Purification of 846
  - Acid Trade 701
- Sulphurous Acid, Action on Vegetation 220
  - Acid Determination 344
  - Acid Manufacture 451
- Sumach Trade in Sicily 356
- Sunflower, Oxidation of Oil of 67
- Superphosphate Analysis 312
  - Wood Ashes added to 394
- Superphosphates 94
  - Nitrogen determined in 647
- Surinam Drug Exports 782
- Sweden, Spirit Duties in 406
  - Wood Oil Industry in 650
- Swedish Peat Moss Litter 855
- Switzerland, Customs Tariff of 139
- Sylvestrene Nitrosochloride 517
- Syntonin 337

- Tables of Specific Gravity 521
- Tahiti Drug Exports 410
- Tallow, Adulteration of 186
  - Borneo 391
- Tan Substances from New South Wales 38, 392
- Tank-Water from Fat-rendering 40
- Tannic Acid and Albumen Compounds 331
- Tannin 517
  - Determination 238, 459
  - Distribution in Plants 759
  - Errors in Estimation of 647
  - Estimation of 593, 779
  - Fixing 206, 207
  - Liquor, Free Acid in 349
  - Manufacture 443

PAGE

- Tanning ... 39, 443, 444, 507, 574
  - Bark, Tunis, Duties on ... 406
  - Chemical ... 683
  - Electric ... 441, 443
  - Liquors, Titration of ... 528
  - Materials, Extraction of ... 528
- Tanno-sulphurous Acid ... 39
- Tap, Three-way (illus.) ... 232
- Tar Acid for Varnish, etc. ... 683
  - Acids ... 429
  - Gas from ... 112, 428
- Tars from Petroleum Acid ... 376
- Tarapacá, Saltpetre Deposits in ... 844
- Tarconine ... 518
- Tariff Changes ... 240, 351, 495, 460, 529, 648, 698, 779
- Tartar, Analysis of ... 349
  - Emetic ... 565, 566
  - Emetic, Substitute for ... 624
- Tartaric Acid, Analysis of Substances containing ... 136
  - Determination ... 239
  - Solution, Preservative for ... 871
- Tartrazine ... 482
- Tea, Damaged ... 531
  - Testing ... 348
- Technology, Chemical ... 24
- Tellurium Ore of Siebenburg ... 326
- Temperature of Combustion ... 380
  - Regulator (illus.) ... 188
- Temperatures, Determination of High ... 846
- Ten-candle Standard Lamp ... 367
- Terebene, Di- ... 115
- Terpenes ... 517, 586
- Terpinol ... 516
- Terpol ... 516
- Tetramethylamidobenzene ... 430
- Tetramethylbenzene ... 381
- Tetramethyldiamidobenzophenone ... 742
- Tetramethyldiamidothiobenzophenone ... 118
- Tetramethylparaphenylenediamine, Ozone determined by ... 404
- Tetramethylphenol ... 439
- Tetrazodiphenyldicarbonic Acid, Colours from ... 432
- Tetrazo, Yellow Colours ... 320
- Tetrazodiphenyl Derivatives ... 673
- Tetrazoditolyl Derivatives ... 673
- Thallium Determination (illus.) ... 343
- Therapeutics ... 865
- Thermifugine ... 866
- Thermo-chemistry ... 739
- Thermodynamics ... 721
- Thermometer, Air (illus.) ... 521
  - Depression of Zero Point ... 438
  - Gas (illus.) ... 691
  - Self-registering ... 613
- Thermometers, Glass for ... 846
- Thermophosphates ... 684
- Thermostatic Battery ... 367
- Thio-Derivatives ... 620
  - Derivatives of Amines ... 672
  - Products ... 341
- Thiobenzophenone ... 204
- Thiocarbonyl Chloride ... 204
- Thiocarbonylacetacetic Ether ... 204
- Thiocarbonyldesoxybenzoin ... 204
- Thiocarbonylmalonic Ether ... 204
- Thioketone ... 118
- Thiophen Reaction with Nitrososulphonic Acid ... 30
- Thioresorcinol ... 341
- Thomas-Slag as Manure for Vineyards ... 574
- Threads, etc., Material for ... 127
  - Manufacture of ... 127
- Thymolchroine ... 315
- Thymoquinone ... 315
- Tiles, Moulded ... 631
- Timber, etc., Preservation of ... 841
- Tin Alloys, Determination of Lead in ... 772
  - Alloys, Lead Determination in ... 237
  - And Antimony, Separation of ... 403
  - Separated from Antimony ... 457
  - Plate Manufacture ... 36
  - Plates, Stripping ... 569
  - Prices of ... 649
  - From Scrap ... 215, 633
  - Recovered from Scrap ... 327, 388
  - Scrap Liquors, Utilisation of ... 36
  - Scrap, Treatment of ... 440
  - Statistics ... 151
  - And Tungsten separated ... 344
- Tinctorial Value of Dyes ... 592

PAGE

- Tinctures, etc., Drawback on ... 875
- Tint, Photochemical Estimation of ... 309, 378
- Tintometer (illus.) ... 424
- Tissues, Resistance of (illus.) ... 564
- Titanium Cyanonitride ... 326
  - Estimation in Iron Ores ... 590
  - Separation from Iron ... 344
- Tiza ... 748
- Tobacco Disease in Greece ... 699
  - Japanese ... 759
  - Manuring ... 684
- Toluidine, Estimation of Para- ... 594
  - Sulphonic Acids ... 498
- Tomato Vinegar ... 130
- Tonquin Import Regulations ... 781
- Trade Reports ... 46, 596, 604
  - Returns ... 876
- Trichloracetic Acid ... 866
- Tri-oleïn, Action of Sulphuric Acid on ... 219
- Triphenylmethane Derivatives ... 746
- Tsilotwor (an Explosive) ... 342
- Tubes, Graduation of ... 645
- Tungsten, Separation of Tin from ... 344
- Turbine for Laboratory use (illus.) ... 379
- Turkey-Red Oil ... 321, 328
  - Red Oils, Analysis of ... 594, 871
- Turnip Manure ... 98
- Turpentine, Oxidation of ... 67
- Type Metal, Solubility of ... 217

- Ultramarine ... 635
  - Artificial ... 573
  - Industry ... 246
  - Manufacture in England ... 651
- United States Chemical Trade ... 700
  - Mineral Products of ... 602
  - Trade ... 242
- Uranium Nitrate for Photographic Prints ... 231
- Urea, Oxidation of ... 308
- Urine, Diabetic ... 594
  - As a Manure ... 40
  - Sugar in ... 134

- Vacuum Pan ... 419, 427
- Valves for Wash-bottles (illus.) ... 232, 643
- Vanadium Determination ... 73
- Vanillin in Alechol ... 336
  - In Spirit ... 223
- Vapours, Hood for (illus.) ... 614
  - Noxious ... 225
- Varnish ... 330, 683
  - Black ... 434, 573
  - Coloured ... 391
- Varnishes ... 392, 443
- Vasicine ... 866
- Vat Wastes, Analyses of ... 171
- Vegetable Fibre in Fabrics, Destruction of (illus.) ... 620
  - Fibres, Treatment of ... 120, 206, 207, 320, 843
  - Materials, Treatment of ... 640
  - Matter removed from Wool, Silk, etc. ... 33
- Vegetation, Action of Sulphurous Acid on ... 220
  - In the Neighbourhood of Works ... 854
- Vernonine ... 517
- Vine in France ... 758
- Vines, Black Rot in ... 758
  - Treatment of ... 39
- Vineyards, Manure for ... 574
- Vinegar from Tomatos ... 130
- Violet, Lauth's ... 560
- Volatile Liquids, Storage of ... 495
- Voltameter (illus.) ... 293, 401, 440
- Vulcanised Rubber ... 330

- Wash-bottle Nozzle (illus.) ... 524
  - Valve (illus.) ... 232, 643
- Washer for Granular Substances (illus.) ... 835
- Washing Powder ... 634
  - Scouring, etc. ... 746, 747
- Waste Liquors, Treatment of ... 131
  - Products, Utilisation of ... 25
- Water, Action of Rocks on ... 338
  - For Boilers, Purifying ... 313
  - From Coal Mines ... 457
  - Colorimetric Determination of Ammonia in ... 403
  - Estimation of Hardness ... 524
  - Examination ... 795
  - Hardness of ... 795, 869

PAGE
Water, Micro-organisms in ... 337
  Purification ... 131, 132, 321, 398, 554, 578, 835
  Etc. Purifier for ... 450, 451
  From Roundwood Colliery, Analysis of ... 729
  Shotley Bridge Spa ... 14
  Softening, for Boilers ... 801
  Supply for Leipzig, New ... 397
  From Wells ... 669
Water-bath Regulator (illus.) ... 231
  Gas ... 109, 112, 114, 496, 554
  Gas, Toxic Action of ... 688
  Gas, Precaution necessary with ... 668
  Pipes, Corrosion of ... 78
  Pipes, Corrosion of Leaden (illus.) ... 15
  Pipes, Leaden ... 669
  Spray (illus.) ... 614
Waterproof Fabrics ... 330
  Fabrics, Ornamental ... 33
Waterproofing ... 320
  Composition ... 573
  Fabrics ... 853
Waters, Artificial Mineral ... 225
  Colliery ... 796
  From Collieries ... 13
  Los Bauctos, Mineral ... 237
  From Peninsula of Methana ... 133
  Treatment of Effluent ... 862
Wattles, Australian ... 38
Wax, Analysis of ... 871
Waxes, Estimation of Paraffin in ... 696
Weights and Measures Bill ... 532
Weldon Mud, Employment of ... 617
  Employed for Purification of Gas ... 3
Wheat, Cultivation of English ... 40
  Manure ... 99
Whey, Antimony Mordant from ... 623
White Lead Manufacture ... 846
Wicks, Incombustible ... 203
Wine from Barley ... 397
  Composition of Alsatian White ... 527
  Influence of Botrytis on ... 580
  Lees, Analysis of ... 349
  Spectrum of (illus.) ... 526
  Testing Purity of ... 860
  Unfermented ... 859
Wines, Artificial ... 513
  Etc. Filtration of ... 638
  Italian ... 688
  Nitric Acid in ... 134, 457
  North Carolina ... 239
  Plastering of ... 762
Wire-worm, Kainite as a Protection against ... 220
Withania Coagulans (illus.) ... 229
Wood, Antiseptic Treatment of ... 35
  Ashes added to Superphosphate ... 394
  Charcoal, Reduction of Gold Chloride by ... 215
  Fibre ... 841
  Oil Industry in Sweden ... 650
  Photography on ... 767
  Preservation of ... 388, 764
  Shavings in Paper ... 863
  Spirit ... 497, 510
  Spirit, Examination of ... 135
  Wool (illus.) ... 499
Wood-made Papers, Action of Gaslight on ... 44
Wool, Absorption by ... 621
  Bleaching ... 120
  Cleaning ... 499
  Cleansing ... 844
  Constitution of ... 841
  Dyeing ... 433, 434, 566
  Dyeing, Indigo Vat for ... 565
  Lakes from ... 622
  Lubricants for ... 852
  Milling, Grease recovered from ... 853
  Etc. Separated from Vegetable Fibre ... 33
  Staining ... 121
  Treatment of ... 206, 207
  Valuation of ... 620
Wort, Cooling ... 223, 336
  Regulator for Stills (illus.) ... 514
Wounds, Treatment of ... 226
Wrightine ... 585
Wringing Machine ... 34

Xanthaurin ... 386
Xanthoxylon Senegalense, Alkaloios of ... 340

Yarn, Dyeing ... 433, 434
Yeast ... 336, 509, 510, 512, 513, 857, 858
  Antiseptic for ... 131
  For Brandy Mashes ... 223
  In Distilleries, Various ... 687
  Manufacture (illus.) ... 224, 447, 449, 637, 687, 688
  Respiration of ... 686

Zinc Amalgam for Removal of Potassium Iodate ... 690
  Blende, Treatment of ... 440
  Determination ... 771
  Electrolytic Treatment of ... 328
  Extraction of ... 678
  Hydrate, Crystallised ... 845
  Lead Ores, Electric Treatment of ... 572
  Pipes, Corrosion of ... 689
  Statistics ... 149
  Sulphide ... 388
  Sulphide Manufacture ... 38
  White ... 38
Zymo-chemical Examination of Air ... 858

NEW BOOKS.

Alcohol, a Treatise on, with Tables of Spirit-Gravities. By Thos. Stevenson, M.D. ... 405
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Feb. 6th (1st Monday).—Dr. H. E. Armstrong, F.R.S. "The Alkaloids, a review of the synthetic methods of preparing 'closed chain' Azo-carbon Compounds."
Mr. Lewis T. Wright. "Studies in Coal Distillation."
1. The influence of the distillation temperature on the quality of the tar.
2. The influence of the distillation temperature on the sulphur compounds—other than sulphuretted hydrogen—occurring in coal gas.
3. The influence of the distillation temperature in the yield of ammonia from coal.

* „ 20th (3rd Monday).—Mr. James B. McArthur. "The Bromine absorption of Mineral Oils."
Mr. C. T. Kingzett. "Note on Camphor Oil and Oil of Sunflower."
Mr. A G. Green. "On a new series of Cotton Colouring Matters."

Mar. 5th (1st Monday).—Mr. Alexander M. Chance. "The recovery of Sulphur from Alkali Waste by means of Lime Kiln Gases."

* „ 19th (3rd Monday).—Mr. John Heron. "The Polariscope and its applications to Brewing."

*April 9th (2nd Monday).—Mr. Lewis T. Wright. "The present position and prospects of the Coal Gas Industry."

May 7th (1st Monday).—Mr. W. J. Dibdin. "Standards of Light."

June 4th (1st Monday).—Messrs. B. E. R. and J. A. R. Newlands. "The mode of using Char in Sugar Refining."
Mr. Thos. T. P. Bruce Warren. "The Adulteration of Olive Oil and methods of detection."

Notice will be given in the Journal and other Scientific Papers of other Meetings and papers.

Communications to be addressed to the Local Secretary.

Meeting held Monday, January 2, 1888.

MR. D. HOWARD IN THE CHAIR.

A NEW PROCESS FOR DESULPHURISING COAL GAS.

BY J. J. HOOD, D.SC., ASSOC. R.S.M., AND A. GORDON SALAMON, ASSOC. R.S.M., F.I.C.

THE purification of coal gas has always been regarded from two points of view, as a necessity and as a difficulty. The former consideration has concerned the general public, and has been duly attended to by the Legislature; the latter has for years constituted the bugbear of gas companies, and has often involved them in costly and for the most part abortive experiments. Purification, from the consumers' point of view, has signified the removal of those compounds which prejudice the illuminating power of the gas, and those which, during its combustion, produce acid vapours which are alike injurious to health and to property. But, although Parliament has laid down certain permissible limits of impurities within which the gas companies are compelled to work, it has not ventured to demand their total removal, because to do so would have been to insist upon that which has not hitherto been found possible of attainment. Even as at present carried out, gas purification is a matter of great expense and trouble, and hence it cannot be wondered at that so many attempts have been made to cheapen and improve the processes now almost universally employed.

Apart from the condensed tarry products, which are eliminated with comparative facility, the chief impurities with which the gas maker has to deal are carbonic acid, sulphuretted hydrogen, carbon bisulphide, and a series of complicated sulphur compounds, the composition of which has not yet been accurately determined. Carbonic acid is troublesome in two ways: it diminishes the illuminating power of the gas, and, on account of its strong affinity for lime, it displaces the sulphur compounds which lime salts may have been induced to take up in the purifiers, and thus, unless removed, it may sweep the sulphur back again into the coal gas. Its extraction generally constitutes, therefore, the first stage in purification, and is effected by means of calcic hydrate spread upon grids in purifiers. Sulphuretted hydrogen is next dealt with, and can without doubt be wholly abstracted from coal gas. It is scarcely necessary to dwell upon the many processes which have been devised for this purpose. It is far from our desire to speak of them with any disrespect, but it must be conceded that there is only one which has hitherto been received with favour by the general body of gas managers in this country. It is that which involves the use of oxide of iron in dry purifiers. The form of oxide almost universally employed is that known as bog-iron ore, a natural product of spongy structure which is found in the north of Ireland. Its carriage to the various gasworks in England naturally constitutes an item of considerable expense. It contains about 35 per cent. of Fe_2O_3. The ore is spread in layers upon grids in dry purifiers, and the gas containing sulphuretted hydrogen is passed through it until, when examined at the outlet, it shows the presence of sulphuretted hydrogen to lead paper. The coal gas is then diverted to another purifier, and the saturated oxide is thrown into heaps and exposed to the air. In this way sulphur is precipitated and the ore revivified. It is then returned to the purifier and is again available for the absorption of sulphuretted hydrogen gas. This cycle of operations is continued again and again until the ore is saturated, *i.e.*, until it refuses to take up any more sulphuretted hydrogen gas. This generally happens after about twelve revivifications, when with favourable conditions it is found that the ore has taken up about 50 per cent. of its weight of sulphur. We have found in carefully-conducted laboratory experiments that there is a small loss in the weight of the ore during the progress of sulphur absorption. The process demands the attention of experienced hands, otherwise complications are likely to arise which greatly interfere with its working. This is more especially the case in small gasworks, where the facilities are not equal to those of larger establishments. On the whole, however, it should be admitted that the process has yielded good results, and the public and the gas companies owe a deep debt of gratitude to its inventor. But we contend that it is an expensive process. For if we take the average cost of a ton of the best ore, delivered in London at 30s., which is certainly not an exaggerated price, and admit that after twelve revivifications it will not, upon the working scale, take up more than 50 per cent. of sulphur, it follows that two tons of ore are required to take up one ton of sulphur. The sulphur that is thus taken up is practically equivalent to pyrites sulphur, because it is principally used for burning to acid. Moreover, after the ore has been roasted to drive off the sulphur, it can never again be used in the purification of coal gas; it is so much refuse, and is thrown away. The saturated material can, therefore, only be regarded as possessing the value of the sulphur it contains, and that in terms of units of sulphur in pyrites. Hence two tons, which cost 60*s.*, are equal in value to one ton of pyritic sulphur. Taking large pieces of pyrites as being worth 4½*d.* per unit, and assuming the pyrites to contain 48 per cent. of sulphur, which is not a low estimate, the value of this ton of pyritic sulphur is about 46*s.*, so that there is a loss of 14*s.* upon every ton of sulphur thus recovered. This is quite exclusive of the cost of labour involved in the revivifications. We are informed that 6*d.* per ton would be about the charge of handling, in which case 6*s.* per ton has to be added for the twelve revivifications necessary to produce an ore containing 50 per cent. of sulphur. This would bring the prime cost of the two tons of ore necessary to obtain the ton of pyritic sulphur up to 72*s.*, in which case every ton of sulphur recovered and subsequently sold or used for burning would involve a loss to the gas companies of 26*s.* This of course would rank as an item in the cost of purification, but it must be admitted that it is by no means a small one.

The carbon bisulphide and other sulphur compounds are much more difficult of extraction, owing to the difficulty of effecting a stable union between these sulphur bodies and any known and available compound. The method which is now adopted is theoretically interesting, but practically unsatisfactory. Carbonic acid and carbon bisulphide present a great analogy in their chemical affinities; and it might be expected that if carbonic acid showed an affinity for the oxide of a metal, carbon bisulphide would exhibit an analogous affinity for the sulphide of the same metal. This is found to be almost generally true of the metals, and well-known instances are to hand in the case of soda, potash, ammonia, and lime. Advantage is taken of this fact in gas purification, lime sulphide being the compound selected for forming a combination with the carbon bisulphide, and probably some of the other sulphur bodies present in coal gas. Lime sulphide has the advantage of being easily made, and sulphuretted hydrogen is unfortunately sufficiently abundant in gasworks to render the production of the lime sulphide comparatively cheap. But although carbon bisulphide possesses the abovementioned affinity for lime sulphide, it is by no means a strong one, nor is the union energetic. Hence the coal gas has to be passed through a very large surface of the lime sulphide, and even then it is never possible in practice to extract the whole of the sulphur compounds. The quantity extracted would appear to be greater in summer than in winter, tending to show that temperature plays an important part in effecting the reaction.

Without reference to the fact that calcic sulphide does not extract the whole of the sulphur compounds other than sulphuretted hydrogen, its use in gasworks is attended by very serious drawbacks. The sulphur extracted cannot be recovered in a manner commercially profitable. If it were roasted the greater part of the sulphur would be converted into calcic sulphate, and no sulphur worth mentioning would be burnt to acid. Therefore no serious attempt is now made by gas companies to recover it, and the whole of it is regarded as refuse, and constitutes the well-known "blue billy" of gasworks. Moreover, calcic sulphide when once it has been charged cannot again be used in sulphur recovery. This "blue billy" is a terrible nuisance, not only to the managers of gasworks, but also to those who live in the vicinity of the works. When exposed to the air the lime is attacked by carbonic acid, and its greater affinity than the sulphur bodies prevailing, carbonate of lime is formed and foul-smelling gaseous compounds are evolved. Some people claim to thrive upon these odours, but the majority object to them. "Blue billy" has therefore to be removed, but its disposal is a matter of difficulty, and often of impossibility. It is used for manurial purposes, but the price which it fetches is nominal.

The nett result of all this is that gas purification leaves much to be desired. It involves heavy outlay with no proportionate return in the form of results achieved. With the exception of the removal of the carbonic acid by means of hydrated oxide of lime, there is no strong affinity exhibited between the compound sought to be eliminated and the substance offered to it for its union. This is probably due to the fact that the purifying agents, the bog-iron ore and the calcic sulphide, are not, from a chemist's point of view, in a state of fine division. It is scarcely necessary to insist upon the importance of this if it is desired to secure the maximum energy of action in the case of a gas being brought into contact with a solid body in the dry state. Apart from this the arrangements for purification are complex. There are three distinct sets of purifiers employed; three distinct compounds placed in them; two bye-products obtained, one of which is useless, the other both useless and objectionable, and after all the purification is only partial.

Now if a substance could be obtained which contained the ingredients necessary to the elimination of the carbonic acid, the sulphuretted hydrogen, and the carbon bisulphide at one operation, it is clear that a step in the right direction would be secured. Its value would be enhanced if it were in a state of unusually fine sub-division, and if it were possessed of far greater affinity for some or all of the gaseous sulphur compounds than is the case with bog oxide or calcic sulphide. If, in addition to this, it did not involve the erection of new plant, allowed of the utilisation of existing purifiers, did not affect the illuminating power of the coal gas, could be used in the dry state, did not necessitate the production of useless and obnoxious waste, and was obtainable at a price which allowed of considerable economy being effected over the present system of working, it is certain that such a substance would merit the careful consideration of those concerned with the manufacture of coal gas. We believe that the compound which we are about to bring before your notice is possessed of these properties. We do not go so far as to make the positive assertion that such is the case, because laboratory experiments are often doomed to failure when an attempt is made to translate them into manufacturing processes. But, although we have possibly been somewhat premature in bringing this substance before your notice—and for this we have a very good excuse—we may state that we have already tried it upon the large scale, and are at present engaged upon a series of practical experiments which will speedily determine its commercial value. We prefer not to publish these results until they are absolutely complete, and if the subject is of sufficient interest to the Society we shall be pleased to communicate them at a later date. Meanwhile we may state that we have every reason to be satisfied with them, and to hope that they will fulfil our most sanguine expectations.

In our attempts to contribute to the solution of the problem of gas purification we have been guided by the importance of employing a dry material, because we are aware of the inconveniences attaching to the use of a liquid, and after repeated experiments we have selected Weldon mud as the most suitable compound available. We do not use it in the ordinary state in which it is known to bleach makers, because the amount of calcic chloride which it contains renders it impracticable on account of the great deliquescence of the latter substance. But its removal by suitable washing is not difficult of accomplishment, and is indeed already effected on the large scale in the process for the purification of sulphate of alumina from iron. In the ordinary method of washing by decantation, we have in three operations been able to reduce the calcic chloride to 2 per cent. on the air-dried mud. It would be feasible to remove it altogether, but as far as can now be judged its reduction to the amount specified would be ample to meet practical requirements once the calcic chloride is washed out of the mud. The latter may be dried either on kilns or by exposure to air until it forms a porous mass which will crumble between the fingers, and which may remain exposed to the atmosphere without any material detriment. In this condition it may easily be broken up and reduced to a physical condition very similar to that exhibited by bog-iron ore. It then consists essentially of a mixture of the hydrated oxides of lime and manganese. Regarding it as possessing the formula $CaOMnO\ (MnO_2)$ it is well known that the ratio of CaO to MnO may be varied in the process of blowing. 0·3 of an equivalent of CaO, and 0·7 of an equivalent of MnO to one equivalent of MnO_2 is a ratio which is certainly within the power of the bleach maker to attain. If a mud of the composition $CaOMnO_2$ could be blown it would be in many respects more suitable for our purpose. A washed air-dried mud with which we have worked with very satisfactory results gave the following figures upon analysis :—

MnO_2	28
MnO	9
CaO	11
$CaCl_2$	3
H_2O	46
Insoluble matter	3
	100

It is scarcely necessary to dilate upon the chemical activity developed by Weldon mud as an oxidising agent. Two important facts have to be borne in mind in connexion with it in order to explain much of its extraordinary energy: the very fine state of sub-division of its constituent particles and its alkalinity. The latter property may not be, however, absolutely necessary, and it is probable that the further development of our process may demand the employment at one stage of an acid mud.

Manganese oxide has a strong affinity for carbonic acid, and therefore by a parity of reasoning to that applied in the case of lime, soda, potash, and ammonia, manganese sulphide should possess an affinity for carbon bisulphide, and we have proved by experiment that such is the case. If the vapour of carbon bisulphide be conducted over manganese sulphide the latter is absorbed, and for some time its odour is not recognisable.

But although manganese is like calcium, inasmuch as its oxides possess a strong affinity for carbonic acid, it is unlike it in this, that manganese oxide has a stronger affinity for sulphuretted hydrogen than it has for carbonic acid. Hence it follows that if we expose manganese sulphide to the action of the air, sulphuretted hydrogen will not be expelled in favour of carbonic acid; and, as a matter of fact, it is perfectly stable in the atmosphere under normal conditions. The energy of the action which hydrated manganese oxide is capable of exerting upon sulphuretted hydrogen is strikingly exhibited by the following experiment. If air-dried Weldon mud be suspended in water in the presence of an acid, and sulphuretted hydrogen be added to the mixture, it will be seen that the mud immediately passes into a state of solution, the following changes taking place :—The manganese dioxide is reduced to manganous oxide, which unites with the sulphuric acid to form a manganous salt; free sulphur is precipitated, and, in course of time, subsides, leaving the clear and well-known pink solution of manganese sulphate.

Then the direct experiment may be performed of passing sulphuretted hydrogen through air-dried Weldon mud without the intervention of either acid or water. The energy of the reaction is remarkable; in fact so great that, with a large volume of the gas, so much heat is developed as to render it almost impossible to retain the hand upon the glass vessel in which the operation may be conducted. The progress of the absorption may be followed by means of the formation of the yellowish-brown sulphide, and it will be found that no sulphuretted hydrogen will issue from the apparatus until the whole of the black mud has become gradually converted into the yellowish-brown compound. But its limiting power of absorption is then by no means reached. If the mixture be allowed to become perfectly cool after the passage of the gas, and it be then thrown out in a heap and exposed to the action of the air, it will again develop heat, free sulphur will be precipitated, and manganese dioxide will again be formed. The mud is revivified, and is again available for the absorption of sulphuretted hydrogen gas. This may be repeated again and again until the mud refuses to absorb the gas. Instead of exposing the mud to the air, it may be subjected to a continuous process of revivification by mixing a small per-centage of air with the gas. When the gas contains a very high per-centage of sulphuretted hydrogen (say 80 per cent.) care must be taken to prevent firing, but in the case of coal gas such a contingency is out of the question because of the high specific heat of its constituents.

It might be argued that the hydrated calcic oxide was the efficient agent in this reaction, or, at any rate, that it took part in it, but we have set this question at rest by passing a current of carbonic acid gas through the mud prior to the passage of the sulphuretted hydrogen. The energy of the action was in no way abated.

It may further be argued that the action is merely analogous to that of bog oxide, and that our process consists in the substitution of manganese for iron. But its superiority is easily proved. The energy of action in the case of bog oxide is not to be compared with that of Weldon mud if heat developed is to be regarded as a reliable index. For whilst in the former case the containing glass vessel is barely warm, in the latter it becomes so hot as to make it extremely unpleasant to hold the hand upon it. Again, if equivalent weights of bog-iron ore and Weldon mud be exposed in similar vessels to a similar stream of sulphuretted hydrogen, it will be found that the latter requires a much longer time to become saturated than the former. But the best test is furnished by an analysis of the two compounds when treated under identical conditions. The figures which we append have been confirmed by independent analysis. Equal weights of the best bog-iron ore and of air-dried Weldon mud were exposed to the action of sulphuretted hydrogen until saturated. They were then revivified under the same conditions for the space of one hour each, and again charged with gas. This was continued for five revivifications, when the sulphur was estimated in each sample. The following results were obtained :—

One hundred parts of oxide of iron (35 % Fe_2O_3) took up 27 parts of S.

One hundred parts of weldon mud (28 % MnO_2) took up 61 parts of S.

Thus, up to this stage, the gain is immensely in favour of the Weldon mud. But it is even after this stage that the advantage becomes more apparent. It is well known that bog oxide materially diminishes in its power of absorption after the first few revivifications, and that after 12 revivifications it will not take up more than 50 per cent. of its weight of sulphur. The following results will show how much more can be taken up by Weldon mud after six revivifications :—

One hundred parts of Weldon mud revivified for 12 hours took up :—

	S. estimated by Acid.	S. estimated by CS_2.
1st time	25 parts	19
2nd „	43 „	37
3rd „	53 „	42
4th „	58 „	45
5th „	66 „	57
6th „	70 „	60

The amount of sulphur estimated by acid treatment shows the total sulphur present, the amount obtained by digestion with CS_2, the free sulphur. We have stated that bog oxide exhibits a slight diminution in weight after saturation with sulphuretted hydrogen and repeated revivifications. The Weldon mud, on the other hand, shows a very marked increase, as is evident from the following figures :—

Gain in weight of Weldon mud after sulphurisation :—

1st sulphurisation	16 % gain
2nd „	30 % „
3rd „	36 % „
4th „	38 % „
5th „	49 % „
6th „	52 % „

It is evident that this must be clearly borne in mind, and the necessary corrections made, when comparisons are instituted between the sulphurising power of bog oxide and Weldon mud.

With respect to the elimination of carbon bisulphide and other sulphur compounds, it is somewhat more difficult to quote figures unless they are derived from experiments made upon the large scale, and these, we have stated, we are not yet in a position to publish. But we may say that we have made a number of tests upon crude coal gas, and have compared the results with those obtained in working in the ordinary manner, and in every case there has been a reduction of fully 25 per cent. in favour of the Weldon mud. In order to be certain that the calcic sulphide, which might possibly be formed in the Weldon mud in the absence of a sufficiency of carbonic acid in the coal gas to saturate the calcic oxide, was not responsible for the elimination of any of this carbon bisulphide, we took the preliminary precaution of passing excess of carbonic acid through the mud.

It is evident that the carbonic acid is efficiently absorbed by the hydrated calcic oxide of the mud, and, if necessary, the amount of the latter may be increased, as already indicated. If it were not, it could not sweep sulphuretted hydrogen into the coal gas, because the sulphuretted hydrogen thus expelled would be taken up by the manganese oxide with which it would come into immediate contact.

In practice we may apply the material in such a way that the gas is first of all exposed to a purifier filled with mud which has already been exposed to the action of gas containing sulphuretted hydrogen, and has been made to contain the maximum of manganese sulphide. This, to effect the elimination of the carbon bisulphide and other sulphur compounds; or the mud thus sulphuretted, may be mixed with air-dried mud not sulphuretted and placed in the same purifier; the trouble of the few necessary revivifications being obviated by passing a due amount of air through the material, as is commonly done in the case of bog oxide. It is evident that the process admits of a number of variations, to suit the conveniences and requirements of different establishments. But this much is evident, that if the process is destined to succeed upon the large scale, as we believe it is, it will effect a much better purification of gas than is possible by the method now generally adopted. The materials employed will be found far more energetic in their action, no new plant will be required, and no bye-products will be produced which will give off foul-smelling sulphureous gases when exposed to the action of the atmosphere.

When the mud is fully charged it may be treated in a variety of ways, with a view to the recovery of the sulphur and the transformation of the residue into fresh and active Weldon mud. We have proved that the sulphurised material will roast far more easily than pyritic sulphur, so that the sulphur may be burnt to acid if desired. But the roasted product is not useless refuse, as in the case of bog oxide. In one experiment we made, 100 parts of original mud gave, on roasting after sulphurisation, 75 parts having the following compositions :—

MnO_2.	15
MnO	31
CaO	15
SO_3	23
$CaCl_2$	1
Insoluble matter	14
Loss on analysis	1
	100

Now, such a residue is capable of being again converted into Weldon mud by suitable treatment with acid and blowing, being first employed for chlorine making. In such a case it must always be remembered that less hydrochloric acid is required than usual, because of the lime not taking it up, the latter being already saturated with sulphuric acid. So that it really becomes a question of the cost of hire of Weldon mud, the air-dried compound being delivered to the gasworks, and the roasted product being returned, or, if preferred, the mud charged with sulphur being returned, and the value of the latter being credited to the gas companies. It should be borne in mind that if the latter course is adopted, and hydrochloric acid added to the unroasted product, free sulphur of high purity is obtained, which is worth about 7*l.* per ton; and the manganous chloride formed is again blown into Weldon mud. Judging by quotations we have received and inquiries we have made, we believe that the conversion of the spent product into fresh mud can be achieved at a rate which will allow of a very large saving being effected over the present method of gas purification.

Thus we see that the Weldon mud used may be passed through a complete cycle of operations, and become again regenerated for use in gasworks. It is unnecessary to recapitulate the advantages which we hope may be effected by our process; we would merely ask that, if our further experiences are favourable, we may be allowed the privilege of communicating them to the Society.

DISCUSSION.

The Chairman regarded the paper as a very interesting and important communication. In dealing with the purification of coal gas, the elimination of the sulphur compounds had undoubtedly been the most difficult part of the problem. The use of bog-iron ore, though an immense step in advance of the older process, was confessedly an imperfect method of dealing with these impurities; and if this new process fulfilled its promise, it would be of great advantage, and an example of the power of chemistry to transform noxious products into sources of revenue. For if the whole of the sulphur of coal gas at present more or less imperfectly dealt with could be restored to commerce in a useful form, it would be a triumph in the utilisation of waste products equal to any that had yet been effected in any industry.

Mr. Frank Mead thought the authors well deserved the thanks of the meeting for communicating the results of their investigation of this matter, which was, so far as he was aware, new and interesting to those concerned in gas purification. He ventured to think, however, that the authors' acquaintance with the present method of purifying gas must be imperfect. They seemed to regard the present sulphur purification process as much more costly than it really was in practice. In the experiments made, too, they had laid considerable stress on the heat generated in their reaction. But it was well known that when sulphuretted hydrogen was passed through a column of ordinary bog ore, intense heat was produced; and indeed Mr. Claus utilised that heat in his process for the recovery of sulphur in the manufacture of sulphate of ammonia from gas-liquor. It was unfortunate that the authors had not up to the present time gone further into the question of cost. The members who were present to hear the paper read were essentially chemists who had to deal with the practical and commercial side of chemical processes, and the question must arise: Will it pay to do this? He had been able to gather no idea from the paper as to the cost of the required material when washed and prepared for the process. He might say, however, that it was an ordinary thing at present for manufacturing chemists to lend gas makers their iron oxide at a rental—that rental being, say, 2*d.* upon each ton of coal carbonized. Such a rental meant an outlay of only about one-fifth of a penny per 1,000 cubic feet of gas, and left therefore an extremely narrow margin for saving by any new process. He had hoped to hear that this process would entirely eliminate the sulphur compounds. Such a process was what all gas companies were anxiously looking for. But he understood from the paper that the process would reduce ordinary London gas compounds by something like 25 per cent., which would mean that, supposing 8 grains to be left at present, it would take out two more of them. That was not a great reduction. The present lime-purification process for the removal of the sulphur compounds was by no means an extravagant one. He could give instances in which the cost of that process did not exceed 5*d.* per ton of coal carbonized. He was using a coal at one work which gave nearly 50 grains of these compounds per 100 cubic feet of gas made; and that large quantity could be reduced to 10 or even 8 grains with ease. So great a reduction would, however, cost more than 5*d.* per ton; but at a cost of 5*d.* per ton these compounds could be reduced to under 15 grains. That was a piece of practical experience which might be of value to the authors when they had to consider the actual commercial results of their own scheme. The authors claimed that by adding a small percentage of air the revivification of their material might go on within the purifier itself. That was a plan which many gas makers adopted, and which had been known for many years. He therefore could not regard the point as novel. He could remember cases in his own experience in which many millions of cubic feet of gas were purified without the necessity for a change of oxide purifier. Oxide purification did not involve much expenditure. By the present process, oxide of iron was charged with sulphur in many cases to the extent of much more than 50 per cent. The present cost of purification was not a large item, and it was not probable that gas makers would abandon their existing practice except for a process which would take out the *whole* of the sulphur compounds or could be shown to be more economical than the one now in use. The British public looked for cheap gas, and, he ventured to think, would rather have it cheap than that gas companies should go to any great expense in reducing the sulphur compounds by two or three grains. At any rate, he thought the public would object to pay, say, 2*d.* per thousand more, in consideration of only a few more grains of sulphur being taken out. Still, any process which would do that cheaply would commend itself to the gas companies.

Prof. C. W. Heaton thought it was clear that the manganese mud process was, chemically, a great improvement on the oxide of iron process. He confessed that the further treatment of the oxide seemed to present some difficulties. Further knowledge on that point must be waited for, and it was to be hoped that the Society might soon have another contribution on the subject from the same authors.

Mr. C. E. Groves inquired whether the Weldon mud as returned to the producer after the final revivification would be wholly in the condition of manganese oxides, or whether a portion would be sulphide and the rest binoxide. This point was important, because, on treating the mixture with an acid, if sulphide were present an equivalent proportion of the binoxide would be used up in decomposing that sulphide so that sulphur might be precipitated; thus:—$MnS + MnO_2 + 4HCl = 2MnCl_2 + S + 2H_2O$. When treated with hydrochloric acid, therefore, each equivalent of manganese sulphide would destroy an equivalent of binoxide of manganese. If the manganese in the mud returned existed as oxides, it would be much the same as when sent out; but if it contained much manganese sulphide it would be worth very little in the chlorine still.

Mr. A. Campbell had had considerable experience of Weldon mud, but knew of none of the composition shown by the authors. The average Weldon mud contained ·65 equivalents of base to 1 equivalent of Mn_2O_2, ·35 existing as MnO, and ·30 as CaO. He would therefore like to ask what the "insoluble matter" consisted of which remained after the mud had been treated.

Mr. Salamon replied that the insoluble matter was sulphate of lime.

Mr. Campbell pointed out that there was also 23 parts of sulphuric acid, and inquired how it was combined.

Mr. Salamon replied that it existed partly as sulphate of manganese and partly as sulphate of lime.

Mr. Campbell rejoined that there must evidently be a large proportion of sulphate of lime produced by so much sulphuric acid, the effect of which in Weldon mud was most detrimental. In fact, the exclusion of this body was most strongly insisted on in order that the solution might be kept clear. Another objection to the large quantity of base which the authors seemed to think so desirable was that when the mud came to be burnt after revivification it would produce a large quantity of sulphate of lime and cause a great loss of sulphur. In comparing the two agents, Weldon mud and bog iron, it seemed to him that much depended on their physical condition. If the bog iron were brought to a finer state of division, it would probably be quite as active as the Weldon mud. The question of cost was of great importance. He did not think that any chlorine maker would part with Weldon mud for even three times the price of bog-iron ore; and then there would have to be added the cost of carrying backwards and forwards from Lancashire or the Tyne a stuff which contained only 50 per cent. at the outside of valuable material; so that the items for carriage and distribution would add much to the cost of the process. He had often burnt off more than 60 per cent. of sulphur from spent iron oxide, and with the process of revivification by introducing a small percentage of air into the purifiers, the proportion of sulphur could be increased.

Mr. B. E. R. Newlands inquired whether the 14 per cent. "insoluble matter" shown on the table was insoluble in hydrochloric acid.

Mr. Salamon replied that it was, but only because it had not been treated for a sufficiently long time to bring it into solution.

Mr. Newlands further remarked that he had frequently bought spent ore containing more than 60 per cent. of sulphur, and that it was not an uncommon thing for such ore to be returned from the gasworks three times the weight of the original oxide.

Dr. Squire asked if Mr. Salamon could explain the irregular way in which the sulphur increased. According to the diagram, after the first revivification, the percentage was almost double, from the 2nd to the 3rd the action did not go so well, from the 3rd to the 4th it went worse still, from the 4th to the 5th it was more active, and from the 5th to the 6th it was as lively as ever. There appeared to be a period of torpidity in the middle.

Mr. G. D. Macindoe admitted that Weldon mud seemed to have certain advantages over bog ore, inasmuch as its action was more rapid, the extraction of sulphur being more thorough, and there being no objectionable residue. But the material employed was more costly in itself, and he feared that not only would sulphur be lost, owing to the production of sulphate of lime, but that the presence of this latter body would render the residual mud very difficult to blow.

Mr. Gordon Salamon said, in reply: We may congratulate ourselves upon having derived at least one advantage from this somewhat premature publication of our process, in hearing the opinions of Mr. Mead and other gentlemen interested in gas making, and we shall make the best use we can of the hints these gentlemen have been good enough to give us. I rather gathered, however, that Mr. Mead's remarks conveyed the idea that there was no need for any improvement in the process of gas purification, unless the whole of the sulphur compounds could be removed. And yet I cannot think this can be so, for I have a vivid recollection of an action brought, I think, by the inhabitants of the Crystal Palace district, to compel the local gas company to take more sulphur out of their gas than they were then doing. I have also a recollection of reading a book, with which Mr. Mead is doubtless acquainted, containing an account of how certain gas companies have to remove their "blue billy" in covered barges in the dead of night. And I have further some recollection of an Act of Parliament fixing the limit which gas companies may not exceed at 22 grains of sulphur, I think it is, in winter, and 17 grains in summer. If what we have said has no novelty about it, if all this could have been done before, and if Mr. Mead finds no difficulty in getting his gas down to 8 grains, I should like to ask him why the Legislature fixed the maximum at 22 grains, when it was known that it could be reduced to 8 grains and all that was left in was necessarily a nuisance. I have heard of a process in which revivification is effected by passing air through the purifiers, and they claim, I think, not to have opened those purifiers for about two years. I do not believe they are opened yet—they are still growing. Now I am not going to say a word against that process: I appear before you as a stranger in the gas world, but I do not think that process has been adopted by the large gas companies, and I do not think that the large gas companies throughout the country keep their purifiers for a year without opening them. Perhaps, indeed, I rather painted the lily white when I said that I had no experience on a practical scale of iron oxide as applied to gas purification, for I could not have spent day after day in large works for months past without acquiring some experience of it; and as a result of my inquiries I may say this, upon the authority of one of the leading gas makers of the country, that they do not on an average get more than 50 per cent. of sulphur into the bog oxide, and they cannot get that without 12 revivifications. I quite grant what Mr. Newlands says, that more than 50 per cent. can be got, but it cannot be got without 12 revivifications; and, inasmuch as the absorption goes very slowly towards the last, it does not pay in practice to revivify up to more than about 50 per cent. I have been anxious to give figures which represent what is obtained in actual practice, and I think that 50 per cent. does represent the amount. Surely if our paper should prove to be the precursor of a practical process, Mr. Mead will grant me that the abolition of "blue billy" is at least an advantage. And if this process succeeds, it certainly will abolish the production of that body. I am aware that revivification can be effected by an admixture of about 1 per cent. of air without throwing out the bog oxide. What I said was meant to convey that in our process it is also not necessary to throw it out. It can be kept in the purifier and the air passed through it. Mr. Mead has spoken of the great heat produced by passing sulphuretted hydrogen through bog oxide. I have never experienced this unless the gas were mixed with air, but I should like to ask him whether he has ever succeeded in passing H_2S through bog oxide for the same time that I have passed it through Weldon mud this evening without getting sulphuretted hydrogen escaping into the air. Can he fairly tell me of any bog oxide which will give such a result? It is evident from the chemical properties of the two substances—quite apart from the fact of the finer state of subdivision, which must itself be important—that our material should be more energetic. Because if you compare the composition of MnO_2 with that of Fe_2O_3 you will see that there is one atom more of oxygen in the Weldon mud, and it therefore follows that it must be more active than Fe_2O_3. With respect to Mr. Groves's question, so far as our experiments have gone, the manganese in the mud is all returned as hydrated oxide, and is just the same as when sent out. If it were not treated with acid the result would be different; but when treated with acid the peculiar reaction of which I have spoken comes into play and ensures the precipitation of the whole of the sulphur, and on the addition of the lime you get it blown back into Weldon mud. As to the question of cost, I can only say this, that the quotations we have got for the hire of the mud show that, if our predictions are fulfilled, we are going to make a very large saving indeed. Because you must bear in mind that the whole of the iron oxide has to be thrown on the roads. The "blue billy" cannot be thrown on the roads because they will not have it there. So it forms hillocks in front of gas works, and if gas managers can get it thrown on the fields they are glad to do so. But with Weldon mud there is no waste whatever; it is all converted back, and the sulphur is recovered in a pure form. Mr. Mead said he could not see where the difference in expense was to come in, as it cost so little to purify at present. I cannot think the companies share Mr. Mead's sanguine views upon this subject. In looking over their items of expenses as published, I find that the cost of purification of London gas is about ½*d.* per 1,000 ft., and that in the case of the Crystal Palace Company it is about 1*d.* Perhaps the litigation I have mentioned had something to do with it, for, if I remember rightly, it went up to over a penny at about that time, and it is there now. That cannot be regarded as an insignificant item of cost. With respect to taking out the whole of the sulphur compounds, I am not going to say that we can do that, nor the reverse. All I can say is that at present our limit is 25 per cent. more than is taken out by calcic sulphide. If our process will do that, and at a less cost, then I think it should recommend itself to those who desire to secure economy in gas works. There is only one other point I need touch on. I do not wish now to go into the question of the composition of Weldon mud, because it would involve a long discussion; but I can assure Mr. Campbell that there is no free sulphuric acid in our mud either before roasting or after. So far as the available sulphur is concerned, it is all recovered by the acid treatment. With respect to Dr. Squire's remark about the "torpidity" of the middle figures of our diagram, I can only say that the sulphur absorbed was found to be variable upon the conditions of revivification, neither more nor less. We do not pretend to have mastered all the details of revivification. We have found some very curious results in connexion therewith, and had we gone on from the 6th stage of revivification, we could have got a great deal more sulphur in than is shown. I cannot further explain the "torpidity:" we have represented the facts as we found them, and hope to clear up all the matters pertaining to them before long.

Liverpool Section.

Chairman: Prof. J. Campbell Brown.

Vice-Chairman: Dr. F. Hurter.

Committee:

J. Affleck.
E. G. Ballard.
Ernest Bibby.
H. Brunner.
J. C. Gamble.
D. Herman.
J. W. Kynaston.
E. K. Muspratt.
Jas. Simpson.
A. Norman Tate.
A. Watt.

Local Sec. and Treasurer:
W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

January Meeting held on the 9th, at University College, Brownlow Street.

DR. J. CAMPBELL BROWN PRESIDING.

MISCELLANEOUS COMMUNICATIONS.

Mr. Douglas Herman laid upon the table some specimens of phosphorus in crystals, which he thought perhaps might interest the members, as that form of phosphorus did not appear to be very generally known, although it was produced some 17 or 18 years ago, he believed in the first instance by himself, and the method of production was very simple. A piece of dry phosphorus was placed in a glass tube closed at one end, the air exhausted by means of a Sprengel pump, and the tube sealed. In the course of a few hours minute sparkling points were noticed on the sides of the tube, and in the course of a month or six weeks those developed into crystals three to five millimetres in diameter. To obtain colourless regular crystals the tube should be kept in the dark, and disturbed as little as possible, as phosphorus in vacuo was very susceptible to changes of temperature. The crystals have been measured by Prof. Story Maskelyne, and found to carry all the seven fundamental forms of the cubic system. In fact, phosphorus presented as perfect an example of crystallization as could exist. One of the crystals measured by Prof. Maskelyne—it was not more than two or three mm. in diameter—had, when complete, certainly 194, and probably as many as 218 faces, being a very complex crystal. The faces of the crystals were often curved, like those of the diamond, and in good specimens the brilliancy was equal to the best cut diamonds. Prof. Maskelyne believed the index of refraction was even greater than that of the diamond, but Mr. Herman was not aware that it had ever been accurately determined for this form of phosphorus. One non-vacuous tube (exhibited) showed the effect of exposure to light, which caused the deposit of a red film on the parts exposed to light.

The Chairman said the Section were much obliged to Mr. Herman for bringing the specimens. Their refractive power was very high, and in fact they were diamonds which did not require cutting. The difficulty was to preserve their brilliancy, as they had to be kept in the dark.

DISCUSSION ON PROFESSOR DEWAR'S PAPER ON THE WELDON PECHINEY PROCESS.

Dr. J. Campbell Brown said it was very kind of Professor Dewar to come down from Cambridge to give them so interesting and valuable an explanation of the process by means of diagrams, and with that living voice which was so much more effective than the mere reading of a paper in print, especially in the case of a process so extremely complicated as was this one. The general moral of the paper seemed to be that another severe blow was aimed at the Leblanc alkali industry.

He saw several members present who would assure Professor Dewar that the Leblanc process would not die easily. And even if the new process should prove to be the cheapest for the production of chlorine, the English manufacturer would make a very good fight before he gave in, and if he was beaten on one point by a new process he would meet the difficulty by inventing another.

They had the advantage of having present Mr. Muspratt and others who had actually seen the process in operation, and he had no doubt Dr. Hurter would have some very substantial reasons to show why the Leblanc manufacture should not yet despair.

Dr. **Hurter** said they had been told by Mr. Weldon for many years past that the Leblanc process was doomed to die an early death. A few years ago Mr. Weldon thought they were likely to be extinguished in the course of two or three years, but they were still there. Five years ago he had read a paper on the prospects of the chlorine industry. In that paper he took up a position that there was no chlorine compound from which chlorine in the free state could be produced so readily and ought to be produced so cheaply as from hydrochloric acid itself. There was no need to look at the difference between the cost of ammonia soda and the cost of Leblanc soda to arrive at the cost of hydrochloric acid. This cost would in the future be the cost of sulphuric acid added to the cost of salt and the labour connected with its production. It appeared to him that they would have to look at saltcake as waste product, as it was already in some places in France absolutely useless and worthless. Thus the cost of hydrochloric acid must in future be the cost of sulphuric acid added to the cost of salt. There was no doubt that, if chlorine could be produced by the new process at 118 frs., with their present cost of sulphuric acid and their present production of chlorine from hydrochloric acid, it would be out of their power to compete with that process, and therefore the chlorine industry would pass over to Stassfurt. He did not think, however, that the English manufacturers would sit down in despair and let it go to Stassfurt without making a tremendous effort to keep it here, but in what direction that effort was to be made he was not just then prepared to say, but at all events he would stick to the ship and try to steer it through the difficulties.

With regard to the process itself he had little to say. The reports of gentlemen who had been to Salindres corresponded exactly with what Professor Dewar told them. He admired the ingenuity displayed in the design of the apparatus as shown, and he himself would have hesitated before putting up so complicated an apparatus as exhibited to them by Professor Dewar. After hearing of the temperature, which was something like 700 to 800 degrees, he must admit that all credit was due to the engineers and to M. Pechiney for having the courage to put up so expensive a plant, and he must congratulate them on having found that such a complicated apparatus would stand. He himself would not have expected it to have done so.

One great difficulty which they had to overcome with their Deacon apparatus was the contamination of the chlorine with products of combustion, and the employment of a baker's oven in this new process was really a very happy idea. It was well known that when they had to manufacture bleaching powder with dilute chlorine, the main difficulty was not exactly the dilution of the chlorine itself, but it was the carbonic acid and other gases which accompanied the small amount of chlorine. In this apparatus the difficulties of contamination with carbonic acid appeared to be entirely overcome, for there were no products of combustion surrounding the chamber in which the chlorine was being produced. The curve shown would, he believed, give about an average of 4 per cent. of chlorine, spread all over the time. That in itself would not cause very great difficulties in the manufacture of bleaching powder, and therefore they must take it for granted, although bleach had not yet been made, that M. Pechiney would certainly succeed in making the bleach also; and they must not flatter themselves that because bleach had not been made it would not be made.

They must take it for granted that the result of this process would be chlorine at the maximum cost of 118 francs in France, and 94 francs in England, per ton of chlorine, and, considering that the Stassfurt people would have nothing to pay for hydrochloric acid, he did not see how British makers with their present processes could compete for the manufacture of chlorine. Something new must be found, and the gentlemen connected with the Leblanc industry would have to turn to and find another way of making chlorine from hydrochloric acid. He did not despair but that they would find something to meet that difficulty, and it would take the Stassfurt people some little time before they erected sufficient plant to make all the chlorine the world could buy. They had still some years to breathe in, and he hoped that some way would be found out of that difficulty. Germany had already the whole of the coal tar industry, and he hoped the chlorine industry would not go to Germany too, which would certainly be a serious blow to British chemical industry. From the process explained by Prof. Dewar it would appear as if they must look in future to the ammonia soda process for soda, and to chloride of magnesium as the source of chlorine; because it seemed as if chloride of magnesium could be made to yield free chlorine directly, whereas free chlorine could not be made directly from salt. He thought that if they would charge the whole of the saltcake to bleaching powder, with the Leblanc process for the conversion of saltcake into alkali, they would be tolerably well able to compete with ammonia soda, as far as he knew, but they would not be able to compete in the chlorine industry with that new process, unless every particle of hydrochloric acid made could be converted into free chlorine, and neither the Deacon process nor the Weldon process could come anywhere near that mark, nor even the two combined.

For various reasons the Deacon process had not been able to bring out the whole of the hydrochloric acid contained in salt as free chlorine. At the temperature at which they made the chlorine he had not been able to invert the reaction by passing chlorine gas with steam through glass tubes to produce hydrochloric acid and oxygen. Still, the process seemed to be limited; the decomposition could not be carried on to any extent. It was usually between 40 and 50 per cent., but the per-centage of decomposition varied according to the amount of air which was added to the hydrochloric acid. In this respect it also differed from the magnesium process, if he had understood Prof. Dewar correctly, for in this process the variation of oxygen tension within certain limits seemed to make no difference to the final composition of the gas, that is to say, the absorption of oxygen was complete between certain limits. If they put more oxygen in, the absorption was no longer complete. In the Deacon process the amount of chlorine which they got from the hydrochloric acid depended upon the oxygen they mixed with the hydrochloric acid. The more oxygen that was mixed the greater the per-centage of hydrochloric acid which was decomposed. They had, however, to increase oxygen enormously if they wanted to approach a 100 per cent. decomposition, so much so that the chlorine became too dilute for the purpose of manufacturing bleaching powder, and they could not even then reach that 100 per cent. Of course the English manufacturers would make a very hard fight before they would be beaten by the Stassfurt people, and he hoped it would be a long time before they could really say they had been beaten.

As regarded the thermal questions, chloride of magnesium was of course one of those compounds which, in order to convert it into an oxide, required, as far as he knew, the absorption of heat, whereas (and that was the position he took five years ago) the conversion of hydrochloric acid into chlorine and water was possible with the evolution of heat, and he did not then think it likely that such a dissociation process could compete. The enormous amount of fuel shown in the diagram proved that heat was required to a considerable extent. He never thought that the dissociation processes would seriously interfere with their trade, but he was afraid they were going to, and they must look around and try to find some other dissociation process with which they could oppose M. Pechiney. He was very much obliged to Prof. Dewar for having taken the trouble to come down, and he was sure that they all thanked him for the very able and clever account of the process.

Mr. Henry Brunner said he had thoroughly tested the process in the laboratory about 20 months ago, and had come to the conclusion then that it would work satisfactorily, provided suitable apparatus could be designed for it. The results shown on Professor Dewar's diagrams were to him as old acquaintances, being almost identical with those which he had himself obtained. Though he had regarded the process as in itself a workable one, he had not expected to see it in operation on the large scale during his lifetime, for he did not think that there existed in this country or abroad a chemical engineer capable of overcoming the difficulties which the problem presented. In looking over the President's description of the process in the Society's journal, he had been simply amazed by the apparent ease with which M. Pechiney had mastered those difficulties. If the gentlemen concerned in designing and producing the apparatus could be induced to write an account of their experiences in this matter, such an account would form a text-book on chemical engineering with which even Professor Dewar would hardly find fault. The chlorine produced was undoubtedly dilute; he did not think it had been stated whether it was free from carbonic acid.

Professor Dewar said it was absolutely free.

Mr. Brunner, continuing, would have expected that at the moment when the heating gases were turned off from the furnace and the air entered it, some small portion of carbonic acid would have been formed which would go off with the first portions of chlorine evolved. This portion of carbonic acid would of course be small, but it might be sufficient to render the production of high-strength bleaching-powder difficult. He had much pleasure in seconding the vote of thanks to Professor Dewar proposed by Dr. Hurter.

Mr. E. K. Muspratt said there were two reasons why he was reluctant to make any observations, first, what he had to say about the process he had said in London, and had appeared in the *Journal*; and second, that Dr. Hurter and Mr. Brunner had really very nearly exhausted any criticism that he was prepared to make on the paper. Everyone, as he said in London, who has seen the process in operation, were astounded at the engineering difficulties that had been overcome, and the simple manner in which all the operations were conducted in this apparently complex machine. Everything worked easily without a hitch; the process went on as if it was the simplest process in the world, and he had not the slightest doubt that M. Pechiney was perfectly correct that, with the improvements which are likely to be introduced in the larger apparatus that is about to be erected, the cost will be very much what was given on the diagram. That, of course, was a serious matter for all the Leblanc makers, but although two years ago he had said in a haphazard way that if this process was really made a successful one, the chlorine industry would go to Stassfurt, he was not quite convinced that that would be so readily the case. It was very difficult to estimate the economical factors in any chemical process. Dr. Hurter had pointed out that they must now look to hydrochloric acid as practically the raw material for making chlorine, and that they must look upon the sulphate of soda simply as the cost of sulphuric acid and the salt.

At the same time they must bear in mind that sulphate of soda had a value, and would always have. Sulphate of soda was raw material used in the manufacture of glass, and not carbonate of soda. Well, to the extent that sulphate of soda was used in the manufacture of glass and other manufactures as raw material, they had a valuable by-product which the manufacturer of chlorine from chloride of magnesium would not have.

On the other hand at Stassfurt they might have magnesia or magnesium solution as a by-product, which would really make the manufacture of chlorine still cheaper than what they expected. It was very difficult to estimate what form the manufacture of chlorine would ultimately take. The best plan would be for the Leblanc makers to do all they could in the meantime to perfect their process. Common salt was their raw material, and they must seek in every possible way to get the manufacture of the alkali and of the chlorine effected in the most economical manner. And he was not quite certain, notwithstanding that beautiful process, that it would be impossible to compete with salt as a raw material against chloride of magnesium. He was sure they were all very much obliged to Professor Dewar, and that all the members who had come there had been rewarded by a most interesting paper.

Professor Dewar, in reply, thanked the Section for the very kind way in which it had received him.

Judging from certain of his remarks, he feared that Dr. Hurter was labouring under a false impression. He was sorry to have to say that, because he had got the idea that Dr. Hurter never had false impressions. But he seemed to think that he (Prof. Dewar) had some kind of personal satisfaction in the probable death of the Leblanc process. That was certainly not the case, and not one word of prognostication on the subject had fallen from him. He had never spoken of the approaching death of the Leblanc industry—for one reason, because he had noticed that when anyone anticipated the death of a thing the event was always a long time in coming about. But apart from that, there were other and stronger reasons why he should not entertain any such view. All Mr. Weldon's friends would be able to substantiate his statement that when the process which he had just described began to work well on the small scale Mr. Weldon was deeply grieved, because of the probability that it would not prove acceptable to his old friends. He was a friend of Mr. Weldon's, and felt a pleasure in representing him; therefore he would be false if he felt any pleasure in anticipating the death of that industry which was so dear to Mr. Weldon and to those friends who, by their generous support, had been the means of carrying out his own great invention. At the same time it was well to be warned against the disaster which Dr. Hurter expected. They had recently seen vast changes in British manufactures. They had seen, for instance, the abolition of the kelp industry, a revolution of the paraffin industry, and an extraordinary change in the manufacture of coal tar products. All these industries had varied, while the Leblanc process had appeared to be a staple and as it were indigenous to our soil. But was it the best frame of mind to be in, to believe that such an industry would be a permanent one? He thought it wise to be warned that such might not be the case. The total change or the loss of a particular manufacture might occur any day. Such losses had been sustained before, simply because those concerned in them had been asleep. If Leblanc soda makers were in that condition now, the process which he had brought before them would wake them up, and if it did that it would have done good. The ingenuity of the devices employed in it would be a stimulus, he hoped, to newer processes of even greater complexity, and would at any rate eradicate for ever the idea that a process involving a reaction of the reversible character which he had described could not be a practical success. M. Pechiney had proved that such a process could be worked industrially, even with the complicated plant before them. His hearers might be sure that this was but the beginning of such complexity, and that it would not end there. A complex machine was at no disadvantage if it were controlled by intelligent heads and hands, as was proved by the efficiency of a delicate chronometer as compared with an old eight-day clock. With reference to the composition of the gases issuing from the furnace, perhaps Mr. Brunner had forgotten that there was a sequence in the reactions in the furnace. The first effect of charging the furnace with oxychloride was the production of hydrochloric acid and vapour of water. This mixture of vapours went off first (carrying with it any carbonic acid which might have been left in the furnace chambers), and was rapidly condensed in the glass tube condenser. Then the subsequent decomposition of the oxychloride took place by the action of oxygen upon it, and the gases which resulted from that reaction were free from carbonic acid; consisting simply of chlorine and air. Hence, as had been admitted by Mr. Mond and Dr. Hurter, the chlorine produced would be quite suitable for the manufacture of bleaching-powder. Although the present maximum yield of chlorine was only about 8 per cent. of the gases coming from the furnace, M. Pechiney had no doubt that the effect of his modifications of the plant would be to raise it to 15 or 20 per cent.; and, judging from his own laboratory experiments, there was no reason why it should not ultimately reach 30 per cent., with a temperature of about 1,000° C. He felt somewhat surprised at the position taken up by his friend Mr. Muspratt. In his paper on this process, read before the London Section, he had quoted from Mr. Muspratt's presidential address delivered in 1886, and had given him the credit of a very shrewd forecast. But it now appeared as if Mr. Muspratt had either forgotten the fact or did not like it. At any rate, having reflected on the matter, he seemed to desire to withdraw his forecast as to the transition of the chlorine industry to Stassfurt, and considered that there were so many troubles and difficulties in the way that the thing was likely to remain as it was at present.

Mr. Muspratt.—No, no!

Prof. Dewar, continuing. That state of mind was not characteristic of Mr. Muspratt's presidential address, in which everything was so definite and clear. But he would make another quotation from that address which was even more to the point, and which he would be glad to hear answered, because it was a forecast of the present state of the chlorine industry, made by one who was not only an authority on it, but who had given careful attention to the subject at the time, and so was not to be lightly contradicted. Mr. Muspratt had said: "One ton of bleach can be made from $2\frac{1}{2}$ "tons of common salt. But a satisfactory position "of the trade can only be approached when the "bleaching-powder and the other chlorine products "together are the equivalent of the quantity of "salt decomposed." That all would admit; but then he went on to say: "*and such a price is obtained* "*for the chlorine as will compensate the Leblanc* "*maker for his loss on the alkali produced.*" It seemed that this second part was now to be eliminated. He could only say he was glad to find that there had been so much progress in so short a time; that Leblanc makers were so confident that they could compete with ammonia soda that they were going to eliminate that second part. Nothing was now said of the necessity for that chemical equivalence, and there was no reference to the subsidiary requirement that the price of their chlorine should compensate for the loss on their alkali. He had been assuming that that was still necessary. If he was wrong in that assumption, then, of course, things would be considerably modified; but if he was right, then, as Dr. Hurter had suggested, it would be necessary to develop something entirely new, and the old Weldon process would have served its day, as Mr. Weldon had expected, to be replaced by a process, either his own or someone else's, much superior to it.

Newcastle Section.

Chairman: P. P. Bedson.
Vice-Chairman: J. C. Stevenson, M.P.
Committee:
Alfred Allhusen.
G. T. France.
John Glover.
John Morrison.
John Pattinson.
J. B. Payne.
H. R. Procter.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
C. T. Richardson.
T. W. Stuart.
Local Secretary and Treasurer:
J. T. Dunn, The School, Gateshead.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting in the College of Science, January 11th, 1888.

DR. BEDSON IN THE CHAIR.

DISCUSSION ON DR. BEDSON'S PAPER ON COLLIERY WATERS.

Mr. John Pattinson sent the following note:—

In connexion with this paper it may be of interest to some members of the section to place on record the composition of some other colliery waters which I have had to examine from time to time.

One of the most interesting is a very strong brine found in one of the collieries in the neighbourhood of Sunderland. Besides the somewhat unusual constituents, soluble barium and lithium, found by Dr. Bedson in the Redheugh water, this water it will be seen contains a notable amount of bromine. Its composition is as follows per gallon:—

Chloride of sodium	6936·39	grains.
Chloride of lithium	Trace	
Chloride of potassium	39·55	,,
Chloride of calcium	1960·00	,,
Chloride of magnesium	368·90	,,
Chloride of barium	8·96	,,
Iodide of magnesium	0·08	,,
Bromide of magnesium*	43·39	,,
Chloride of ammonium	4·83	,,
	9362·10	,,

A water from Holmside Colliery is peculiar on account of the large quantity of sulphates it contains and the small quantity of chlorides.

It contains as follows per gallon:—

Protosulphate of iron	12·90	grains
Sulphate of alumina	15·40	,,
Sulphate of lime	76·44	,,
Sulphate of magnesia	60·00	,,
Sulphate of soda	55·02	,,
Chloride of sodium	1·50	,,
	221·26	,,

Some of the colliery waters contain notable quantities of chloride of magnesium, especially in the Sunderland district, and where these are used for steam raising a corrosive action on the boilers has frequently been observed, probably arising from the decomposition of the chloride of magnesium into hydrochloric acid and hydrate of magnesia. It is not at all an unusual thing to find hydrate of magnesia in boiler deposits from such waters, indicating a decomposition of this kind. A water from Broomhill Colliery in Northumberland contained as follows per gallon:—

Carbonates of lime and magnesia	22·19	grains
Sulphate of lime	8·01	,,
Sulphate of magnesia	0·50	,,
Chloride of magnesium	10·20	,,
Chloride of sodium	7·00	,,
Organic matters	1·30	,,
	49·20	

but many waters contain much larger quantities of chloride of magnesium than this.

Another unusual constituent I have sometimes found in waters, especially from the Pelton and Tanfield districts, viz., carbonate of soda. A water from South Tanfield Colliery had the following composition per gallon:—

Carbonates of lime and magnesia	10·50	grains
Carbonate of soda	23·60	,,
Sulphate of soda	1·22	,,
Chloride of sodium	1·95	,,
Organic matter	0·73	,,
	38·00	,,

Another water from Murton Colliery contained 2·98 grains of carbonate of soda per gallon. Three waters from Pelton Colliery contained 35·85, 24·29, and 39·90 grains per gallon respectively. Some of the sludge water from a boiler using the last-mentioned waters contained 1,239 grains of carbonate of soda per gallon—an amount almost sufficient to have suggested its utilisation as a source of alkali before the days of ammonia-soda.

Dr. Bedson remarked that the subject of colliery waters was attracting notice elsewhere, Mr. De Rance having read before the Manchester Geological Society a paper on Brine Springs in the Coal Measures. None of those mentioned by him seemed to contain such large amounts of solids as those examined by Dr. Bedson.

Mr. J. H. Payne read the following note on the subject:—

ANALYSIS of WATER from MANVERS MAIN COLLIERY, SOUTH YORKSHIRE, November 1887.

	Grains per gallon.		Grammes per litre.
Calcium sulphate	168·74	....	2·411
Strontium sulphate	trace	....	trace
Calcium carbonate	3·53	....	·050
Sodium chloride	6207·70	....	88·681
Calcium chloride	1366·55	....	19·522
Magnesium chloride	551·55	....	7·879
Ammonium chloride	12·22	....	·175
Magnesium bromide	50·30	....	·718
Alumina and ferric oxide	1·75	....	·025
Silica	1·40	....	·020
	8363·74		119·481

Temperature of water 73° Fahr., sp. gr. 1·085 = 17° Tw.

Sample taken at a depth of 400 yards from surface by manager to Manvers Main Colliery, Mr. Thomson, to whom I am obliged for it.

He informs me also that the water is in small quantity, and only found where it drains to lowest levels. Bubbles of gas often seen passing through it. (Nature of these I have not had opportunity of examining.) Sample when I received it contained a slight ochreous deposit.

Dr. J. H. Smith read the first part of a paper on a new method of estimating nitrogen, publication of which is deferred till the paper is completed.

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* Containing 37·71 grains of bromine.

AN ANALYSIS OF SHOTLEY BRIDGE SPA WATER.

BY HENRY PEILE, F.C.S.

This mineral spring is situated near Shotley Bridge, a small village in the north of the county of Durham. It has for many years been used by people suffering from rheumatism and skin diseases.

The water when first collected is perfectly clear, but has a slightly brown tinge. If allowed to stand some time it becomes turbid, owing to the carbonic acid gas escaping, which renders the carbonate of iron insoluble. It has a strong taste of iron, which, however, it loses on standing, and that of common salt may then easily be detected. This change is due to the precipitation of the iron

The flow of water at the well is about 30 or 40 gallons per hour. It rises from the spring, through a stone shaft, about 20 ft. deep, and runs through an iron pipe into a stone basin, which is coated with a thick deposit of oxide of iron from the water.

In the analysis of the water, the following methods were employed:—

The total solids in the water were determined by evaporating 250 cc. to dryness, and then heating the residue obtained at 180° C.

The method employed in estimating the ammonia consisted in distilling the water with caustic soda, and then estimating the ammonia in the distillate by Nesler's colour test. In order to show that the ammonia existed in the water as chloride, a small portion of the solid residue was ignited in a platinum basin, white fumes escaping, which on examination gave the characteristic reactions of ammonia and chlorine.

In the estimation of the calcium chloride, 250 cc. of the water were boiled until all the carbonic acid had been expelled, the calcium carbonate being thereby precipitated. The calcium chloride in the filtered liquid was then determined in the usual way.

In the estimation of magnesium, potassium, and sodium, one litre of water was evaporated to dryness, and the residue treated with hydrochloric acid and water. The iron and calcium were removed by precipitation. Pure ammonium phosphate was then added, and the magnesium phosphate filtered off and weighed. The excess of ammonium phosphate was removed by adding oxide of lead. The ammonium salts were expelled by ignition The alkalies were then weighed as chlorides, and separated with platinum chloride.

For estimating the lithia, ten litres of water were evaporated to dryness. The iron, calcium, magnesium, &c. were removed, and the lithia was then precipitated, and weighed as phosphate.

The total carbonic acid was determined by adding pure lime to 250 cc. of the water. The carbonate of lime obtained, was treated with acid, and the carbonic acid evolved was absorbed in potash bulbs.

The chlorine, bromine, and iodine were precipitated with nitrate of silver, and weighed as chloride, bromide, and iodide of silver. For the separation of bromine and iodine, 25 litres of water were evaporated to dryness. The total amount of bromine and iodine in the residue was determined by means of a standard solution of chlorine water.

The method employed in estimating the iodine was as follows: 1 cc. of chloroform was added to the solution of the residue, obtained by evaporating the water to dryness. Standard chlorine water was then added drop by drop, until the violet coloration of the chloroform, due to the liberation of iodine, had entirely disappeared.

The complete analysis of the water, also the per cent. composition of the solid residue, are shown in the following tables:—

ANALYSIS OF THE WATER.

——	Grains per Gallon.	Grams per Litre.
Barium chloride	3·983	·0569
Ammonium chloride	·294	·0042
Calcium chloride	18·424	·2632
Lithium chloride	·455	·0065
Magnesium chloride.	3·059	·0437
Potassium chloride	3·591	·0513
Sodium chloride	121·331	1·7333
Calcium bicarbonate	27·748	·3964
Magnesium bicarbonate..	Traces.	Traces.
Ferrous bicarbonate	1·085	·0155
Manganous bicarbonate..	Traces.	Traces.
Magnesium bromide	·531	·0075
Magnesium iodide	·0037	·000056
Silica.....................	Traces.	Traces.
Phosphates	Traces.	Traces.
Albumenoid ammonia....	Traces.	Traces.
Total chlorine	93·100	1·330
Total iodine	·0035	·00005
Total bromine	·4613	·00659
Total carbonic acid	23·380	·3340
Free carbonic acid	5·831	·0833

Specific gravity at 15·5° C = 1·00197.

Temperature of water at the well 10° C, the air at the time of observation being 14° C.

COMPOSITION OF RESIDUE, DRIED AT 180° C.

Total Solid Residue = 2·484 Grams per Litre.

——	Grams per Litre.	Per Cent. Composition.
Barium chloride	·0569	2·29
Ammonium chloride	..	..
Calcium chloride	·2632	10·95
Lithium chloride	·0065	·26
Magnesium chloride	·0437	1·76
Potassium chloride	·0513	2·06
Sodium chloride	1·7333	69·77
Calcium carbonate	·2753	11·03
Oxide of iron	·0155	·62
Magnesium bromide	·0075	·30
Magnesium iodide	·00005	·002
Magnesium carbonate....	Traces.	Traces.
Silica.....................	Traces.	Traces.
Phosphates	Traces.	Traces.
Manganese	Traces.	Traces.
Total	2·45325	99·092

The barium present in the water was estimated in the following manner: One litre of water was boiled for four hours in order to precipitate the salts held in solution by carbonic acid. Sulphuric acid was then added to the filtered liquid, forming a white precipitate which was filtered off and weighed. The precipitate, upon qualitative examination, proved to consist of barium sulphate. The precipitated carbonates from the boiled water were dissolved in hydrochloric acid, and on the addition of sulphuric acid only a very slight precipitate of barium sulphate was obtained.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Third Meeting for this Session was held in the Society's Rooms, 207, Bath Street, Glasgow, on Tuesday, 10th January 1888.

MR. J. J. COLEMAN IN THE CHAIR.

THE CORROSION OF LEADEN WATER PIPES.

BY PROF. CARNELLY, D.SC., AND W. FREW, UNIVERSITY COLLEGE, DUNDEE.

SOME time ago we obtained possession of several pieces of lead piping, which had been in use for 80 to 100 years for conveying water to Fingask Castle, near Perth. It had been originally laid for some distance in a stone-built drain connected with the castle. This piping was very largely corroded and, though $\frac{3}{16}$ in. thick, was in many cases quite eaten through, and deeply and extensively honeycombed in others. This corrosion, which extended only half round the pipe, had evidently started from the outside, for the inside of the pipe, where it had not been perforated, was in perfectly good condition, and merely covered with a very thin yellowish white incrustation. The cavities formed externally in the walls of the pipe by the corrosion were filled with a very hard brick-red deposit, almost the colour of red lead. This deposit was in places covered with a very thin white film or incrustation.*

The following is a photograph of some of these pieces of pipe:—

An analysis of the red deposit, after scraping off any of the white incrustation, gave the following results, from which it is seen that it consisted almost entirely of a red modification of lead monoxide PbO.:—

PbO	= 98·38	or	PbO	= 95·60
CaO	= 0·38		$PbCO$ ..	= 3·38
FeO	= 0·27		$CaCO_3$ ..	= 0·69
MgO....	= 0·06		$MgCO_3$..	= 0·13
SiO_2	= 0·20		$FeCO_3$ ..	= 0·43
Cl	= 0·01		SiO_2	= 0·20
CO_2.....	= 1·07		Cl	= 0·01
H_2O	= 0·08		H_2O	= 0·08
	100·45			100·52

The thin white incrustation overlying the red deposit had the following composition:—

PbO	= 95·65	or	PbO	= 81·32
CaO	= trace		$PbCO_3$......	= 17·10
MgO........	= 0·14		$MgCO_3$......	= 0·30
FeO	= 0·07		$FeCO_3$	= 0·16
CO_2.........	= 3·02		Cl, SiO_2, H_2O	= 1·12
Cl, SiO_2, H_2O	= 1·12 by diff.			
	100·00			100·00

This last analysis, however, is only approximately correct, as in order to obtain a sufficient quantity the white film had to be scraped off, and in the operation got mixed to some extent with the red part. The composition of the old lead pipe itself was:— $Pb = 99·74$; $Sb = 0·07$; $Fe = 0·05$; $= 99·86$.

It was ascertained:—(1.) That only a certain length of the pipe had been corroded; (2.) That the whole length of the pipe which was corroded (but no more) rested on some brickwork covered with mortar; and (3.) That the half of the pipe which was corroded was undermost and had been embedded in the mortar.

We were also told by practical plumbers that a leaden pipe laid through a wall and in contact with the mortar almost always suffered corrosion with the formation of a red incrustation, similar to that in the pipe under examination. The key to this extraordinary corrosion, therefore, was evidently the presence of *free lime*. The white outer film, however, had most likely been the result of the combined action of the air and water on the lead monoxide, as is shown by the very much larger quantity of lead carbonate.

That it was free lime and not carbonate which had caused the corrosion was proved by the fact that a piece of lead pipe, which had been laid in a bed of chalk, did not exhibit the least trace of corrosion. The pipe referred to was evidently a very old one, as, instead of being round, it was oval and had been made by soldering the two edges of a piece of sheet lead.

We also obtained possession of another piece of lead pipe which had been found laid in a bed of blue clay at Seggieden, near Perth. It was very much corroded, but in this case the substance of the pipe was completely eaten away without the formation of any incrustation. This pipe had been laid about 80 years, and is represented in the following photograph :—

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* Since completing this investigation we have found that Bamberger (Dingl. polyt. J. 245, 35) has also observed a similar corrosion in a piece of lead pipe which had rested for five years in a layer of Portland cement. In this case the red deposit consisted of $PbO = 96·80$; $CO_2 = 1·74$; $H_2O = 1·13$; $CaO =$ trace; $= 99·67$. Pereira has also recorded a similar case.

We were also told by practical plumbers that a peaty soil was less liable to act on lead pipes when laid in it than a sandy soil, or rather a soil consisting of water-washed sand (river sand). The water from the Bagshot sands also corrodes lead, as shown by Swaine Taylor, and G. Brande and Warington.

In order to throw some light on the above and similar cases of corrosion, we have made several series of experiments, but before stating the details of these it will be well to give a brief account of some of the more modern opinions as to the circumstances which affect the action of water on lead, so far as they bear on our own investigations.

The proposal to supply Glasgow with water from Loch Katrine led to quite an extensive series of researches on the action of water on lead, for according to Miller the water from this loch was more corrosive in its action on lead than any other which he had had occasion to examine. It is a very soft water, but he concluded that softness alone could not be the cause of its corrosive action, since other waters almost equally soft, such as that from the Dee in Aberdeenshire, were non-corrosive. Now it was found that the corrosive action of the Loch Katrine water could be entirely prevented by causing it to flow over fragments of old red sandstone and limestone; while Dr. Taylor stated that the addition of one 50,000th part of calcium carbonate also prevented it; the same opinion being also held subsequently by Graham, Miller, and Hofmann. The most important of all the investigations on this subject, however, is that of Crookes, Odling, and Tidy, the details of which are given in their very admirable "Report on the Action of Water on Lead," made to the Water Committee of the Corporation of Huddersfield in 1886, a report which should be consulted by all who are interested in the water supply of towns. Their investigation was limited chiefly to the action of soft waters on lead, and they found that :—(1.) Those soft waters which, when taken from the service pipes, contained a notable quantity of lead, gave on the average 0·21 grain of silica per gallon ; (2.) In those in which there was no lead the silica present = 0·53 grain per gallon ; (3.) In those in which the action was intermediate the silica = 0·39 grain per gallon. It was thus evident that the corrosive action of the water was conditioned mainly, if not altogether, by the amount of silica present, and this was further confirmed by laboratory experiments, made by shaking up different forms of silica with water and afterwards allowing the water to act on lead. Their main conclusions were :—(1.) That a water becomes lead-proof when the dissolved silica is about 0·5 grain per gallon ; (2.) That it is essential, in order to ensure the protective action, that the silication of the water should be maintained. They found that the best method of effectually silicating the water was to use a mixture of flints and limestone, but give no reason or experiments to explain this.

We now proceed to describe our own experiments, which were made for the purpose of ascertaining the action of slaked lime, limestone, sand, calcium silicate, &c. on lead. The method we employed was as follows :—Pieces of clean bright lead were accurately weighed, and completely immersed in distilled water made up to a thin paste with the substance the action of which was to be tested. There they were allowed to remain, without being disturbed, for the specified time at the ordinary temperature. Each piece was then washed with water, being also gently rubbed with the finger, wiped with a cloth, dried at 80° C., and again carefully weighed. To each set of experiments there was a duplicate ; the one set being carried out in beakers with free exposure to the air, and the other set in well stoppered 8-oz. glass bottles. These bottles were filled about two-thirds with the substance, and the lead was therefore out of contact with air, with the exception of the small quantity in the upper part of the bottle. In the first series of experiments were used pieces of lead pipe as nearly as possible of the same size (viz., $1\frac{7}{8}$ in. long, $\frac{1}{2}$ in. diam. outside, and $\frac{1}{8}$ in. thick), but as this occasionally gave rise to error, owing to the difficulty of cleaning the lead after immersion without scratching it, pieces of sheet lead, cut to exactly the same size, were employed in all the remaining series. These pieces of lead measured 2 in. × 1 in., and were $\frac{1}{12}$ in. thick. All the experiments under each series were carried out simultaneously and as nearly as possible under like external conditions. The results are given :—(1.) As absolute loss, this being simply the actual loss of weight ; and (2.) As per-centage loss, calculated on the average weight of the pieces of lead.

SERIES I.

Lead Pipes (average weight = 73·4158 grammes).—Time of exposure 28 days.

IN BEAKERS.	Absolute Loss.	Per Cent. Loss.	IN BOTTLES.	Absolute Loss.	Per Cent. Loss.
Slaked lime	·3075	·418	Slaked lime and sand	·0685	·093
Water	·1845	·251	Slaked lime	·0680	·092
Slaked lime and sand	·0870	·118	Water	·0475	·064
Sand	·0075	·010	Old mortar	Spoilt.	Spoilt.
Old mortar	·0070	·009	Calcium carbonate	·0055	·007
Calcium carbonate and sand	·0050	·006	Calcium carbonate and sand	·0035	·004
Calcium carbonate	0	0	Sand	·0025	·003

SERIES II.

Sheet Lead (average weight = 25·575 grammes).—Time of exposure 28 days.

IN BEAKERS.	Absolute Loss.	Per Cent. Loss.	IN BOTTLES.	Absolute Loss.	Per Cent. Loss.
Slaked lime	·2720	1·064	Slaked lime	·0210	·082
Water	·1180	·461	Water	·0165	·064
Slaked lime and sand	·0825	·322	Peat	·0165	·064
Peat	·0290	·113	Aluminium hydrate	·0125	·049
Aluminium hydrate	·0095	·037	Slaked lime and sand	·0095	·037
Calcium carbonate	·0050	·019	Old mortar	·0010	·003
Sand	·0040	·015	Calcium carbonate	·0005	·001
Old mortar	·0020	·007	Calcium carbonate and sand	·0005	·001
Calcium carbonate and sand	0	0	Sand	0	0

SERIES III.

Sheet Lead (average weight = 25·907 grammes).—Time of exposure 14 days.

IN BEAKERS.	Absolute Loss.	Per Cent. Loss.	IN BOTTLES.	Absolute Loss.	Per Cent. Loss.
Slaked lime	·1555	·600	Slaked lime	·0585	·220
Water	·1060	·414	Slaked lime and sand	·0370	·140
Slaked lime and sand	·0975	·381	Peat	·0295	·120
Peat	·0180	·070	Water	·0280	·108
Aluminium hydrate	·0060	·023	Aluminium hydrate	·0075	·028
Sand	·0045	·018	Sand	·0040	·015
Calcium carbonate	·0030	·012	Calcium carbonate	·0035	·013
Old mortar	·0030	·012	Calcium carbonate and sand	·0030	·011
Calcium carbonate and sand	·0025	·010	Old mortar	·0020	·007

SERIES IV.

Sheet Lead (average weight = 25·885 grammes).—Time of exposure, 14 days.

IN BEAKERS.	Absolute Loss.	Per Cent. Loss.	IN BOTTLES.	Absolute Loss.	Per Cent. Loss.
Slaked lime	·1450	·567	Slaked lime and sand	·0440	·172
Slaked lime and sand	·1100	·430	Water	·0340	·133
Water	·1030	·403	Slaked lime	·0325	·127
Peat	·0255	·100	Peat	·0215	·084
Aluminium hydrate	·0065	·025	Aluminium hydrate	·0110	·043
Calcium carbonate and sand	·0035	·013	Calcium carbonate	·0035	·013
Sand	·0030	·012	Sand	·0030	·012
Calcium carbonate	·0020	·007	Old mortar	·0020	·007
Old mortar	·0015	·005	Calcium carbonate and sand	·0005	·002

In the next series of experiments, substances other than those previously tried were employed, except that water and calcium silicate were repeated for purposes of comparison. Experiments were also made simultaneously to determine the effect of the presence of sand, calcium carbonate, and calcium silicate in reducing the corrosive action of ammonium and potassium nitrates respectively. When the substance is soluble in water the second column of the table gives the amount dissolved in 50 cc. of water, *i.e.*, in the quantity of water used.

SERIES V.

Sheet Lead (average weight=21·076 grammes).—Time of exposure 28 days.

—	Amount of Substance in Column I. dissolved in 50 cc. of Water.	Mixed with				
		Water only.	Sand and Water.	Calcium Carbonate and Water.	Calcium Carbonate, Sand, and Water.	Calcium Silicate and Water.
		Per-centage Loss.				
IN BEAKERS.						
Ammonium nitrate	0·1 gramme	1·829	·048	·006	·012	·010
Water..................	..	·766	..	..	..	..
Potassium nitrate........	0·1 gramme	·544	·004	·012	·004	·006
Calcium sulphate	Thin paste	·133	..	..	..	..
Magnesium sulphate.....	25·6 grammes	·039	..	..	..	..
Blue clay	Thin paste	·033	..	..	..	..
Magnesium oxide	Thin paste	·012	..	..	..	..
Calcium silicate	Thin paste	·010	..	..	..	..
IN BOTTLES.						
Ammonium nitrate	0·1 gramme	1·493	·012	·002	·010	·004
Calcium sulphate	Thin paste	·071	..	..	..	..
Water..................	..	·058	..	..	..	..
Blue clay	Thin paste	·046	..	..	..	..
Magnesium sulphate.....	25·6 grammes	·019	..	..	..	..
Calcium silicate..........	Thin paste	·010	..	..	..	..
Potassium nitrate........	0·1 gramme	·008	·006	·004	·006	0
Magnesium oxide	Thin paste	·008	..	..	..	..

The sand employed in the above experiments was what is known as pure white silver sand; the calcium carbonate was precipitated chalk; the old mortar was taken from an old wall which had been built over 50 years ago; the lime was the ordinary quicklime used for building purposes; the calcium silicate was ground Wollastonite $CaSiO_3$.

We tried peat because it is said to protect lead pipes from corrosion when laid in it; and aluminium hydrate was tried because it is the principal constituent of the blue clay which caused the corrosion of the piece of pipe referred to above.

The precipitated aluminium hydrate we employed contained 50 per cent. of water, but we did not know the temperature at which it had been dried.

The following table contains the averages of the results given under Series II., III., and IV., and alongside of these are placed the results obtained in Series I. and V., arranged in the order of their corrosive action, beginning with the most powerful:—

IN BEAKERS.	Loss per Cent.			IN BOTTLES.	Loss per Cent.		
	Series I.	Series II., III., IV., average.	Series V.		Series I.	Series II., III., IV., average.	Series V.
Ammonium nitrate.............	..	..	1·829	Ammonium nitrate	..	..	1·493
Slaked lime	·418	·745	..	Slaked lime.....................	·092	·143	..
Water..........................	·251	·426	·766	Calcium sulphate.............	..	..	·071
Slaked lime and sand	·118	·377	..	Slaked lime and sand.........	·093	·116	..
Potassium nitrate	..	..	·544	Water	·064	·101	·058
Peat	..	·094	..	Peat	..	·089	..
Calcium sulphate................	..	..	·133	Blue clay	..	..	·046
Aluminium hydrate.............	..	·028	..	Aluminium hydrate...........	..	·040	..
Magnesium sulphate...........	..	..	·039	Magnesium sulphate..........	..	..	·019
Blue clay........................	..	..	·033	Calcium silicate..............	..	..	·010
Sand	·010	·015	..	Potassium nitrate............	..	..	·008
Calcium carbonate..............	0	·013	..	Magnesium oxide	..	..	·008
Old mortar	·000	·008	..	Calcium carbonate............	·007	·009	..
Calcium carbonate and sand	·007	·008	..	Sand	·003	·009	..
Magnesium oxide...............	..	..	·012	Old mortar.....................	..	·006	..
Calcium silicate.................	..	..	·010	Calcium carbonate and sand..	·005	·005	..

The above results show :—

(1.) That in almost all cases the corrosion is much greater with free exposure to the air than when air is excluded. Thus the action of water is diminished to about one fourth, and that of slaked lime to about one fifth by the exclusion of air.

This confirms the observations of previous investigators. The diminution in the corrosive action on exclusion of air, as a rule, is the most marked in the case of those substances which exert the greatest corrosive action.

With aluminium hydrate and blue clay, however, the exclusion of air somewhat increases the corrosive action.

With calcium carbonate, old mortar, calcium silicate, or a mixture of calcium carbonate and sand, the presence or absence of air seems to make very little difference, for though the average results are somewhat in favour of the exclusion of air, yet the individual results are sometimes one way and sometimes the other. The effect of excluding air is, however, by far the most marked in the case of potassium nitrate, which with free exposure to air is almost as corrosive as water alone, but becomes equal in protective power to calcium silicate when air is excluded.

(2.) With exposure to air the corrosive action of water on lead is very considerably increased by the presence of ammonium nitrate or of slaked lime, and in the absence of air also by calcium sulphate and by a mixture of slaked lime and sand.

The presence of any of the other substances tried, with or without exposure to air, materially diminishes the corrosive action.

This is the case even with potassium nitrate, though it is usually stated that nitrates increase the action of water on lead.

(3.) The energetic action of slaked lime, which is considerably greater than that of water alone, either with or without the exclusion of air, fully explains the corrosion of the leaden pipe we obtained from Fingask Castle, as well as the general experience of plumbers, that lead pipes when laid through a wall in contact with the mortar undergo rapid corrosion.

The lead which was exposed to the action of slaked lime became dotted over with red spots or patches, these being the commencement of an incrustation similar to that on the old lead pipe from Fingask Castle.

Notwithstanding that the presence of sand, as we shall see directly, has a most important effect in protecting lead from corrosion, yet its presence in mortar is not sufficient to prevent the corrosive effect of the slaked lime, for though it reduces it considerably, it still exerts a corrosive action about equal to that of distilled water. The corrosion of leaden pipes by mortar must take place pretty rapidly and must be complete comparatively soon after the laying of the pipe, for as the free lime becomes carbonated and silicated, the corrosive action will become less and less; for as the above results show, old mortar as well as calcium silicate and carbonate separately exert a powerful protective action on the lead.

(4.) The results also explain the non-corrosion of the old lead pipe which had been laid in chalk, the latter being a highly protective substance, but scarcely account for the great corrosion of the pipe which had been laid in blue clay. The blue clay we tried, however, was not the same as that in which the pipe had been laid, for we were unable to obtain any of the latter.

The results also confirm the practical experience that a protective action is exerted by a peaty soil, though this protective action is not very great.

The lead after exposure to peat and water was covered with a faint black film, as if it had been exposed to the action of sulphuretted hydrogen; it is probably the formation of this film which protects the lead to some extent from the action of the water.

(5.) The most important result, however, is the great protective action exerted by sand, calcium carbonate, old mortar, calcium silicate, and a mixture of sand and calcium carbonate. As regards sand, this confirms the results already obtained by Crookes, Odling, and Tidy, and detailed in the report already referred to.

In this report they show that the action of soft water on lead is regulated by the amount of silica contained in the water, and also that the most effectual way to silicate a water is to pass it over a mixture of flints and limestone.

They do not, however, give any reason or experiment to show why a mixture of these two should be more effectual than either alone. Now calcium carbonate and sand are about equal as to their protective powers, therefore a *mere mixture* of them should not be any more efficient than either alone. But the above results show that a mixture *is* a better protective substance. We believe that the true explanation is to be found in the formation of calcium silicate. This appears to be proved by the fact that calcium silicate itself, either as such or in the form of old mortar, is more effective than either calcium carbonate or silica separately: thus, taking the mean of all the determinations in Series I. to IV., we have :—

Sand (silica) .... = ·011 } About equal.
Calcium carbonate............ = ·010 }
Old mortar.................... = ·007 } About equal.
Sand and calcium carbonate = ·006 }

This was further confirmed by a series of experiments made specially for the purpose of testing this result. The mean of four separate experiments in each case gave as follows :—

Sand (silica) .... = ·010 } About equal.
Calcium carbonate............ = ·013 }
Calcium carbonate and sand = ·006 } (Compare also sect. 7).
Calcium silicate .... = ·0043 }

The results fully account for the great difference in the corrosive action of new mortar (slaked lime and sand) and old mortar (calcium silicate, calcium carbonate, and sand), the action in the latter case being from 20 to 40 times less than in the former.

(6.) The protective action of sand, calcium carbonate, calcium silicate, and of a mixture of calcium carbonate and sand, even in the presence of nitrates, and more especially of ammonium nitrate, is rendered evident by the fifth series of experiments.

Thus the presence of calcium silicate altogether prevents the corrosive action of both potassium and ammonium nitrates, so that the lead is no more affected than if calcium silicate were used alone.

Sand and a mixture of calcium carbonate and sand have a similar action, though it is scarcely so marked as with calcium silicate or with calcium carbonate. Thus, taking the averages of all the experiments, we have :—

Sand .... = ·017 }
Calcium carbonate and sand = ·008 } In presence of
Calcium carbonate.......... = ·006 } KNO_3 and $NH_4.NO_3$.
Calcium silicate .... = ·005 }

This, therefore, is further confirmation of the conclusions given in sect. 5 as to the relative protective action of these substances.

One curious result should be noticed :—viz., the great protective action exerted by calcium carbonate in presence of potassium and ammonium nitrates, being less than a mixture of sand and calcium carbonate.

Now, this is a curious result, considering that calcium carbonate is not so protective as a mixture of sand and calcium carbonate when in presence of distilled water.

The probable explanation of this is, that as calcium carbonate is not perfectly insoluble in water, the small quantity in solution may act on the ammonium nitrate and mutual decomposition take place, forming calcium nitrate and ammonium carbonate.

As calcium nitrate is not so corrosive as ammonium nitrate, and as ammonium carbonate is a great protective agent even in small quantities (as proved by Dr. R. D. Thomson, *see* Crookes, Odling, and Tidy's report, page 23), this may possibly be the explanation.

(7.) The protective action of calcium carbonate does not seem to depend on the presence of carbonic acid with the formation of the bicarbonate, since it appears to be equally effective when air is excluded.

(8.) The protective action exerted by magnesium oxide is very remarkable. In this respect it is equal to calcium silicate. One would rather have expected otherwise, since calcium oxide has such a powerful corrosive action. The magnesium oxide contained only a very small quantity of carbonate, which could not easily be avoided.

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The next meeting will be held on February 8, 1888.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held at Mason College, Birmingham, on the 14th December 1887.

MR. CHARLES HUNT IN THE CHAIR.

ON WATER GAS FOR HEATING AND ILLUMINATING.

BY ALFRED WILSON, ENGINEER, STAFFORD.

In the Wilson gas producer, which has at various times been described in communications to this Society, fuel is gasified by the agency of a mixture of air and steam which is injected continuously at the lower part. In various other forms of gas producer in which producer or generator gas is made, water or steam is also used in conjunction with air for decomposing the fuel. In producers worked in this way the steam serves several useful purposes, one of which is to promote a forced current and increase the speed of combustion, and another is to keep down the temperature of the fuel to a certain proper point.

The steam is decomposed and increases the proportion of hydrogen in the gas as compared to what would result if air alone was used. A knowledge of these circumstances has caused the gas so produced to be not unfrequently styled water gas, and a certain amount of confusion has consequently arisen which it is desirable should be removed by a short reference to the subject of nomenclature. The mixture of gases, some of them combustible and some incombustible, made by the action of air alone or of mixtures of air and steam on fuel in a continuous manner, and containing more than 50 per cent. of nitrogen, is properly styled producer gas or generator gas, whilst the mixture of gases produced by the action of steam alone on fuel maintained in an incandescent state, either by conduction or periodical revivifying by means of air, is properly termed water gas, and such gas contains practically no nitrogen, and is almost wholly composed of combustibles.

The only other mixture of combustible gases which is commonly used (if the natural gas from America and other wells in the earth is for the moment excepted) is the gas manufactured by distillation in retorts in almost all our towns, and which is so well known as coal gas. This latter mixture of gases also consists almost wholly of combustibles. To more readily make a comparison of these three kinds of gas so largely used, and which, as before mentioned, are all of them mixtures, a table is subjoined giving in detail their composition by analysis and other physical characteristics and their thermal value.

COMPOUND GASES.

—	Composition of 100 parts by Volume.						Per-centage of Combustible.	Cub. ft. in 1 lb.	Cub. ft. air to burn 1 cub. ft.	Fah. units per 1 cub. ft. of Gas.
	N	H	CO_2	CO	CH_4	C_2H_4 &c.				
Coal Gas	—	48	—	8·0	36·0	3·8	95·80	30	5·20	694
Water Gas . . .	3·7	48·6	3·3	44	0·4	—	93·00	107	2·20	293
Producer Gas from Coal . .	56·11	11·55	4·00	26·89	1·45	—	39·89	14	1·10	140

Many interesting and important points might be evolved by taking these comparative figures as a basis of a treatise on combustible gases in general as commercially employed, but they are here introduced for the purpose of assisting in facilitating the wider employment of a fixed definition well understood. The object of the present paper is particularly to refer to only one of these mixtures, viz., water gas.

When steam is passed through incandescent fuel, there is first produced hydrogen and carbonic acid, the latter gas on further contact with hot fuel decomposing additional carbon and issuing together as a mixture of hydrogen and carbonic oxide. This is essentially water gas; but on a manufacturing scale the reaction is not absolutely perfect, and some 5 to 8 per cent. of impurities exist, as indicated by the analysis above given. This reaction, by which water gas is made on an industrial scale, has been well known for many years, and practised largely in the United States, and to some extent in Europe, and experimentally in this country. In England, however, no plant has been erected till within the last few months, unless on a very limited scale, which possessed elements of durability in construction and economy in working, sufficiently marked to enable the process to become a permanent industry.

It is the object of the present paper to describe a development of water gas-making plant as adapted to European conditions and requirements, which may fairly be claimed to have established its reputation by years of uninterrupted successful commercial use. It is to be regretted that the honour of having obtained this practical success cannot be claimed by British chemists or engineers. Endeavours were made many years since here in Birmingham to establish the water gas plant of the American inventors, Messrs. Lowe and Strong, but it could not take root, and it has been at Essen, in sight of the factory of the indomitable Krupp, that German engineers have patiently worked the matter out to its present form.

In decomposing ordinary fuel it is always the incombustible residue, ashes or slags, that constitute the rock on which the reforming inventor's ship is sure to strike. The materials naturally provided for the use of man are held to have a constitution perfect for his ultimate need when his laboratory is sufficiently powerful in research to lay bare the plan of their most complex structures; if this is so, every furnace engineer or owner must needs hope that an early understanding may be arrived at in the case of coal, so that the advantages of the presence of its many impurities, up to now so obscure, may be realised and turned to profit.

In the manufacture of water gas in a chamber containing fuel through which air alone and the steam alone is alternately caused to pass, the difficulty of the clinkers was a serious one, because the temperature is at times sufficient to melt the scoriæ, and again so much reduced as to cause it to set into masses liable to adhere to brickwork, and thereby cause much wear and tear. Probably this was one reason that promoted the earliest successful use of water gas plant in the United States, because anthracite coal, which contains so little ash, was largely used as fuel for the purpose. The following is an analysis of anthracite coal:—

Carbon	92·56
Hydrogen	3·33
Oxygen	2·53
Ash	1·58

The gas produced from this fuel, and having an analysis similar to what is given in the above table, is then carburetted by means of cheap kinds of petroleum, stored and distributed like coal gas, and exclusively used in at least 200 towns in the United States.

In a paper read during the present year before the Ohio Gas Light Association by Mr. G. H. Christian, it is stated that on a daily make of 300,000 cubic feet of such gas of 20 candle-power, 1,000 cubic feet are produced from 50 lbs. of hard coal or coke and four gallons of naphtha, the naphtha costing $3\frac{7}{8}$ cents (= 2*d.*) per gallon.

In a report by a committee of the Franklin Institute, it is stated that the judges had submitted samples of carburetted water gas used by the Siemens-Lungren Gas Light Company to photometric examination, with the following results:—

Gas consumption per hour	3·9 cub. ft.
Ignition pressure	0·15 inches.
Candle power for 5 cub. ft. per hour	23·50 candles.
Candles per cub. ft	4·7 „

A short description may now be given of the types of water gas generators erected in Europe, as illustrated by the diagrams.

These consist of three modifications, adapted to small, moderate, and large productions. Fig. 1 represents the smallest size of generator adapted for a production of 300 cubic feet of water gas per hour. The fuel, which is coke, breeze, or anthracite, is fed by the opening at A as required, so as to keep the generator B about full. Air is injected below the grate at C, and the heat from the waste gases is abstracted by the regenerator D before escaping by the chimney E. Additional air is supplied at point S to burn the generator gas. When the fuel has thus been raised to the necessary heat, steam or water is caused to pass in at H, traversing the regenerator and subsequently the column of fuel, where the decomposition is effected, and the resulting water gas passes out at K, through a water lute check to the scrubber. The heating up by the blast occupies 10 minutes, and the manufacture of water gas alternate five minutes; the reversal being accompanied by the changing of the two dampers N, N. This apparatus measures externally only 4 ft. 6 in. by 3 ft., and as the blowing up can be done by a man with a foot-blower such as is capable of blowing one blacksmith's fire, and the steam obtained by allowing water to flow into the regenerator, the apparatus may be worked without any steam power, and is adapted to small applications such as laboratories or for lighting isolated houses or other buildings.

Fig. 2 illustrates a generator for a production of 2,000 cub. ft. per hour, and the water gas burning here this evening was made in an apparatus of this size, erected by the author at Stafford.

The external diameter of the shaft is about 3 feet, and the total height about 16 feet from the ground line to the charging platform on the top. In this case, it being understood that the generator is filled with coke from top to bottom and ignited at the hearth, a steam jet exhauster A is used, which sucks air in at the bottom and through the column of fuel, discharging the resulting products of combustion by the funnel B into the atmosphere. The inlet for the air and the outlet for the products of combustion are both opened and closed by slide-valves, coupled together so that one movement of a wheel closes or opens both simultaneously.

The blowing up to raise the lower part of the column of fuel to incandescence having proceeded for 10 minutes, the wheel is reversed and the steam shut off from the exhauster and directed into the top of the generator by means of a valve coupled to the same wheel as the air-valves just described. In this case no superheater for the steam is used ; it at once descends the column of coke, and having effected the mutual decomposition with the carbon of the fuel, passes out at the bottom by the outlet pipe C, which dips 9 ins. below water in a lute box. This seal acts as a self-acting valve which neither the pressure of the gas from the gasholder nor the suction of the steam jet is able to force, thus precluding any danger of gas leaking back when once made, or of air passing towards the scrubber. From the top of this lute box the gas passes to a water scrubber of ordinary construction, which in this case is 3 ft. diameter and 9 ft. high, and thence to the gasholder. The pressure of steam used is from 30 to 50 lbs. per square inch, and the pressure of gas in the holder to 2½ inch water column.

In making gas all the attendant has to do, therefore, is to turn the hand-wheel round at intervals of 5 and 10 minutes, and to charge fuel into the generator by the opening at the top every hour or two, when it has sunk to two or three feet from the top. When this generator is worked continuously the yield of gas is about 25,000 cub. ft. from each ton of coke, containing 14 per cent. ash, and 5 per cent. water. There is a water ring surrounding the lower part of the generator, which protects that part most exposed to heat and to destruction by the clinkers. This water ring is arranged so that beneath it there is an open annular space, round which the air enters during the blowing operation ; it is also by this that the water gas passes to the outlet during the next process. The slag is thus deposited on the conical surface of the fuel in a covering which extends up to the opening of the water ring, and the cinders may be easily withdrawn by means of four cleaning-out doors of the usual Morton construction, as used for gas retorts. The cleaning out is done every six hours, and occupies from 10 to 20 minutes, according to the amount of cinder produced.

The cooling ring does not lead to much loss of heat, as might at first glance be surmised, for the following reasons : When the cold air is passing in at the bottom it cannot, of course, be robbed of any heat by the water ring, as this is itself warm, and when the water gas descending at a high temperature occupies the space below the ring, it only gives off such heat to the water as must necessarily be lost at a later stage in the scrubber before arriving at the gasholder. Any actual loss of heat by this cooling ring is due to the radiation from the fuel, but this conical bank becoming on its surface quickly covered by a layer of slag or ashes, radiates to a comparatively small extent. Diagram No. 3 represents the type of generators employed for large productions, and are made in sizes to give 10,000 or 20,000 cub. ft. of water gas per hour each.

In plants of such dimensions the generator gas produced in blowing up the fuel to the necessary heat is not allowed to pass into the atmosphere, as in the small generators just described, but is led away and utilised for the purpose of firing boilers, &c., and as it would be objectionable to have a large mixture of steam in this gas, this class of generator, instead of being exhausted by a steam jet, is blown by a blower or blowing engine. This requires a slightly different arrangement of the various valves, but otherwise the construction of the generator is similar to the small one last described, but larger in diameter and also higher.

A generator of this construction, and capable of making 10,000 cub. ft. per hour, was first erected at the works of Messrs. Schulz, Knaudt, and Co. at Essen, three or four years ago, and has since then remained in continuous work, as also a second one which was added.

At first a regenerator of brickwork was employed in conjunction with the generator, heated by the hot gas which escapes when the air is blown in, intended to superheat the steam serving for the production of water gas, and this steam did not pass through the incandescent fuel except after being so superheated. Much wear and tear was, however, experienced in this regenerator owing to the fluxing action of the cindery dust carried over, and it was abandoned with very beneficial results. The product of water gas was in fact doubled without any sensible increase in the consumption of fuel per thousand cubic feet.

The plan now adopted, therefore, is to make the generators high, so that the column of fuel forms a regenerator necessitating no other, and reducing the arrangement to the most simple form.

In order to prevent any danger of the blast passing by leakage along with the gas, an ingenious and highly successful slide-valve was introduced by Mr. Blass of Essen. The construction of this is indicated on diagram No. 4, by which it will be observed to consist of a D-valve, sliding on three ports, and provided with an open water-trough to keep it cool, whilst in the face of the valve between the ports grooves are cut, so that any leakage of air or gas respectively must pass to the atmosphere instead of forming mixtures in the pipes, which might prove dangerous. When once the charge is heated up, the steam is admitted for the production of water gas for about five minutes, when the valves are reversed simultaneously, and the charge is blown up to restore heat during about 10 minutes, the various movements of the apparatus being all controlled in a convenient manner by one lever or hand-wheel. Owing to this construction the generator is converted into a machine, and for three years its mechanism has worked with perfect regularity, whilst the repairs needed by the brick-lining have been of a most trifling description.

The next plant put to work was erected at Witkowitz Iron and Steel Works in Austria, and consisted at first of two generators, each capable of making 20,000 ft. of water gas per hour, also the necessary scrubber and gas holder. In this case the water gas is used for driving open-hearth steel melting furnaces, and for lighting the works on the incandescent system, which will be shortly described, whilst the generator gas is used for firing boilers.

A flame of coal gas, with the same speed of consumption, possesses a surface six times as large as the water gas flame ; and although a cubic metre of lighting gas produces theoretically double the heat by its combustion, the temperature of the flame is at the same time much less. Thus, in a small trial furnace, Bessemer steel was easily melted by water gas and cold air, and poured out in a perfectly fluid state. But the best proof which it is possible to have of the high temperature of water gas is found in the incandescent magnesia light on Fahnehjelm's system. This constitutes an excellent system of gas lighting by incandescence, such as I have the pleasure of exhibiting here this evening. This light possesses, as will be observed, the advantage of absolute steadiness. This follows from the circumstance of having a certain mass of matter in an incandescent state, requiring an appreciable time to cool it, and to effect a variation in the power of the light, and consequently preventing any irregularity in the luminosity of the flame.

In order to obtain the same quantity of light by this system, it is necessary to consume the same quantity of gas as of coal gas. With a consumption of 150 litres per hour (= 5·3 cub. ft.) a magnesia comb gives at first a photometric power of from 20 to 22 candles; after 50 hours it gives but 15 candles; and after 100 hours only 10. The combs cost 1½*d.* each, so that their consumption amounts to 2¼*d.* per 1,000 cubic feet.

The magnesia comb is supported by a wire slipped into a socket on the carrier of an ordinary gas bracket. The burners used are exactly the same as those used for town gas, and so are the globes and all the fittings concerned. In substituting lighting by incandescence with water gas, therefore, no changes whatever are necessary in the existing pipes and gas fittings. The magnesia combs, being quite loose, may be removed and replaced in a moment.

The burners are Bray's No. 3.

As before mentioned, this system of lighting has been adopted with great success at several large works on the Continent, and it is also largely used in America; and seeing that it offers a convenient and beautiful means of illuminating, possessing the convenience of town gas with the brilliancy of the electric light, at the lowest cost of either, it must commend itself for adoption in this country also.

In connexion with the general aspect of this subject it may be remarked that much attention is now being bestowed upon it, as the pure and steady brilliance of the incandescent electric lamp has thrown into unfavourable contrast the ordinary pulsating gas flame, and stimulated inventive research in the direction of incandescent lighting by gas.

There appears no probability that electric lighting for domestic application from house to house will, at any early date, be able to compete in cost with gas lighting, and the further the incandescent system of gas lighting develops, the more distant will that day become. Amongst several kinds of burner lately introduced for incandescent lighting, five of the most distinguished may be enumerated.

1. The platinum wire hood of Professor Lowe, of Philadelphia.
2. The magnesia comb of Otto Fahnehjelm, of Stockholm, composed of rods of calcined magnesia.
3. The cylindrical net of Professor Von Welsbach, of Vienna, consisting of a woven net saturated with a salt of zirconium, &c.
4. The woven conical magnesia hood of Mr. C. Clamond, of Paris, composed of a conical basket of calcined magnesia thread supported by platinum carrier.
5. The Lewis Sellon cone of metal gauge composed of a wire gauze cap of an alloy of platinum iridium.

As so far employed, the first two of these systems are used with ordinary burners and water gas, and the last three with Bunsen burners and coal gas, and their relative photometric efficiency, excepting the first one, varies between four and nine candles per cubic foot of gas burnt per hour.

The respective advantages of these burners, considered collaterally with their photometric efficiency, are controlled from an economic view by their relative endurance and first cost.

Those burners which consist of refractory metals are relatively expensive at first, but last the longest, whilst the mantles made of refractory oxides, being bad conductors and good radiators, have the advantage in illuminating power, but at present at the expense of durability. Looking at the efficiency of these various systems relatively with ordinary gas lights, and taking them all simply as machines for converting heat into light, which appears to be a useful test, the following table has been prepared to show approximately the number of heat units required per hour to produce one-candle power by various ordinary and incandescent arrangements. From this it at once becomes clear that the incandescent system is essentially the one for producing the most light with the least heat.

Light.	Units of Heat per 1 cubic ft. of Gas burnt.	Candle power per hour per 1 cubic ft. of Gas.	Units of Heat to produce one-candle power per hour.
Flat flame …………	694	2	347
Argand ……………	694	2·2	315
Siemens' regenerative.	694	2·6	266
Lowe's platinum……	293	1·4	209
Wenham …………	694	4·5	154
Clamond …………	694	5·0	138
Lewis Sellon ………	694	5·0	138
Welsbach …………	694	7·0	99
Fahnehjelm ………	293	3·5	83

It may be well, before concluding, to revert shortly to the economic aspect of the question of the use of water gas in large quantities for large furnaces and manufacturing purposes, as compared with the cost of gaseous fuel at present generally used for the same purposes.

The most approved and economical types of generator for making producer gas are worked by a mixture of air and steam, and make in reality a mixture of producer and water gas simultaneously.

The water gas generators are alternately worked by air by itself to make producer gas, and then by steam by itself, producing water gas; thus the same gases are ultimately produced by each system, but in the water gas plant they are separated. As the cost of the fuel and attendance is about the same in each case, as is also the loss of heat by external radiation, there can be no material difference in the value of the heating gas produced by either system at a given cost for fuel and otherwise. Thus in the manufacture of water gas, when this is averaged together with the producer gas necessarily generated in the operation, the cost of the water gas is, as demonstrated below, practically the same as that of the mixture known as generator or producer gas; and it cannot, therefore, be more expensive to use water gas for any operation than producer gas, when the value of the latter, also produced by the water gas plant, is credited, as it can be in any works where there are boilers, &c. to be fired.

At the same time, the separation of these gases, so as to have the water gas by itself, has very important collateral advantages and economies which are of great value.

In the manufacture of water gas, if the water gas and the producer gas, also made separately, are subsequently mixed, the analysis of the mixture is substantially almost identical with producer gas made in the best and most economical manner, thus proving that the heating value of the gas made from the fuel is the same by each system, and the value received practically equal.

Producer Gas.

One ton of slack coal, at 5*s.* 6*d.* per ton, yields of this gas about 150,000 cub. ft.
Equals per 1,000 cub. ft. ………… ……………… 0·41*d.*
or slightly under ½*d.* per 1,000.

WATER GAS.

One ton of inferior coke, at 6s. 3*d.* per ton, yields of this 35,000 cub. ft. of pure water gas, and about 140,000 cub. ft. of generator gas = 175,000 cub. ft.

Equals per 1,000 cub. ft. of the whole of the gas produced.. 0·43*d.*

or slightly under ½*d.* per 1,000.

The cost of steam raising and labour is the same in each system for the same analysis of mixed gases.

If water gas is produced for lighting or heating purposes in small quantities of, say, 5,000 ft. per day, its cost in the holder, reckoning 5 per cent. interest on capital and a small allowance for depreciation as well as fuel, labour, and all other expenses, is about 1*s.* per 1,000 cub. ft.; but if made in quantities exceeding, say, 50,000 ft. per day, or on a large scale, the cost of the gas falls to less than 6*d.* per 1,000 cub. ft. in the holder.

The cost of producing the gas will thus vary in different cases, depending upon the amount produced and the cost of fuel. It is naturally most economical to run each generator to its full capacity continuously. The coke or breeze used may be estimated to cost at present from 7*s.* 6*d.* to 8*s.* per ton, delivered to the consumer, as an average.

Several water gas plants are now in course of erection for various purposes; one near Frankfort is for blowing the glass globes for electric lighting.

Nottingham Section.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held at Nottingham on November 23rd, 1887.

MR. LEWIS T. WRIGHT IN THE CHAIR.

CHAIRMAN'S OPENING ADDRESS.

THE many technical uses to which the various hydrocarbons are put, and especially the interest that always surrounds the aromatic hydrocarbons, make the numerous and valuable investigations of the last few years into the composition of petroleum oils and the tars resulting from the destructive distillation of fossil vegetable matters very welcome additions to our knowledge, and will help us soon to a clear comprehension of what Dr. Armstrong calls the "genesis of the hydrocarbons." The importance of the petroleum, paraffin, and coal tar industries, and the scientific researches of Beilstein, Markownikow, and others into the composition of the naturally occurring hydrocarbons, and the work of Armstrong, Watson Smith, and Lunge on the tars resulting from the destructive distillation or partial combustion of coal under varying circumstances, have given us a clearer insight into the origin of the hydrocarbons, and their pyrogenic relations one to the other, than we had five years since. We now know that if we distil coal and allied substances at very low temperatures we shall procure large quantities of hydrocarbons of the paraffin series, with some olefines and those naphthenes having the same general formula as the olefine hydrocarbons, until recently thought to be a new class of hydrocarbons, but now, thanks to the labours of Markownikow, Konowalow, and others, known to be hydrocarbons of the benzene series and the same as those known as the hexahydrobenzenes; and that the more we increase the temperature of distillation the more are the paraffins destroyed, being replaced to a large extent by aromatic hydrocarbons. I am inclined to think that the hexahydrobenzenes are a link in the chain of pyrogenic events resulting in the formation of the hydrocarbons of the benzene series in company with other hydrocarbons containing two or more benzol nuclei. The general character of the petroleum oils from various localities, and the fact that the variations in the relative proportions of the different classes of hydrocarbons of these are similar, and always in the same direction as the variations we find to take place with the oils resulting from the destructive distillation of coal at comparatively low temperatures, incline me to the opinion that these petroleum oils are the result of the destructive distillation of coal *in situ* by volcanic heat, and that the deposits of anthracitic coal represent the coke left as solid residue. The tars resulting from this subterranean distillation have, in being filtered through the rocks of various formations, and by coming in contact with water, lost some of their soluble constituents—such as the alkaloid and phenoloid bodies. What the effect of the immense pressure under which this action must have taken place may have been, there is not much information to guide us; but increased pressure will probably be found to be equal in effect to a lowering of the temperature.

Within the period covered by the foundation of this Society, our knowledge of the theory of destructive distillation has considerably advanced, and we now know the class of bodies to expect to predominate at various temperatures of distillation. We know that a particular temperature is favourable to the formation of particular bodies, and that a temperature exceeding this most favourable temperature will result in the diminution of these bodies and the increased formation of others. The oxygenated bodies—such as the phenols, &c.—are certainly decreased in amount at high temperatures. What becomes of the *debris* of these destroyed phenoloid bodies is not yet known; but the answer, when it comes, will not be without value.

Amongst the great advances made by or with the assistance of chemical technology, the application of scientific principles to the combustion and utilisation of the coal of which this country is the greatest producer, have not been the least. For many years the gases discharged into the air from the mouths of our blast furnaces were lost to us, though it seemed but a simple matter to utilise them for fuel purposes in the heating of the blast and raising of steam. However, the economy, so far, that has resulted from their utilisation amounts, as we have been told by Sir Lowthian Bell, to an annual saving of 6,000,000 tons of coal. The magnitude of this saving will be the more real to us if we consider that it is in amount equal to two-thirds of the total quantity of coal carbonised in the United Kingdom for the manufacture of coal gas in gasworks. Latterly, further attempts have been made to extract wealth from these blast furnaces. The immense wave of manufacturing activity, which seemed to be at its summit nine years ago, had brought the prices of ammonia, benzol, anthracene, and pitch, which were then only recovered in gasworks, to such a high figure, that the waste gases of our furnace, and even domestic fires, glimmered as mines of wealth before the eyes of chemists and capitalists. The attempts to recover some portion of these waste products were barely brought into execution on the fall of the wave. How many millions of pounds all these waste products would have been worth to us if recovered, and if prices had not fallen in obedience to inexorable laws, I hardly like to suggest; but it would have been something like 25,000,000*l.* per annum. Whatever justification the attempts at the recovery of waste products may have had at the time of their initiation, they are of doubtful economy now. The immense volume of the gases to be dealt with and cooled entails large and costly plant, and a great loss of heat. It is interesting to note that the amount of ammonia contained in blast-furnace gases is similar to that contained in coal gas; thus showing that about the same per-centage of the total nitrogen of the coal comes into evidence as ammonia when coal is entirely distilled in closed vessels, or suffers but a partial combustion in the blast furnaces. I do not say that the quantity of ammonia in blast-furnace gases was not known many years ago; but it is only of very recent years that we have practical demonstration of the amount on a large scale. The tar yielded by blast furnaces is not of great industrial value; the pitch it yields is sadly wanting in the agglomerating properties requisite for the fabrication of briquettes of patent fuel, which is the chief use to which this material is applied; and the hydrocarbons in this tar are not of the most valuable kind. The same remarks apply to the collection of waste products from producer gases. There seems to have been far more justification for the attempts made to recover the waste products from coke-ovens; for when coal is carbonised in long, narrow coking-chambers of the Coppée type—such as are found in the Otto-Hofmann and Simon-Carvès coking ovens—the volume of gases per ton of coal is smaller even than with coal as distilled in gasworks. That the the oven coke made in this country, which is said to amount to 12 million tons per annum, will in the near future be made in ovens especially adapted to the recovery of the useful constituents of the now wasted gases, and that the tars produced will be similar to the best gas-retort tars, there can be no manner of doubt. We are all perfectly alive to the fact that the world at this moment is utterly unable to absorb all the useful articles that can be manufactured in this country from 20 million tons of coal; but let us think that these uses are quite modern, and that the men who founded them are still among us comparatively young and active. The wave of civilisation is a wave of translation, and, like all waves, is made up of summits and valleys; but its progress is ever forward—

> "Ras't nicht die Welt in allen
> Strömen fort ——?"

We cannot stand still—we must go forward; and though we are at the bottom of a valley in the wave, we shall soon be rising again to a period of activity that must surpass all our past experiences—a period of activity in which chemists will play a very prominent part. I am inclined to think that we shall not have very many years to wait for an age that will readily absorb all that is now known to be useful in the gases resulting from the distillation or semi-distillation of coal, and when we shall be distinctly nearer the Elysium of the chemist—no waste products. A period of increased commercial activity will bring a greater demand for all articles useful to mankind. Coal will be dearer, and there will be all the more reason to extract everything valuable that can be obtained from it.

It may appear curious that the new method of consuming solid fuels, which I have called the "fractional" method—wherein the solid fuel is first supplied with one half of the air needed to completely consume the requisite quantity of carbon, so as to produce first the monoxide of carbon, and then the second half of the air is introduced to consume the carbon monoxide into carbon dioxide—has not found almost universal application.

This fractional method of combustion is known to be very superior to the older system of supplying the air all in one dose, so as to burn the carbon at once into carbon dioxide *en bloc*—a method which cannot be carried out perfectly in practice on account of the solid state of the one element in the reaction. In certain industrial processes this fractional method of combustion is largely employed; and much of its success doubtless hangs upon the ease with which the heat in the waste gases can be transferred into the secondary and even primary air required for the combustion of the fuel. Whilst this system of regeneration has been identified with the name of Messrs. Siemens, we must distinguish between their alternate method of regeneration, wherein the waste gases are led into a chamber until it is sufficiently heated, and then turned into another chamber, whilst the incoming air is passed through the chamber just heated by the waste gases, and so on, and the continuous method, wherein the air to be heated is always passing through the same channels, which are "sandwiched" between flues conveying the waste gases. Whilst the alternate method may have its advantages in special cases, the continuous method is no doubt the better. The final result of the systems of furnaces wherein the fuel is fractionally consumed in combination with regenerators or recuperators is the high resulting temperature, its regularity, and the great economy in the consumption of fuel. For purposes such as the raising of steam, where the waste gases, when they have completed their work, have a comparatively low temperature, the use of the fractional method with regeneration has been but very partially employed. If we consider that, in any process requiring a certain elevated temperature, the heating gases leave the process at a temperature more or less higher than that at which the required reaction is taking place, and that the higher the temperature required for the process to take place, the greater will be the heat in the waste gases, and the more obvious will be the reasons for transferring it into the incoming air. Whatever may have been the case 40 years ago, with old-fashioned boilers badly set, I believe now, with proper steam appliances, it is not impossible to obtain an efficiency of 75 to 85 per cent. of the calculated calorific power of the fuel in the water. Allowing for radiation and conduction of heat, which would be more on the gas-producer system if the producer were outside the boiler (as it would have to be with the present types), and allowing for the necessary amount of heat in the chimney gases to provide draught, there is not much room for economy. Anyhow, our knowledge respecting these matters seems more prominent just now, when fuels are exceptionally cheap, and therefore the economy not so apparent. On all these subjects of coal distillation and utilisation the pages of our *Journal* are well filled with information; and we must wait a bit before we shall see fully utilised all the knowledge that has been steadily accumulating of late years relating to chemical technology.

When Goethe said the world meant something to the capable, he was neatly expressing a truth that is apparent to us all; and there can be no doubt, I suppose, that those who have the good fortune to be the capable ones have before them an ever-ardent desire—the advancement of their species. They do not wish to be alone, the capable ones, but strive to make all so, feeling only by the capability of the all can the all secure its proper place and position in this world's economy and happiness. And thus it is that those who have dipped deeply into the great ocean of knowledge, and found that there are pearls hidden in its most cavernous depths—who have their point of view pitched on some high peak, lonely though it may sometimes be—are always anxious that those whose vision has been bounded by the overhanging sides of the dark ravines may get a glimpse of the world to be conquered. The fountains of knowledge need no jealous guard lest the crowd should drink too freely of their springs. Millions can never drink them dry; their sources are too infinite to ever fail. There is an impression —nay, not an impression, but a solid conviction—in the minds of most of our countrymen, that we have of late been somewhat lagging behind in the pursuit of useful learning; not that old learning of the schools, which groped over the dry fossil bones of an extinct culture, but in the learning of the modern man, who seeks to know the habits of the forces of nature, that he may the better subdue and tame them to the uses as well as the benefit of his race. And now we are all crying out for more instruction in the real, practical knowledge of life, that shall make our people capable of using their hands and brains in the service of the present era of applied sciences. It is said that we are not so well equipped as are our neighbours in the knowledge of the scientific principles upon the application of which our manufactures are really built up, and that we are going to be beaten in the race for wealth, or already have been beaten by these said neighbours, who have been more diligently and in better season sowing the seeds of these artistic and scientific principles in the great industrial fields of practice. How far is it true that in this special sense our people are less instructed than other peoples? Whilst I would be the first to claim for this country the proud possession of individuals—captains of industries—who, judged by the highest standard you like to apply, are superior, in both the theoretical and the practical knowledge of their special industries, to any that might be the boast of other nations, yet I do not think we have so numerous a second and third grade of scientifically educated subalterns; and this makes our average low. At the same time, I must say, in defence of our working and artisan classes, as the result of my experience, that they possess a large intelligence, readiness, handiness, and a bountiful share of intuition, qualities often enabling them to unconsciously see their way through complicated mechanical and other problems that would require somewhat laborious calculation from a scientifically-trained mind. Nor must we forget that our great industries have been built up by the energy, intelligence, and manliness of men who, if they have not actually always been working men in the strictest sense of the word, have yet sprung directly out of the loins of the working classes. I have often observed that by what we call education—I mean the *curriculum* of the schools—a man loses intuition as he gains his severe scientific mental training. It may not be your experience, but it certainly is mine. I have often been startled by the manner in which a workman will hit out, as it were, without knowing why, the cause of some little disturbance in some complicated operation, whilst absolutely unable to explain, even to himself, the manner in which he has mentally resolved the idea. He simply feels that it is so. I know that intuition often leads one deeply astray—the misses may be more than the hits; but so do the best methods of mental analysis, if they are not rigorously controlled. It is just this power of control, however, that gives the scientific method the great pull. Whilst defending the old intuitive rule-of-thumb system, which was admirable, coming as it did from a people of such personal character and energy as ours, and whilst I shall deplore the loss of that intuition, and those flashes of invention called genius, which I feel a high scientific training will bring about, yet I know that the gain will be greater than the loss, because our large industries have reached a stage when the things likely to be discovered intuitively have mostly been discovered, and there is now only room for those things that can be brought to light by plodding research or pure chance, which latter is always, in the long run, an undesirable element to rely on.

Let us consider the case of a manufacture in which it is granted we are excelled by our German friends, viz., the manufacture of coal-tar colours, a manufacture demanding for its prosecution on any lines whatever the highest attainable knowledge of one of the most recondite of sciences—organic chemistry. This is distinctly one of those businesses in which intuition and rule-of-thumb alone would simply be paralysed, and, *per contra*, of all industries the one in which the triumph of highly-trained brain power is the most unmistakeable. Why should the Germans have largely monopolised this business? Because they possessed to the largest extent the knowledge wherewith to carry it on. Whilst we have the raw material, they possess the magic ferment that will transmute it into wealth. What could have been to the busy manufacturer in the days when organic chemistry was first budding forth, a more uninviting or apparently unprofitable study than the synthesis of urea? But the labours of Wöhler and Liebig were not in vain, for the seedling they reared and fostered became in the Fatherland an indigenous plant that is now yielding a golden harvest. Nor should we envy them their harvest; for whilst they were absorbed in abstract studies, which seemed then never likely to emerge from the laboratory, were not our engineers and mechanics building the ships and railways, and gas and water works, of the world? That we can now, as we stand, wring from the Germans their pre-eminence in this particular manufacture seems almost impossible. We have not the *personel* wherewith to organise a comprehensive Farbenfabrik; and, besides, do not they hold the very patents—the right to manufacture most of these things? There is some hope of the alizarine trade being well established here; but that is a comparatively simple manufacture. It seems to me an anomalous state of things that a foreigner can secure a patent in this country, affording him every protection against infringement, for an article that he never manufactures here, but only sells; and I think it is a question for grave consideration whether such patent protection should be provided in this country for foreign manufactures. If our people are not so well instructed in the scientific principles that must be an essential foundation to successful modern industries, how are we to remedy the defect?

By technical education, we are told. I often wish that we could have the term "technical education" precisely defined, for I am not quite sure that by "technical education" we all understand the same thing. Were not some of the Continental schools that we have heard about largely founded to originate classes of skilled labour, till then not existent? In that sense the foundation of schools of electrical engineering were lately an absolute necessity in this country; and I believe the Finsbury Schools of the City and Guilds of London Institute will be found to have been of immense benefit to our country. But schools of iron and steel manufactures, or of shipbuilding, of cotton spinning or weaving, &c., would be an absolute failure here. The best schools are the workshops of these industries, which are naturally established here because we understand them; and, in spite of all that pessimists may say to the contrary, I do believe we understand them. If our iron and steel industries were to combine to found a school for teaching the practice and theory of these industries, how long would that school represent the best existing practice? It would be like building a traction-engine with the wheels on one side smaller than those on the other side, and wearing away at a faster rate. The practical wheels on the one side would always be getting smaller, whilst the theoretical wheels would be perhaps getting larger, and the locomotive would be describing circles of continually diminishing radius.

It seems to me that, to benefit our established industries, we require for all classes concerned a large and liberal scientific instruction in mathematics, mechanics, drawing, chemistry (both theoretical and analytical), and physics, which must be made readily available to all our working classes. We should want these sciences thrown open to all in a kindly sympathetic way; and they should be dealt with in a truly practical manner—always leaning to the practical side, and seeking for illustrations, applications, and demonstrations from actual manufacturing processes, supplemented with lectures in the larger institutions, from men actually engaged in, and conversant with technological pursuits. We want in every locality schools of science teaching where no cold, lifeless *pabulum* will be dealt out; not like the school—the white house on the hill—spoken of in "Contarini Fleming," where they teach words, but places where there can be grafted in the minds of the student real, living ideas that will fructify and bear fruit.

And we must remember that, in raising the tone of the industrial classes, we shall be raising the tone of those who have already been able to secure the blessings of higher education. Do we not learn from others, even from the humblest? Are we not more indebted to others than to ourselves for what we know?

"Und was man ist das blieb man Andern schuldig."

In raising the cultivation of the masses, the educated classes will gain much, for the higher the degree of cultivation of those around us, the higher will be ours; and natural selection will still play its usual part. It would not be difficult to give a young man more knowledge of chemistry than Lavoisier or Davy ever had; but had these men lived to-day, would they not still be Lavoisier and Davy? I am quite sure the members of this Society of ours will not be wanting in the efforts they will have to make to keep the application of the science of chemistry to useful purposes in this country at the highest possible level; and I think we may be permitted to unite in a feeling of pride for the work it has already performed in the comparatively short period of its existence. I must appeal to you all to maintain the position of this Section amongst the others; and, in doing so, I feel sure of your loyalty to the aim that we had in founding this Society, viz., the advancement of the knowledge necessary for the utilisation of chemical action on a large scale.

DISCUSSION.

Dr. Clowes wished to congratulate their new Chairman and to thank him for the address which he had prepared for the Society. The portion of the address treating on technical education was of special interest to many members present: the question as to what were the best methods of imparting technical education in chemistry was still an open one, and free expression of opinion would be of value.

At the University College he had always insisted on the necessity of acquiring a knowledge of the principles of chemistry, and of allied sciences, before proceeding to study applied chemistry. And in framing the instruction in the branches of technical chemistry, the chemical lecturers had invariably concurred in teaching the applications of chemistry to each particular industry, and had never entertained the idea of teaching manipulation and methods which a workman would learn better in the dyehouse, the brewery, or the works. Probably, when this division of technical training into instruction in scientific principles on the one hand, and experience acquired in the works on the other, was more thoroughly understood, both employers and employed would more eagerly avail themselves of the technical scientific courses which had of late years been developed in the educational institutions of all the large centres of population in this country.

Mr. Coleman said if he understood Mr. Wright correctly, he entirely agreed with his views on technical education, *i.e.*, that the aim should be to teach those things which were not taught in the workshop, and to supplement those that were, by pointing out the scientific principles on which workshop practice was based. He thought it simply impossible for a college to take the place of the workshop, and teach technology in a trade sense. The aim should be, first, to teach those sciences, particularly chemistry, that underlay each branch of technology, and then treat the subject as fully and exhaustively as possible from a scientific standpoint, not endeavouring to compete with the workshop teaching, but to supplement it.

With regard to the present system of teaching chemistry, it was an exceedingly difficult matter to remodel it. Students came to a college to prepare, say, for a certain examination, and most examining bodies divided the science in a most arbitrary way into non-metals, metals, and organic chemistry; hence teachers were compelled to some extent to follow this rule. It was, however, a pleasure to notice that some influential colleges had broken through this rule, and also one examining body, viz., the Science and Art Department. So that at no distant time, they might see taught first those things which it was most essential for a chemical student to know, no matter to which of the three *present* divisions they belonged to.

Mr. E. Francis said it was a difficult matter to state precisely what was meant by the term technical education; and it was not easy to frame a course of instruction suitable for schools. Scholars, he was of opinion, learned as much through their fingers as through their eyes. Instruction in the use of all the ordinary wood-working and metal-working tools was of primary importance. With regard to the teaching of technology, he thought that the principles underlying the application of science to special industries should certainly be first taught in schools. There really was no such a thing as one chemistry for dyers and another for brewers, and another for the iron trade; the principles of chemistry were of universal application, and these should receive attention in all schools. Mathematics were equally general, and no teaching in technological subjects could be complete without a study of this branch. The best places to learn technology were those where the particular branches were regularly carried on, *e.g.*, the bleach works, &c.

A great deal might be done in the schools in laying a foundation of scientific truths to enable a student to work with more intelligence in the workshops, but he did not think that any great benefit would accrue from an attempt to turn the schools and laboratories into small dyehouses or miniature manufactories. The students of the School of Mines, after a three years' course in the principles of chemistry and metallurgy, went to Swansea and became attached to the various copper, spelter, and other works for a time, and there learned the processes in actual operation. The principles were learned in the school, and the application in the works.

Mr. Small thought that there was a very prevalent misconception as to the true function of what was termed technical education. Considering the matter from the broad educational point of view, there was perhaps some tendency to begin specialising too soon, before a thorough grasp of elementary principles had been obtained. Comparing our educational system with that of Germany, we had probably as good teaching in many of our colleges and schools, but on the whole fewer students had the advantage of a thoroughly progressive system, passing consequently from lower to higher grade schools. In any consideration of a more extended governmental system of technical education, one of the most important questions would be that of payment by results—in his opinion a great incentive to mere "cramming" in the Science and Art Department schools.

Mr. J. R. Ashwell dissented from some of the opinions expressed about technical schools and technical education. It had been said that workshops were the best schools in which to learn an industry, yet he contended that workshops were the worst schools in which to learn the theoretical principles which governed successful practice. It was to be deplored that technical schools were so often merely miniature workshops. For instance, dyeing was taught in various technical schools in England, but was there *one* school where a definite course of systematic instruction was given upon the properties and formation of coloured lakes considered apart from the fabrics which they dye? The subject was practically ignored in modern English text books. He believed it was equally ignored in technical school dyehouses. There was need for the instructors to be conversant with the scientific as well as the purely commercial aspects of their subjects, but above all, their teaching must be thorough.

There was need for greater specialisation. For instance, the London and City Guilds Institute prescribed courses of study and held examinations in technical subjects, and amongst these were written examinations upon cotton, wool, and silk dyeing. In cotton dyeing, a lace dyer, a hosiery dyer, a yarn dyer, a velvet dyer, a piece dyer, all took the same examination, irrespective of their different styles of work, upon the broad principle that what was unsuitable for one style of work might be of use in another, and therefore all ought to know it. But the hosiery dyer dared not dye chrome yellows and oranges for sanitary reasons, and Prussian blues for commercial reasons; but these colours were needed elsewhere, and therefore the hosiery dyer must be examined in them. Again, the lace dyer obtained many of his colours by passing lace through coloured starch, yet he was treated on the same footing as a velvet dyer, or a piece dyer, or a yarn dyer, or a hosiery dyer. In one style of cotton dyeing it was of minor importance as to whether or not the colours resisted soaping, whilst in another style it was essential that the colours should resist frequent soapings. It would be easy to multiply illustrations of the need for more specialisation as well as for a greater adaptation of technical instruction to commercial ends.

Mr. Wright suggested that here a difficulty would at once arise, for they would require several schools of dyeing. Attempts to teach a man his trade in the school or college must end in failure.

Mr. Pentecost, referring to the coal tar industry, believed that, although in the past the superior chemical knowledge of the Germans had given them a lead in this industry, yet the enterprise of their manufacturers accounted to a large extent for their present superiority. Such enterprise seemed lacking on the part of English manufacturers. With regard to technical education of dyers, he contended that the dyehouse was the best place to carry out experiments and practical work suggested by the knowledge acquired in the technical school. Chemical teaching in the Nottingham schools was more thorough now than at any previous time; and as there was every facility now for youths to attend evening technical classes, he believed that dyers would be more successful 10 years hence than at present. It was comparatively useless to attempt to get the older dyers to their technical schools; but youths and young men with some chemical knowledge, obtained at school, might easily be induced to attend the technical classes. They would thus be enabled not only to bring scientific knowledge to bear upon their business, but also to develop habits of accuracy of measurement and of carefully recording their results for future reference.

Mr. F. C. Humphrys fully agreed with the remarks of the previous speakers with reference to technical education, but the Chairman in his opening remarks had dwelt on various improvements, which, he said, came but slowly into general use. There was a chemical and a commercial side to this question. Improvements such as that noticed, *i.e.*, regenerative firing and many others, were known to be of great advantage, but unfortunately they have their executive committees to educate, and these gentlemen hesitated to sanction anything which might add to capital expenditure. They had also apparatus which, while not the best of its class, was not sufficiently old or worn to warrant its abandonment.

Mr. Curry was particularly struck with one point mentioned by the Chairman, viz., the intuition found in so many workmen. His own experience most fully corroborated it: when a difficulty had occurred in the working of a process, an idea or opinion given by a workman had often solved it at once, yet that workman could not state how his idea originated or the process of reasoning by which he came to the conclusion. He could not, however, agree with some of the speakers when they virtually condemned specialism. Surely when a man had obtained a training in general chemistry it would be better for him to devote his time, energy, and talents to one particular branch of chemical industry, and so obtain as complete a knowledge of the subject as may be obtainable; but if he took a number of branches he could not expect to reach a high standard in all.

Mr. Paton said that one gentleman had spoken of the learning of practical knowledge at the University College. He thought it was all nonsense, and a waste of time to attempt to teach handicrafts or give a workshop training in a college—for it could not be done. It was almost useless to do more than teach the sciences which underlay or pertained to each trade. The trade itself must be learnt in the workshops, among workmen.

Mr. Wright, in reply, said he would rather have a man that had been taught properly the sciences bearing upon his industry than one who had received what was thought in a school to be gas making, but would not be gas making at all. He would like to see the term "technical" education done away with, and another name substituted therefor, for the more one thought of it, the more one saw it could not be done.

He was glad to see that one of the speakers had taken up the question of the intuition of the British workman. Faraday said as he went into the works that his chemistry fell out of his finger ends so surprised was he at the simplicity and beauty of the large scale processes he saw. The Government, he thought, should control and be responsible for the education of the country.

In laboratories one often found people that were very clever as to C. C.'s and grammes, but they could never deal in tons or millions of cubic feet or cubic yards. He thought the attempt to teach trade in schools would tend towards a pedagogic state of affairs. The man of business was, of course, always trying to make money; the scientific man worked only for the love of science, and in this lay the difficulty, unfortunately.

With respect to the patent laws he showed the injustice of them by stating that if they were to start the manufacture of colour, they would be immediately stopped by the representatives of German houses. Protection he thought ought to be removed from colours not manufactured in this country, or they could not hope to see an improvement.

In conclusion he hoped that members would give him some assistance with regard to papers, and that if they could not do so personally, they would get their friends to help; for it would be a bad thing to let the Society go back now, for although, as he had already mentioned, their Section was the smallest, nevertheless they had certainly not been behindhand in the matter of papers. He thought for the prestige of the town, the Section ought to strain every nerve in this respect. His own difficulty was, that although he had sufficient material for several papers, it was purely a question of time in putting them into form.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Hydraulic Blowers for Laboratories. A Beutell, Chem. Zeit. **11**, 1382.

Arzberger's blower, which is commonly used in laboratories, requires a very considerable water pressure, and consumes large quantities of water. The author devised an apparatus, shown in Fig. 1, which gives very satisfactory results with water of a low pressure. The water-tube has two contractions at *b* and *c*, and between these two the tube widens to a small sphere *d*. A small opening, *e*, allows air free admission to the sphere. Below *c* the tube is bent to prevent the air from going backwards. Two points are essential for the efficient working of the pump. The water must pass through the contraction *c* absolutely in the very centre, and the diameter of *b* and *c* must be well proportioned. Experiments showed $d_b = 2{\cdot}5$ mm. and $d_c = 3{\cdot}0$ mm., a good proportion. Fig. 2, which explains itself, shows the manner in which the pump is fixed to act as a blower. The overflow must be so regulated that the cylinder is always half full of water.

Fig. 1

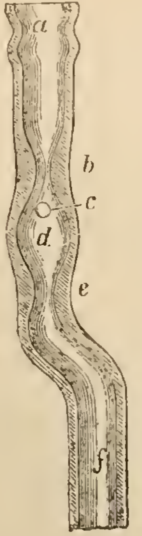
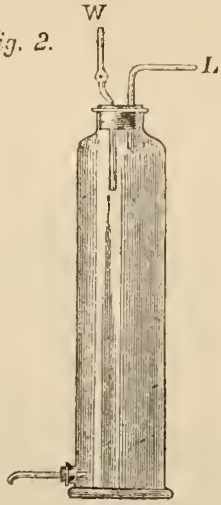


Fig. 2.



Here is a comparison of the working of the two blowers:—

Water Supply: 617 mm. Mercury Pressure.

Arzberger blower yielded per 1 litre of water 0·45 litre of air of 144 mm. water pressure.

Beutell blower yielded per 1 litre of water 0·89 litre of air of 157 mm. water pressure.

Water Supply: 2984 mm. Mercury Pressure.

Arzberger blower yielded per 1 litre of water 0·52 litre of air of 445 mm. water pressure.

Beutell blower yielded per 1 litre of water 0·87 litre of air of 660 mm. water pressure.

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*.	½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*.......	1*d*.
" 1*s*. 6*d*., " " 2*s*. 4*d*.......	1½*d*.
" 2*s*. 4*d*., " " 3*s*. 4*d*.......	2*d*.

It was found that for a high-water pressure the contractions at *b* and *c* should have another proportion to each other, as for a low-water pressure. After many trials d_b = 1·0 mm. and d_c = 2·5 mm. were decided upon, with the following very satisfactory result :—

WATER SUPPLY: 2981 mm. Mercury Pressure.

Beutell blower yielded per 1 litre of water 2·35 litre of air of 332 mm. water pressure;

that is to say, a result 4½ times more favourable than with an Arzberger blower.—S. H.

Hargreaves' New Motor. Liverpool Journal of Commerce.

A NEW motor has been recently invented by Mr. Jas. Hargreaves, the inventor of the well-known Hargreaves' Salt-cake Process, in which liquid fuel is used for transmitting the propelling power. The power of the engine exceeds that of 30 horses, and about two gallons of coal tar or heavy oil are consumed per hour. The combustion is carried on inside the cylinder itself. The reason of the great amount of work performed by the fuel is that the heat is intercepted, returned to the cylinder, and made to do duty over again. The exhaust gases are reduced to so low a temperature that the hand can be placed on them without inconvenience, although they contain all the products of the combustion of the fuel. The importance of the invention is pointed out in the fact that the fuel used is less than ½ lb. per horse-power per hour, and no large steam boilers are required.—W. S.

Improvements in Means or Apparatus employed in connexion with Filters for the Purpose of Cleansing the same. E. Perrett, London. Eng. Pat. 561, January 13, 1887. 8*d*.

THIS invention relates to that class of filters in which the filtering material, *e.g.*, charcoal, pumice, or the like, is contained in a cylindrical vessel, and resting on a perforated plate therein. In order to remove the impurities accumulated in the filtering bed, a centrifugal-pump fan, or air injector, is used to cause a circulation or motion of the liquid in the vessel in a direction contrary to the direction of the filtration, whereby the dirt, &c. is loosened and carried away.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Improvements in or relating to Furnaces burning Hydrocarbons. W. P. Thompson, Liverpool. From W. B. Wright, Chicago, U.S.A., and E. T. Williams, Troy, U.S.A. Eng. Pat. 13,431, October 4, 1887. 8*d*.

THESE improvements relate to a furnace wherein the gas used is produced by passing steam and oil into heated retorts. In the case of a boiler furnace the retorts are situated in the firebox, and burners are disposed at convenient points below the retorts and in the fireflue, while the air required is heated by being brought from the rear of the furnace through channels constructed in the brickwork. The setting or masonry behind the bridge, instead of being flat, is made concentric with the boiler, and the rows of burners follow the same curve. An important feature is the injector used for supplying the oil and steam; the construction of this is detailed at length in the specification. —A. R. D.

Improvements in the Production of Illuminating Gas, Ammonia, and other Products, and in Apparatus therefor. H. Kenyon, Manchester. Eng. Pat. 13,627, October 8, 1887. 6*d*.

THE gas-producing retorts are worked in nests of, say six, and are coupled together in pairs, all the connexions of each pair being interchangeable. Attached to each nest is a heating retort, preferably of firebrick, and situated immediately over the furnace. The walls of this retort enclose a heating coil, which can be connected to any of the gas retorts. A mixture of steam and hydrocarbons is driven through the heating-coil into the last charged of any pair of gas retorts. These latter are only heated to from 850° C to 1150° C, but the mingled steam and hydrocarbon vapours should be considerably hotter. The gases pass from here to the first charged of the pair, where the action of the hot retort and the remains of the charge, now becoming incandescent, is such that the tarry compounds are split up and a gas very rich in hydrocarbons of the aromatic series is produced. If a polysulphide of ammonium be introduced along with the steam and hydrocarbon vapours the use of lime or oxide of iron for purification can be dispensed with, a washing with water being all that is required. To increase the production of ammonia and hydrocarbons of the aromatic series, the retorts should be charged with a slack rich in nitrogen, oxygen, and hydrogen, along with about equal proportions of such nitrogenous materials as leather waste, hair, dried blood, &c. In this case, it is preferred to scrub the gas with refrigerated heavy oil for the removal and recovery of the benzol, &c.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

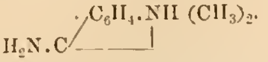
The Reaction of Thiophen with Nitroso-sulphonic Acid. C. Liebermann. Ber. 20, 3231.

THIS reaction is based on the blue colour which appears on shaking benzene containing thiophen with nitroso-sulphonic acid. The author has traced this reaction more closely, and finds that the colour is due to the formation of several substances, one of which is soluble in alkali with a purple colour. The reagent is best prepared by gradually introducing 8 per cent. KNO_2 into pure sulphuric acid, shaking and filtering. One drop of this reagent is spread over the bottom of a test-tube, and agitated with 2–3 drops of the benzene supposed to contain thiophen. In the absence of the latter the sulphuric acid merely turns a brownish-yellow, otherwise it assumes first a green and on continued agitation a deep blue colour, which does not change for several hours. 0·00025 grms. thiophen may thus be easily detected.—A. R.

IV.—COLOURING MATTERS AND DYES.

Auramine. C. Graebe. Ber. 20, 3260.

IN this article a short and authentic account is first given of the discovery of the "Phosgene Colours." *Auramine* is now prepared by heating tetramethyldiamidobenzophenone with sal-ammoniac and zinc chloride at 150°–160°. The commercial product is the hydrochloride and its formula $C_{17}H_{21}N_3HCl + H_2O$. Auramine O of the "Badische Anilin- und Soda-Fabrik" is the pure colour, Auramine I. and II. are, however, reduced with dextrin. The hydrochloride is best crystallised from alcohol. If crystallised from water, the solution should not be heated over 70°, otherwise, and especially on boiling, the auramine is resolved into tetramethyldiamidobenzophenone. Mineral acids effect this decomposition even in the cold. The spectrum of concentrated solutions of auramine presents some characteristic lines, one very bright red band from division 28–42 of the Bunsen-Kirchhoff scale, and a less intense yellow band from division 52–56. Auramine is largely employed, especially for mixing with other basic colours, which dye cotton mordanted with tannic acid. *Auramine-base* is obtained from the hydrochloride by treating with ammonia, and cooling. It is somewhat unstable, even losing ammonia on dissolving in hot alcohol. Though its formula is represented by $[C_6H_4N(CH_3)_2]_2C:NH$ no nitroso- or acetyl-derivative could be obtained. By reduction with sodium amalgam and alcohol *Leuc-auramine* $[C_6H_4N(CH_3)_2]_2CH . NH_2$ is formed, melting at 135°. It is colourless, and shows some characteristic colour reactions, the most interesting being that with glacial acetic acid, in which the base dissolves with an intense blue colour, and dilute acetic acid gives a similar colouration on heating. The blue compound V. Meyer thinks must have the formula—



$$H_2N.C\diagup C_6H_4.NH(CH_3)_2.$$

Sulphuretted hydrogen acts on auramine with formation of *Tetramethyldiamidothiobenzophenone* $[C_6H_4N(CH_3)_2]_2C{:}S$, melting at 202°, and distinguished by its fine ruby-red colour. The properties of this body have recently been described by Baither (this Journal, 1887, 660).—A. R.

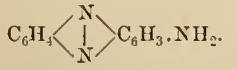
Purpurogallol. Samuel C. Hooker. Ber. **20**, 3259.

On adding potassium ferricyanide solution (87 grms. in 330 cc water) to a solution of pyrogallol (20 grms. in 330 cc water) there is an immediate evolution of gas, the solution loses its deep red colour and purpurogallol separates out. (Ber. **20**, 1277.) It is filtered off after half an hour, when the oxidation is complete. The yield amounts to 13·5–14 per cent. of the pyrogallol employed.

Purpurogallol may also be obtained by oxidising gallic acid with a solution of potassium nitrite. The author mentions a very sensitive and characteristic reaction of purpurogallol. A trace of nitrous acid or KNO_2 added to a sulphuric acid solution of purpurogallol causes the red solution to change to an intense violet, which colour, however, soon disappears.—A. R.

Remarks on the Constitution of Phenosafranines. Ph. Barbier and L. Vignon. Bull. Soc. Chim. **48**, 338.

It is well known that safranines are produced by the condensation of one molecule of a paradiamine and two molecules of an aromatic monamine. The condensation is brought about by oxidising agents. If a mixture of one molecule of phenylenediamine (1:3) and one molecule of aniline be oxidised at a low temperature, a blue compound is formed, which is very unstable and gradually changes into phenosafranine. If two molecules of aniline act on one molecule of paraphenylenediamine, the same blue compound is obtained, but in far greater quantity. Treated with zinc and dilute hydrochloric acid, this blue compound splits up into aniline, which remains in solution, and another substance, which can be precipitated by sodium chloride, and behaves as a leucobase. It is slowly oxidised to $C_{12}H_9N_3$, the hydrochloride of which dissolves with a red colour. Its reactions and chemical properties are identical with those of diamidophenazine, and the authors believe this base to be amidophenazine



$$C_6H_4{<}\overset{N}{\underset{N}{|}}{>}C_6H_3.NH_2.$$

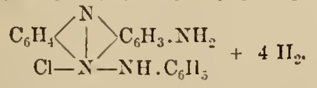
Treated with nascent hydrogen it takes up two atoms of hydrogen and forms the leucobase—

$$C_6H_4 = (NH)_2 = C_6H_3.NH_2.$$

On the other hand, the authors reversed the process and succeeded in making the blue compound by oxidising at a low temperature leucamidophenazine in the presence of an aniline salt. From this they conclude that the phenazine group exists in the safranine molecule, and explain the theory of the formation of phenosafranine by the following equations :—

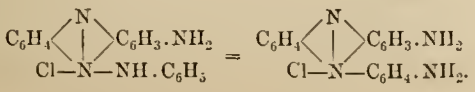
(1.) Formation of the blue compound :—

$$NH_2.C_6H_4.NH_2 + C_6H_5.NH_2 + C_6H_5.NH_2.HCl =$$



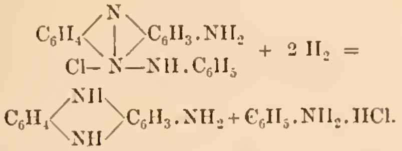
$$C_6H_4{<}\overset{N}{\underset{Cl-N-NH.C_6H_5}{|}}{>}C_6H_3.NH_2 + 4\,H_2.$$

(2.) Conversion of the blue compound into safranine :



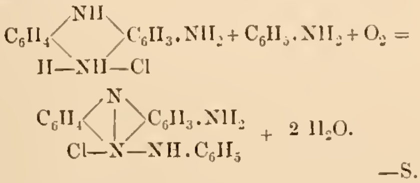
$$C_6H_4{<}\overset{N}{\underset{Cl-N-NH.C_6H_5}{|}}{>}C_6H_3.NH_2 = C_6H_4{<}\overset{N}{\underset{Cl-N-C_6H_4.NH_2.}{|}}{>}C_6H_3.NH_2$$

(3.) Decomposition of the blue compound by nascent hydrogen :



$$C_6H_4{<}\overset{N}{\underset{Cl-N-NH.C_6H_5}{|}}{>}C_6H_3.NH_2 + 2\,H_2 =$$
$$C_6H_4{<}\overset{NH}{\underset{NH}{}}{>}C_6H_3.NH_2 + C_6H_5.NH_2.HCl.$$

(4.) Formation of phenosafranine by the oxidation of the leucamidophenazine in the presence of aniline :—



$$C_6H_4{<}\overset{NH}{\underset{H-NH-Cl}{}}{>}C_6H_3.NH_2 + C_6H_5.NH_2 + O_2 =$$
$$C_6H_4{<}\overset{N}{\underset{Cl-N-NH.C_6H_5}{|}}{>}C_6H_3.NH_2 + 2\,H_2O.$$

—S. H.

Producing Colours from Aniline. R. Pinkey, London. Eng. Pat. 1863, June 30, 1870. (Second Edition.) 6*d.*

The object of this invention is to produce green, purple, and more especially aniline black, by the oxidation of aniline salts in presence of salts of nickel instead of the salts of copper, iron, or antimony which have hitherto been employed for this purpose. The colours thus produced may be employed for dyeing, printing, writing, or marking goods or fabrics of silk, wool, linen, cotton, straw, leather, feathers, hair, &c. For dyeing operations a bath is employed containing the solution of aniline salt, nickel salt, and oxidizing agent, viz., potassium or sodium chlorate. The goods may also be first dipped in a preliminary bath of aniline salt, and then in the second oxidizing bath containing the chlorate and nickel salt. After treatment the goods are aged and then dipped in an acid or alkaline bath according to the shade of colour required; nitric acid, for example, giving a green, and an alkaline bath a purple or black shade. Although the proportion of the ingredients may be varied, the inventor recommends about 320 parts of aniline hydrochloride, 20 parts of nickel chloride, and about 25 parts of potassium, or 60 parts of sodium chlorate with 640 parts of water. For printing purposes the soluble or insoluble salts of nickel may be employed, or a mixture together with a thickening material, such as gum, starch, or dextrin, the other constituents being as before. The sulphide is mentioned as an insoluble nickel salt. The proportions for printing are about 320 parts aniline salt, 20 of the nickel salt, 25 of potassium, or 60 of sodium chlorate, 640 of water, and 200 of thickening material. For writing or marking the proportions are the same as for printing, the goods after marking being first "aged" and then immersed in an acid or alkaline bath, according to the shade required. Other compounds of nickel besides the chloride or sulphide may be employed.—R. M.

Improvements in the Manufacture of Azo Dyes. J. Y. Johnson. From the "Farbenfabriken vorm. F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 17,083, December 30, 1886. 6*d.*

These colouring matters are produced by the action of the tetrazo-compounds obtained from benzidine and homologues, diamido-anisoïl and homologues, diamidostilbene and fluorene, &c., or their sulphonic acids upon the alkyl-derivatives of the naphthylamines or their sulphonic acids. The colouring matters thus produced are similar in properties but bluer in shade than the corresponding compounds produced from unalkylized naphthylamines. The following examples are given :—(1.) Diazotised tolidine and the sodium salt of methyl-β-naphthylamine-β-monosulphonic acid give a compound which dyes cotton from an alkaline bath of a bluish red shade resembling safranine. (2.) Diamidostilbene is diazotised and combined with benzyl-α-naphthylamine in alcoholic solution. The azo-colour is insoluble in water but soluble in alcohol, and is sulphonated by acting upon it with three times its weight of fuming sulphuric acid containing about 20 per cent. of anhydride at about 15° C. (3.) One molecule of the tetrazo-compound is combined first with one molecule of the alkylized amine or sulphonic acid, and then with a second molecule of another alkylized amine, sulphonic acid, phenol, carboxylic acid, &c. Mixed azo-compounds are by this means obtained in accordance with the usual methods.—R. M.

An improved Process for the Production of Colouring Matters from Carbolic Acid and other Phenols. H. J. Walder, Unterstrass, Switzerland. Eng. Pat. 126, January 4, 1887. 6*d.*

These colouring matters are produced by the action of nitrous acid on the monosulphonic acids of the phenols. The method of preparation is illustrated by the following examples:—(1). One molecule of phenol is heated with one molecule of sulphuric acid (66° B.) to 135° C. until the melt is of a light brown colour. When cool it is diluted with an equal bulk of water, the solution heated to 40–45° C., and one molecule of potassium or sodium nitrite gradually added, the temperature being kept below 50° C. The pasty melt is then diluted with 10–15 volumes of strong brine, and allowed to stand for several hours, when the colouring matter separates out. It is a brown dyestuff soluble in water. (2.) β naphthol ($1\frac{1}{2}$ parts) is heated with one part of sulphuric acid (66° B.) to 160° C., and then treated with nitrite and brine in precisely the same manner as in the last example. The colouring matter is brownish red and soluble in water. (3.) Resorcinol (11 parts) is sulphonated by heating with 10 parts of sulphuric acid (66° B.) to 135° C., and then treated as before. The product is a soluble brown colouring matter.—R. M.

An improved Process for Producing Colouring Matter from Anthraquinone. H. J. Walder, Unterstrass, Switzerland. Eng. Pat. 127, January 4, 1887. 6*d.*

Anthraquinone is converted into its disulphonic acid by heating with 4–5 parts of sulphuric acid (66° B.) to 260° C. until the melt is soluble in water. The product is then allowed to cool, diluted with water to four or five times its volume, filtered, and to the filtrate solid potassium or sodium nitrite is gradually added in the proportion of two molecules of nitrate to one of the quinone. During the addition of the nitrite the temperature must not be allowed to rise above 25° C. Common salt is then added in excess, and then after standing for some time the dark coloured deposit is filtered off, washed, pressed, dried at 100° C., and pulverised. The powdered substance is then fused with two parts of caustic alkali till the mixture ceases to froth and begins to become pasty. The melt when cool is dissolved in water, filtered, and the filtrated acidified with muriatic acid. The precipitate is collected, washed, and dissolved in dilute sodium carbonate, again filtered and precipitated by acid. The pasty colouring matter is soluble in alkalis, with a dark brown colour, and dyes mordanted cotton a red-brown shade.—R. M.

The Manufacture of Dye Matters from Red Sanderswood and certain other Woods. G. Thomas, Manchester. From A. Zander, Königsberg, Prussia. Eng. Pat. 875, January 20, 1887. 6*d.*

The dyeing matter, known as "santaline," is extracted from the wood by methylated spirit or by warm solutions of caustic soda, soda crystal, bicarbonate, borate, phosphate, or corresponding potash compounds. The colouring matter thus extracted is precipitated by acid, collected, washed, and dried. In this form the colouring matter is insoluble in water, but can be made soluble by heating with six parts of sulphuric acid (66° B.) at 35—45° C., until a specimen is soluble in water. Instead of ordinary acid fuming acid containing 10 per cent. of anhydride can be used, four parts of this acid being required and a temperature of 10—20° C. being sufficient for the sulphonation. The product is poured into cold brine and the colouring matter thus precipitated is soluble in hot and cold water, and can be used like the soluble coal-tar colours. In the old process of dyeing with this wood the goods had to be brought into direct contact with the finely ground wood, and the dust afterwards removed by beating.—R. M.

Sulphonic Acids of Meta-cresol. Ad. Claus and J. Krauss. Ber. 20, 3089—3095.

In the sulphonation of *m.*-cresol, whatever the conditions, only one mono-sulphonic acid is obtained. By employing more sulphuric acid a di-sulphonic acid is formed, and finally, by heating with fuming sulphuric acid at 180°, a tri-sulphonic acid is produced.

m.-Cresol-p-Sulphonic Acid $C_6H_3(OH)(CH_3)SO_3H$ [1:3:4] is very readily formed by heating *m.*-cresol with an equal weight of H_2SO_4 at 120°, or by allowing the mixture to stand for three or four days at the ordinary temperature. It crystallises from water or dilute H_2SO_4 in small colourless plates or needles ($+ 2\,H_2O$), which melt at 75° (uncorr.). From strong H_2SO_4 it separates in large colourless plates ($+ 1\frac{1}{2}\,H_2O$), which melt at 96°. The dehydrated acid is a crystalline solid of melting point 118° (uncorr.). The acid is very soluble in water and alcohol, easily in ether and benzene. Fe_2Cl_6 produces a violet colouration. It is oxidised by chromic acid to toluquinone, proving that it has the above constitution. The potassium salt ($A'K + 2\frac{1}{2}\,H_2O$) forms small soluble crystals; the barium salt ($A'_2Ba + H_2O$) is easily soluble. The characteristic copper salt ($A'_2Cu + 3\,H_2O$) crystallises from water in glistening green rods or prisms.

m.-Cresol Disulphonic Acid $C_6H_2(OH)(CH_3)(SO_3H)_2$ [1:3:4:2 or to 6] is obtained by heating *m.*-cresol with 4—6 times its weight of sulphuric acid at 120°—140° for a few hours, or by allowing the mixture to stand at the ordinary temperature for four or five days. The acid forms an oily fluid, very soluble in water and alcohol. The potassium salt ($A''K_2 + 3H_2O$) forms colourless plates; the barium salt ($A''Ba\ \frac{1}{2}\,H_2O$) is very soluble, and the copper salt excessively soluble.—A. G. G.

Meta-nitroquinoline. Ad. Claus and A. Stiebel. Ber. 20, 3095—3097.

Meta-nitraniline (10 pts.) can be converted into a nitroquinoline by heating with glycerol (14 pts.), sulphuric acid (14 pts.), and picric acid (2·6 pts.). The nitroquinoline is separated from the simultaneously formed phenanthroline by means of cold petroleum-ether, in which the former is only slightly soluble; the yield is about 1 pt. The new nitroquinoline $C_9H_6(NO_2)N$ crystallises from hot water or alcohol in thin colourless needles, which melt at 131°·5 (uncorr.). Its hydrochloride $C_9H_6(NO_2)N.HCl$, forms long needles, melting at 225° (uncorr.), and is decomposed by water. The platino-chloride $\{C_9H_6(NO_2)N.HCl\}_2PtCl_4$ forms large yellow prisms.

Meta-amidoquinoline $C_9H_6(NH_2)N$ is formed by reduction of the nitroquinoline by $SnCl_2$ and HCl. It crystallises from alcohol in long silky needles, which melt at 186° (uncorr.).—A. G. G.

Ortho-Cresol-sulphonic Acid. Ernst Hantke. Ber. 20, 3209.

With a view of ascertaining whether the action of sulphuric acid at different temperatures on ortho-cresol is different to that on phenol, the author has found that, when ortho-cresol is heated with sulphuric acid at 100°, only ortho-cresol para-sulphonic acid is produced; at ordinary temperatures, however, both this acid and ortho-cresol meta-sulphonic acid are formed. Moreover, when its concentrated aqueous solution is heated, the latter acid is converted into ortho-cresol para-sulphonic acid. In this case it is evidently the sulpho group which has taken up a different position in the nucleus, whereas in the case of the analogous conversion of ortho into para-phenolsulphonic acid, by heating the former with sulphuric acid at 100°, it is open to doubt whether the hydroxyl or the sulphonic group has been displaced.—A. R.

On the Colouring Matters which combine with Mordants. St. v. Kostanecki. Ber. 20, 3146–3149.

Of the various colouring matters at present known, a limited number only have the property of combining with metallic oxides to form stable coloured lakes. By a comparison of the constitution of these mordant-dyeing colouring matters, the author has arrived at the following conclusions:—

(1.) *Nitrosophenols (quinone-oxims) combine with oxide-mordants if the NO group stands in the ortho-position to the OH group.* If the NO group is para to the OH, the compound does not dye mordants. Thus, α-nitroso-β-naphthol, β-nitroso-α-naphthol, mono- and di-nitroso-resorcinol and nitroso-β-orcinol, all of them ortho compounds, have this property; whilst nitroso-phenol and α-nitroso-α-naphthol, which are para compounds, have no affinity for oxides.

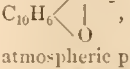
(2.) *Phenolic colouring matters combine with oxide-mordants when they possess two OH groups in the ortho-position to each other.* If the two OH groups have any other relative position the compound has no affinity for mordants. Thus alizarin, styrogallol, and galleïn, in all of which the two OH groups are ortho, have this property; whilst oxyanthraquinone, all the other isomers of alizarin, and fluoresceïn have no affinity for mordants. The affinity for mordants of all the colouring matters derived from gallic acid (*e.g.*, galleïn, anthragallol, cœruleïn, galloflavin, and gallocyanin) is due to the ortho-position of the two hydroxyls. The same law holds good in the case of the nitrophenols: thus nitro-pyrocatechin (nitro-catechol) and nitro-pyrogallol readily dye cotton mordanted with alumina. —A. G. G.

Naphthylamine-sulphonic Acids. G. Schultz. Ber. 20, 3158—3162.

β-Naphthylamine-sulphonic acids. Fr. Baeyer and C. Duisberg (Ber. 20, 1426) have shown that by sulphonation of β-naphthylamine sulphate at a high temperature a new mono-sulphonic acid (the so-called "δ" acid) is obtained. This acid is converted by the diazo reaction into a naphthol-sulphonic acid which Baeyer and Duisberg consider to be identical with Cassella's naphthol-sulphonic acid F (2 : 2′), obtained by heating α-naphthalene-disulphonic acid with NaOH. On the other hand A. Weinberg (Ber. 20, 2906) considers that the δ-sulphonic acid of β-naphthylamine is a mixture and not identical with the acid obtained by heating the naphthol-sulphonic acid F with ammonia. The author brings additional proof in support of the identity of these two acids, and shows that Weinberg had probably not obtained the δ-acid in a pure state. The sulphonation of β-naphthylamine sulphate at a high temperature yields a mixture of about equal quantities of Brönner's acid (the "β"-acid) and the δ-acid. The complete separation of the two isomers is somewhat difficult, but is best effected by repeated crystallisation from *warm* water in which the δ-acid is by far the most soluble.

The pure δ-acid crystallises in long glistening needles, which on boiling with water lose H_2O and are converted into an almost insoluble crystalline powder. The calcium salt crystallises in plates ($+ 6H_2O$) with a blue fluorescence; 1,000 parts of water at 15° dissolve 3·8 parts of the salt. By conversion into the corresponding napthol-sulphonic acid, and fusion with NaOH, it yields the dioxynaphthalene of melting-point, 186°, whose acetyl derivative melts at 129°. In all these respects, and also in its reactions with diazo-compounds, Cassella's acid behaves identically with the δ-acid. The deltapurpurin of commerce is prepared from the mixture of the β- and δ-acids without separation, and hence the different reaction with acetic to that of the product from Cassella's acid. By means of the more soluble magnesium salt the pure deltapurpurin can be isolated from the commercial product, and then gives identically the same reactions as Cassella's compound.

α-Naphthylamine-sulphonic acids. The α-naphthylamine-sulphonic acid obtained together with naphthionic acid by sulphonation of acetyl-α-naphthylamine (M. Lange, Ber. 20, 2940) is identical with Laurent's acid (obtained by sulphonation and reduction of nitronaphthalene). On conversion into the corresponding α-naphthol-sulphonic acid and fusion with NaOH both acids give the same di-oxynaphthalene (1:4′), which melts at 250°. Laurent's acid is also formed simultaneously with naphthionic acid by sulphonation of α-naphthylamine hydrochloride.

By nitration and reduction of naphthalene-α-sulphonic acid a mixture is obtained of Laurent's acid with a new α-naphthylamine-α-sulphonic acid (1:1′). The α-naphthol-sulphonic acid obtained from this exhibits the characteristic property of being readily converted into an anhydride  $C_{10}H_6\langle{}^{SO_2}_{O}\rangle$, which distils undecomposed at the ordinary atmospheric pressure, and crystallises from benzene in long colourless prisms of melting-point 154°.—A. G. G.

Errata.—In December issue, 1887, p. 817, first column, line 2, *for* "Möhlan," *read* "Möhlau." and p. 816, second column, line 46, *for* "27—33°," *read* "427—433°."

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improvements in the Manufacture of Ornamental India-rubber Waterproof Fabrics. G. C. Mandleberg, H. L. Rothband, S. L. Mandleberg, Pendleton, Manchester. Eng. Pat. 1255, January 26, 1887. 6*d*.

Any suitable woven fabric is made waterproof by "spreading" one or more coats of india-rubber proofing on it. Whilst the last coating is still in an adhesive state, it is covered with the dust of fibre of wool, hair, silk, or cotton or any other suitable animal or vegetable fibre, reduced to short lengths. The excess is afterwards brushed off. If patterns are desired on the fabric, the pattern in india-rubber or similar cement can be printed, stencilled, or otherwise applied to the fabric (prepared as above described), and dust of the required quality and colour put on. The fabrics thus obtained may be vulcanized. They have the appearance of woven fabrics.—F. W. T. K.

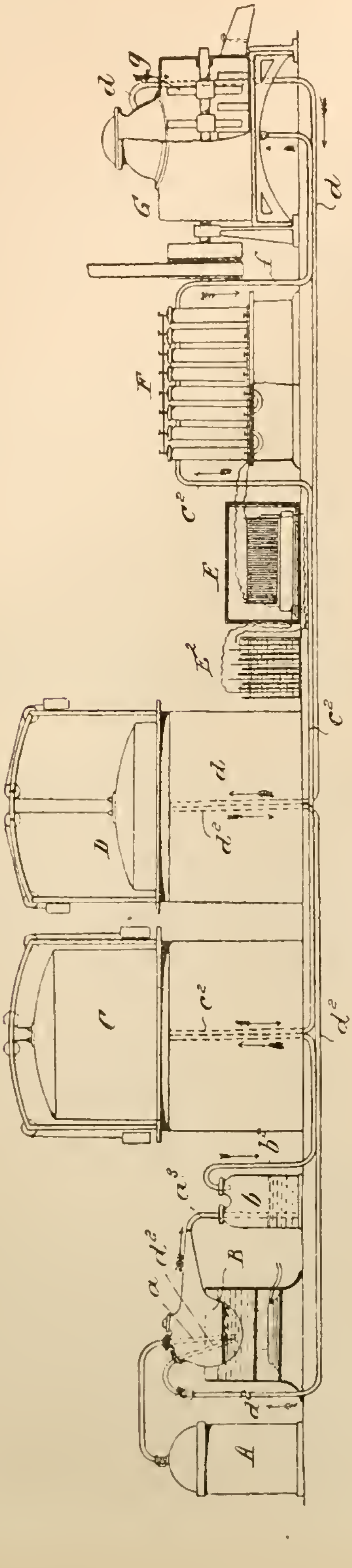
An Apparatus for Separating Wool, Silk, or other Animal Fibre from Vegetable Fibre or other Vegetable Matter. S. S. Bromhead, London. From U. C. Allen, Washington, U.S.A. Eng. Pat. 11,570, August 25, 1887. 8*d*.

The inventor claims the use of a rotary cylinder furnished with projecting teeth, so arranged that the material to be treated can be thoroughly agitated and exposed to the action of the hydrochloric acid gas, whereby the disintegration of the vegetable matter is effected. The arrangement of certain valves for the inlet and outlet of the gas is also claimed as a novelty.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Improvements in Bleaching Fibrous Substances used for making Paper. A. Brin, London, and L. Q. Brin, Paris. Eng. Pat. 4953, April 2, 1887. 8*d*.

The bleaching is effected by means of a gas called by the inventors "chlor-ozone," obtained by electrifying a mixture of chlorine and oxygen. The oxygen is contained in the receiver A. The chlorine is generated in the retort B by the action of hydrochloric acid on manganese dioxide. The mixed gases pass by the pipe a^3 into the wash-bottle *b*, and thence by the pipe b^2 into the gas-holder C. They are then made to pass by the pipe c^2 into the ozone generator F, where they are converted into "chlor-ozone." E^2 represents the battery and E the induction coil for producing the current. The electrified gases then pass into the vessel G, in which the bleaching operation is conducted, the material to be bleached being thoroughly agitated by means of the paddles *g*. Any excess of gas not absorbed in the vessel G passes into the gas-holder D, and may be used again. The oxygen which passes into the retort B is said to revivify the oxide of manganese employed for the preparation of the chlorine.—E. J. B.



Improvement in Chemical Fluid Ink Erasers. J. W. Tallmadge, New York, U.S.A. Eng. Pat. 13,500, October 5, 1887. 4*d.*

The ink-erasing fluid consists of a solution of chloride of lime, to which a very small amount of acetic acid is added.
—S. H.

Improvements in the Process of and Apparatus for Soaping, Rinsing, and Wringing Textile Materials, Fabrics, and Garments. J. Heselwood, Leeds. Eng. Pat. 13,821, October 28, 1886. 8*d.*

The apparatus consists of a series of five pairs of rollers, the upper one of each set being corrugated. Soap solution or pure water can be applied by means of pipes placed between each pair of rollers.—E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

On Colloid Cadmium Sulphide. E. Prost. Chem. Rep. **34**, 261.

In extension of the work done by Graham and H. Schulze on soluble arsenious and antimony sulphides, and by W. Spring on colloid copper sulphide and other bodies, the author has experimented with cadmium sulphide. By completely precipitating an ammoniacal solution of cadmium sulphate with hydrogen sulphide, thoroughly washing the deposited cadmium sulphide by decantation with water, and suspending the precipitate in water through which a rapid stream of hydrogen sulphide is led for some time, the cadmium precipitate soon becomes flocculent, then milky, and finally disappears altogether. After boiling off every trace of hydrogen sulphide, a perfect solution of cadmium sulphide (CdS) results; it is of a gold-yellow colour by transmitted, and appears fluorescent by reflected light. Strong solutions have a greater tendency to coagulate than those more dilute; thus a solution containing 4 grms. of CdS per litre may remain clear for several days, whilst one with 11 grms. per litre will coagulate completely after 24 hours. But the presence of minute quantities of foreign bodies suffices to re-precipitate the sulphide, and the author finds that Schulze's observations on the analogous re-precipitation of the antimony and arsenious sulphides are for the most part corroborated by the behaviour of the CdS solutions. Thus he finds that the coagulating power of a salt is in no way related to its molecular weight, but is determined by the combined metal; monovalent elements show the least and trivalent the greatest energy, whilst the divalent metals occupy an intermediate position, the influence of the acids being usually imperceptible. Potassium sulphate is active even when diluted to 1 : 1666, aluminium sulphate to 1 : 232558. In alums the influence of the trivalent element predominates. Again, for acid salts the energy is greater than for the corresponding normal compounds. Cadmium salts themselves have a very high precipitating value, $CdSO_4$ acting at a dilution of 1 : 250000, $Cd(NO_3)_2$ at 1 : 285714. The degree of concentration of the solution appears to be without influence on the manner of coagulating.—W. G. M.

Improvements in the Manufacture of Phosphoric Acid. W. B. Giles and A. Shearer, London. Eng. Pat. 16,499, December 16, 1886. 8*d.*

In a former patent specification (Eng. Pat. 1886, 715) the same inventors described the distillation of crude phosphoric acid by the aid of a current of steam or hydrochloric acid, as a convenient method for purifying a crude acid. They now modify their process by performing the distillation by the aid of a vacuum in the condenser and a slow current of superheated steam through the retort. If a crystallised phosphoric acid be desired, the crude dilute acid is boiled down to the necessary concentration and allowed to cool. Crystals are quickly formed, which are separated from the mother liquor, which latter also contains all the impurities of the crude acid. The mother liquor, after further concentration, is then subjected to distillation, whereby all the phosphoric acid is obtained in a pure form.—S. H.

A Process of and Apparatus for Manufacturing Ammonia. B. J. Mills, London. From T. B. Fogarty, Brooklyn, U.S.A. Eng. Pat. 13,746, October 11, 1887. 8*d.*

This invention relates to the production of ammonia from atmospheric nitrogen. The process depends on the production of cyanides and cyanates as an intermediate step, and the conversion of these into ammonia. The mode of operating is as follows:—A mixture of air and steam is forced through a furnace containing incandescent coal, whereby a fuel gas is produced containing a large percentage of nitrogen. This gas is passed through a superheater and thence into a retort, which is maintained at a white heat, and contains a charge of pulverised carbon and alkali. A feeding screw supplies the retort continually with alkalised carbon which works its way downward, meeting everywhere nitrogen and steam, the consequence of which is, that the nitrogen combines with the carbon and alkali to form cyanides and cyanates, and these, in turn, are immediately decomposed by the steam into ammonia, oxides of carbon and hydrogen. The alkali is set free and enters into fresh combinations. The gaseous products and undecomposed solid matter escape from the retort into a hydraulic main, wherein the heavier portion of the solid matter is deposited, while the rest passes onward through a washer and condensers to a scrubber, where the ammonia is separated from the other gases.—S. H.

A Process of and Apparatus for Producing Sulphate of Ammonia. B. J. Mills, London. From T. B. Fogarty, Brooklyn, U.S.A. Eng. Pat. 13,747, October 11, 1877. 8*d.*

The object of this invention is the production of ammonia sulphate by producing, first, ammonium carbonate or its components through the combustion of alkalised carbon in an atmosphere of air, steam, and nitrogen, and second, separating from the gases the resulting ammonium carbonate by means of gypsum with the production of ammonium sulphate and calcium carbonate. The mode of proceeding is, in the first instance, the same as described in Eng. Pat. 1887, 13,746. But in this case the ammoniacal gas, after washing and cooling, is passed into a chamber which is provided with shelves, covered with a mixture of gypsum and sawdust. Here the ammonia and carbonic acid are retained, decomposing the gypsum—calcium sulphate—with the production of ammonium sulphate and insoluble calcium carbonate. The former is recovered by lixiviation and the solution worked up in the usual manner.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Improvements in the Manufacture of Glass. T. C. J. Thomas, London. Eng. Pat. 12,076, Sept. 22, 1886. 4*d.*

A blast of oxygen is driven through the molten material. This causes the impurities to rise to the surface as a scum which can be easily skimmed off.—A. R. D.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Improvements in Treating Wood with Antiseptic and Preservative Fluids. T. Royle, West Ham. Eng. Pat. 734, January 17, 1887. 6*d.*

The wood undergoing treatment is placed in a vessel covered with a non-conducting composition. It may be either wet or partially dry tar oil, creosote oils, or other such substances, previously heated, these being forced into the vessel through perforated pipes; the temperature of the vessel and contents is at the same time maintained at 100° to 104° C. by means of steam pipes. The oil in the water which will thus be extracted escapes from the vessel by a series of small over-flow pipes leading into a common main. When sufficient water has been removed the contents are put under pressure, obtained either by forcing in more hot oil, or by air-compression. The wood is then removed in the usual way, and with the customary precautions as to temperature.—C. C. H.

X.—METALLURGY, MINING, Etc.

Improvements relating to the Extraction of Aluminium from its Chlorides, and to Apparatus therefor. H. H. Lake, London. From Count R. de Montgelas, Philadelphia, U.S.A. Eng. Pat. 1751. February 3, 1887. 8*d.*

Pure aluminium chloride solution is made by dissolving about 4 lbs. of alumina in hydrochloric acid, evaporating and redissolving in a like quantity of hot water. This solution usually has a yellow colour, and is placed in one compartment of a cell divided into two by a porous partition. The other compartment is filled with a strong solution of sodium chloride, and contains an anode of aluminium, whilst the former is provided with a cathode of brass or copper. A current of electricity is passed through the solution, in the direction above indicated, until the yellow colour of the aluminium solution has been discharged, thus indicating a conversion into double aluminium sodium chloride. This new solution is now evaporated, redissolved in hot water, and electrolysed in a similar cell, but with a carbon anode surrounded by fused lumps of the double chloride with an extra equivalent of sodium chloride. The anode may be made by moulding a mixture of coke dust, the double salt, sodium chloride, and tar, or of carbon and amorphous aluminium (a by-product from the process patented in 1886, No. 10,606), in which case the packing of solid matter around the electrode may be dispensed with. The cathode may be of thin aluminium, when the electrode and deposit should, by preference, be ultimately fused together; if of brass or copper, the deposit is scraped off and melted under flux.—W. G. M.

On the Brittleness of Iron after Corrosion. A. Ledebur, Stahl-u-Eisen, 1887, 681.

Hughes has shown that brittleness after corrosion is exhibited by all kinds of iron and steel, and is more marked if a plate of amalgamated zinc be connected with the iron so as to form a couple in the solution; and that it cannot be ascribed to accidental flaws in the metal employed. If two iron wires are made electrodes in a bath of sulphuric acid, the anode will be much attacked, but will be scarcely affected in regard to brittleness, while the cathode will become bright on its surface, but will be extremely brittle. Hughes and Roberts ascribe this effect to the occlusion of hydrogen by the iron. The author, after a long series of researches, finds that the character of iron and steel is always altered if exposed to influences which occasion an evolution of hydrogen upon the surface, and that contact of the iron with zinc intensifies this effect, so that a shorter time is necessary to produce it. The resistance to flexure, as well as the transverse strength, is always diminished, as is the extensibility under tension, while the modulus of rupture is practically unaltered, unless in some cases by the excessive corrosion itself. Heating the metal suffices to remove the brittleness, and placing it in a dry place for some time may have a similar effect; but mechanical working in the cold is without effect in this direction. Cast iron is not influenced, or is less so than wrought iron, by superficial hydrogen development. Four samples of corroded iron heated carefully in pure dry nitrogen, gave off 0·0021 to 0·0052 per cent. of hydrogen respectively—numbers which the author thinks cannot represent quite the whole of the hydrogen actually present.—W. G. M.

Improvements in the Application of Aluminium. Bayerisch Ind. u Gewerbebl., 1887. 318.

The recent improvements in the manufacture of aluminium have reduced its price so considerably that a much larger field of usefulness is now open to it. The readiness with which it may be cast and chased, its colour and lightness, combined with its non-liability to tarnish, indicate a special application in jewellery and the manufacture of apparatus. In the market, aluminium is to be obtained in the form of ingot, sheet, foil, and wire, and alloyed in certain definite proportions with copper. The commoner alloys are those in which the proportions of aluminium to copper are, (1), 10:90 (gold-yellow in colour); (2), 5:95 (resembling 14 carat gold); and (3), 2·5:97·5 (the copper in this case containing also silicon). All these bronzes are readily fusible, may be rolled with facility, take a high polish, and resist tarnishing; the No. 3 alloy would be a suitable substitute for telegraphic silicon bronze. It is possible that many have already experimented in applying aluminium to the arts, and have failed, partly from want of experience in manipulating a new material, partly from difficulties in casting; for if melted in a clay crucible, this metal reduces silicon from the substance of the pot, becoming itself grey and brittle in consequence. Lime crucibles, or clay pots either brasqued or lined with well-ignited cryolite alumina, must therefore be used for casting aluminium. In soldering the pure metal, it is found that the clean surfaces rapidly become coated with an almost imperceptible film of oxide, which, although protecting them from further oxidation, is nevertheless sufficient to prevent their union in the usual way. The surfaces to be joined must, therefore, be scraped or scratched perfectly bright and be covered with a film of paraffin, then a thin rolled piece of soldering alloy (Zn : Sn : Pb = 5 : 2 : 1) is placed on each, and each surface is heated separately. The paraffin first melts and protects the bright portions from oxidation, then the alloy fuses and unites with the aluminium. The overlaid aluminium surfaces may afterwards be soldered as usual.—W. G. M.

Improvements in Coating with Tin or other Coating Metal Sheets, Plates, or pieces of Iron or other Metal. E. Morewood, Llanelly. Eng. Pat. 15,477, November 26, 1886. 11*d*.

After coating and brushing in the usual way the plates are passed into a reserve pot, either containing hot grease or kept at the required temperature by heated air. Hence they are removed two and two by a workman and plunged into the finishing grease pots, which are placed one on either side of him; here they are caught by a cradle and automatically delivered to the finishing rolls, to be subsequently removed by the same workman and set aside for the bran treatment. It is essential that the action of the two cradles and rollers shall be simultaneous. If preferred, a single pot of double length will serve to pass the two plates at one operation. In some cases "in and out" rollers are used, which being set intermediately in relation to each other, do not apply the same pressure to the plates that is given by the usual rolls; this is found to be beneficial, especially when much scruff remains on the plate, as there is less tendency for it to be transferred to the rolls. An outlet at the bottom of the pot permits of the removal of any metal that may collect there, or a pump may be used for the same purpose.—W. G. M.

Improvements in obtaining Silver from Ores, Mattes, or Compounds containing it. E. Hunt, Glasgow, From G. Thomson, New Jersey, U.S.A. Eng. Pat. 285, January 8, 1887. 4*d*.

The finely crushed ore is roasted until nearly "sweet," and after mixing with sulphuric acid or a substance capable of yielding the same, is again heated to convert the silver into sulphate. After transferring to vats brine is added in just sufficient quantity to convert all the silver sulphate into chloride. The soluble salts are then leached out, and the silver chloride is dissolved in any solvent such as brine, precipitated, and treated in the usual way.—W. G. M.

Improvements in the Manufacture of Aluminium and Aluminium Alloys. E. Cleaver, London. Eng. Pat. 1276, January 26, 1887. 6*d*.

Four parts of aluminium sulphate in solution are mixed with one part of lamp black; the mixture after drying is heated to the highest temperature attainable by the use of coal gas and oxygen in a lime-lined furnace, similar to those used for melting platinum. Excess of reducing gas is maintained throughout. The charge is cooled *in situ*, and then mixed with about 20 times its weight of finely divided cast-iron, and fused in a steel-melting furnace if an iron aluminium alloy be required, or with copper if an aluminium bronze is to be produced. The alloying metal may be added in the gas furnace, but this course is not recommended. Aluminium ferrocyanide alone or with carbon yields a rich iron-aluminium alloy, to which more iron may be added if wished; the oxygen supply should in this case be previously heated by passing through red-hot earthenware pipes, as a higher temperature is required.—W. G. M.

Improvements in the Manufacture of Dyes, Disinfectants, Artificial Stone, Artificial Ivory, Artificial Manure, Sodium Chloride, Zinc Sulphate, and Zinc Carbonate. R. H. Worthington, London. Eng. Pat. 4,583. March 28, 1887. 6*d*.

The products and processes described in this specification relate to "the sub-products arising from the extraction of "tin from iron in tin scraps consisting of the 'chloruret of "'zinc and iron.'"—C. C. H.

Improvements in the Extraction of Antimony from its Ores. A. J. Shannon, London. Eng. Pat. 11,900, September 2. 1887. 8*d*.

A blast furnace with tuyères and doors beneath, and with a covering plate and movable hopper above, is placed in connexion with a series of condensing flues by means of a "down-comer" taking off from the upper part of the furnace. In this cupola the ore is roasted until nearly the whole of the antimony is driven over and collected in the flues as oxide. Poor materials may thus be treated, the one essential in all cases being a strong blast. The spent cinder is withdrawn through the lower doors at the end of the operation. The oxide is mixed with carbonaceous material and smelted in a reverberatory furnace.—W. G. M.

Improvements in the Manufacture of Plumbic Oxide or Litharge, and in Apparatus employed therein. S. C. Rowell and J. W. Newell, Boston, U.S.A. Eng. Pat. 13,409, October 4, 1887. 8*d*.

A long rectangular furnace is divided lengthwise into two compartments by a fire-brick partition; in one of these is a long fire-grate surmounted by a series of metal air-heating pipes, in the other are three superposed chambers, the two lower separated by a fire-brick arch, the middle and upper by a metal screen. These are so arranged that the products of combustion from the grate, after heating the air in the above-named pipes, pass into the highest of the three superposed chambers, and so heat by radiation the one immediately beneath it; at one end of the furnace they are then led into a chamber beneath a metal retort, and thence to the chimney shaft. A portion of the air blown through the heating pipes passes into the intermediate of the three chambers, and thence to the flue above it; the upper portion is blown through tuyères into the metal melted in the retort. It will thus be seen that both the retort and the intermediate chamber are heated by the products of combustion, but only externally. Lead is melted in the retort and oxidised by means of the heated air supplied through the tuyères; the oxide thus produced is drawn up on to the side of the retort, drained from lead, and conveyed through a channel (usually closed) into the intermediate chamber, where it remains in contact with air at a fair temperature until it has attained to the right shade of colour, when it is transferred through another channel into the bottom of the three chambers, whence it is subsequently removed and ground. The litharge is quite free from carbonate, as it has never been in contact with the products of combustion.—W. G. M.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

An Improved Method for the Production of Coherent Masses of Peroxide of Lead for Use as Voltaic Battery Elements, and for Use in Electrolytical and Metallurgical Operations. D. G. Fitz-Gerald, London. Eng. Pat. 16,608. December 17, 1886. 6*d*.

Monoxide of lead is mixed in suitable proportions with an insoluble or nearly insoluble salt of lead as lead sulphate, and formed by water into a paste which can be moulded; combination takes place and causes the mass to set. The plates are superficially converted into peroxide of lead by immersion in a hot solution of the hypochlorite of sodium or magnesium. By previously admixing a little electrolytically-formed peroxide of lead, the latter part of the operation is rendered unnecessary. The conversion of the plates is completed electrolytically.—E. T.

Improvements in and relating to the Manufacture of Material for the Production of Carbon Filaments for Incandescent Electric Lamps and other Articles. W. R. Lake, London. From La Société A. Cruto & Cie., Turin, Italy. Eng. Pat. 13,092. September 27, 1887. 4*d*.

"The main object of this invention is to employ ulmic or "similar materials, such as metagallic acid or other acids," for the purpose specified in the title. The following is one method proposed for obtaining a suitable ulmic material. 80 grms. of sugar dissolved in 100 cc. of distilled water are filtered, and diluted during filtration with another 100 cc. of water. To the filtrate is added, drop by drop, about 300 grms. of sulphuric acid, with constant stirring. After standing about 12 hours, a further 300 cc. to 400 cc. of distilled water is added, also drop by drop, and with constant stirring. After cooling it is again slowly diluted with water to a density of about 2° B., and then filtered till a sufficient consistency is reached to allow the mass to be worked on a slab with an india-rubber roller. It is next freed from air in a receiver attached to an air-pump, and is then in a very plastic condition and suitable for being moulded into articles of any form. After slow drying, first at ordinary temperature and then at 100° C., these articles, protected from the air by powdered charcoal or by an inert gas, are carbonised by a powerful heat in a reverberatory furnace.—A. R. D.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Contributions to the Investigation of Cod-liver Oil and Vegetable Oils. E. Salkowski, Zeits. Anal. Chem. **26**, 557—582.

The object of these investigations was means for the detection of vegetable oils in animal fats, and more especially in cod-liver oil.

1. *Melting point and point of solidification.*—The use of capillary or even narrow tubes is to be avoided, as the results obtained, when using these, are contradictory. The oils were placed (a few cc. at a time) in thin test tubes of, as far as possible, the same diameter. It is necessary to note that in determining the melting point, or point of solidification of these oils, *time* is an important factor. Thus, *e.g.*, a cod-liver oil which remained liquid on being cooled down to − 15° C, solidified on being subjected to a temperature of − 4° C for several hours. It is also found that a sample which has been solidified once, solidifies again more easily than when a fresh sample is taken. Solidification is usually preceded by a cloudiness in the oil. Taking the melting point of snow, for the sake of convenience, and experimenting with various samples of cod-liver oil, it was found that out of 11 samples eight remained permanently liquid, two became cloudy and viscous, and one became solid. Now although, as it is seen, considerable differences occur, still, by observing the time which a sample of cod-liver oil takes to solidify at 0°, it is possible to detect the addition of palm oil, cocoa-nut oil, and palm-kernel oil. Thus, a cod-liver oil which solidified with considerable difficulty was found to do so in 30 minutes at 0° C, when it had been treated with the above oils in quantities equal to 20 per cent. of the pure cod-liver oil. The pure cod-liver oil, which solidified most easily, was then still liquid, and only became very cloudy and viscous in an hour's time.

(N.B.—The above addition of 20 per cent. extraneous oil was always made, as adulterations with smaller quantities would scarcely pay.)

2. *Application of the Reichert-Meissel method of butter analysis.*—The usual assertion that cod-liver oil contains marked quantities of the glycerides of the lower fatty acids was not found to hold good for the cod-liver oils at present in the market. Using the Reichert-Meissel process (as given in the *Vereinbarungen bayrischer Chemiker*, p. 218), with a slight modification to ensure greater accuracy, he found that the aqueous distillate from five grs. of cod-liver oil required from 0·10 to 0·20 cc. of $\frac{N}{10}$ soda solution. A large number of vegetable oils were similarly tested, and it was found that in the majority of cases, the quantities of $\frac{N}{10}$ soda solution required were too small to be of any use in detecting their presence in cod-liver oil by this method. The exceptions are cocoa-nut oil (7·28 cc. $\frac{N}{10}$ soda sol.) and palm-kernel oil (3·48 cc. $\frac{N}{10}$ soda sol.). Determinations of the values of saponification seem useless.

3. *The sulphuric acid reaction.*—Salkowski has investigated this reaction carefully, and has come to the following conclusion. The sulphuric acid is best added to a chloroform solution of the cod-liver oil. The indigo-blue colour first observed is due to colouring-matter, which belongs to Kühne's *Lipochromes*. The succeeding purple colour is due to the presence of cholesterin, of which he found a very appreciable quantity in the oil. The final brown colour is due to the fatty acids. Examination of numerous vegetable oils showed that (1) only in the case of palm oil was a body similar to the liprochrome obtainable; (2) the fatty acids in the vegetable oils did not give the reaction with sulphuric acid; (3) with the exception of palm oil, they all contained a body analogous to cholesterin, namely "phytosterin," (Hesse, 1878). The cholesterin and phytosterin can be obtained by saponifying the oil and extracting with ether. Now cholesterin crystallises in plates, phytosterin in needles, and by this means Salkowski has been able to detect adulterations. The special cases he has examined were samples of cod-liver oil, to which he added 20 per cent. of rape-seed oil, linseed oil, and cotton-seed oil. He also found that in all these cases the melting point of the cholesterin was lowered from 146° to 139°, or 140° C. Adulteration with rape-seed oil may further be detected through the erucin in it.

4. *Free fatty acids in cod-liver oil.*—Salkowski agrees with Hager that the good qualities of cod-liver oil now in the market practically contain no free fatty acids. Since most vegetable oils contain appreciable quantities of free fatty acids, this difference might possibly assist in the detection of adulterations.

In conclusion, he points out that the phytosterin may lead to the detection of vegetable oils in animal fats. Butter seems to be an exception. It possibly already contains a little phytosterin. The estimation of the volatile fats which are not soluble in water (*e.g.*, in cocoa-nut oil), may sometimes prove useful.—F. W. T. K.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Improvements in the Process and Means for Concreting Amber Shavings. James Karpeles, Vienna, Austria. Eng. Pat. 688, January 15, 1887. 8*d*.

The particles of amber are placed in a strong cylindrical vessel, and a lid of considerable thickness, and fitting the cylinder like a piston, is put on the top. A small rectangular portion of this lid rises above the upper surface of the latter and fits into the lower end of the inner hollow space of a mould. This rectangular portion of the lid is provided with a number of perforations, which pass right through to the lower side of the lid. The outer surface of the mould (which is placed on the lid) is cylindrical in shape, and also fits the cylindrical vessel. Four guiding pillars for this mould are fixed on the cylindrical vessel, a heavy metal (copper) block, which loosely fits the hollow in the mould, is slipped in. A circular cap is put on the mould. The broad rim of this cap has four holes for the tops of the pillars to pass through. These latter are provided with nuts, and by screwing these down the apparatus is firmly held together preparatory to being placed under a press (preferably a hydraulic press). The temperature of the apparatus is then raised to about 300° C. (near 500° C. the amber undergoes decomposition) which renders the amber viscous. The lid and mould are then forced down into the cylindrical vessel, and the viscous amber passes through the perforations into the hollow of the mould, pushing up the block in the latter till the hollow is full. The pressure may then be allowed to act on the plastic mass till perfectly cooled and hardened.—F. W. T. K.

Improvements in the Manufacture of Sulphide of Zinc, White. H. H. Gunn, Edinburgh, Midlothian. Eng. Pat. 955, January 21, 1887. 6*d*.

A zinc ore, preferably the sulphide, is roasted in a very fine state of division, and at not too high a temperature. The zinc is then obtained in the form of sulphate. Any zinc oxide formed is converted into sulphate by adding finely-ground iron pyrites towards the end of the roasting process. The mass is then treated with a small quantity of sulphuric acid to act on the last traces of zinc oxide, and then thoroughly lixiviated. The zinc sulphate solution (when clear) is slightly acidified with sulphuric or hydrochloric acid and granulated zinc added till any lead, tin, cadmium, bismuth, silver, arsenic, copper, or antimony which may be present has been precipitated. The iron is precipitated by the cautious addition of bleaching-powder solution. The solution is filtered, slightly acidified with hydrochloric acid, and hot barium sulphide solution then added. A white precipitate of zinc sulphide and barium sulphate is obtained. This is dried, roasted in a current of sulphur dioxide, and ground; and is then ready for use. The barium sulphide, free from barium hydroxide, is obtained from the crude sulphide by preparing a saturated solution, drawing off the liquid from the undissolved matter and the barium hydroxide which crystallises out, and either passing in hydrogen sulphide, till the solution ceases to give a precipitate on the addition of magnesium chloride; or adding hydrochloric acid till the magnesium chloride test gives no precipitate.—F. W. T. K.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Some New South Wales Tan Substances. J. H. Maiden, Royal Society of N. S. W. June 1, 1887. Part I.

The following barks and kinos were examined:—

Bark of *Acacia Sentis*, found in all the Colonies except Tasmania; yields 18·02 per cent. of extract to water at 100° C. Tannin 6·32 per cent.

Bark of *Acacia Penninervis*, found in all Colonies except S. and W. Australia. Bark of trunk yields 45·5 per cent. extract and 16·96 per cent. tannin. Vernacular names are "Hickory" and "Blackwood."

Bark of *Acacia Melanoxylon*, called "Blackwood" and "Lightwood," found in all the Colonies except Queensland and W. Australia; yields 20·63 per cent. extract and 11·12 per cent. tannin.

Bark of *Acacia Anema*, called "Mulga," found in all the Colonies except Tasmania; yields 10 per cent. extract and 4·78 per cent. tannin.

Bark of *Acacia Anema var.*, "Narrow-leaved Mulga," found in same locality as the normal species; yields 20·72 per cent. extract and 8·62 per cent. tannin.

Bark of *Acucia Decurrens*, usually called "Black Wattle," but also called "Silver Wattle," found in all the Colonies except W. Australia; yields 42·16 per cent. extract and 32·08 per cent. tannin.

Bark of *Eucryphia Moorei*, called "Plum tree" and "White Sally," found in Victoria and New South Wales; yields 21·4 per cent. extract and 7·74 per cent. tannin.

Bark of *Eucalyptus Stellulata*, called "Black Gum" and "Black Sally," found in Victoria and New South Wales; yields 27·64 per cent. extract and 12·86 per cent. tannin.

Kino from *Eucalyptus Amygdalina var.*, called "Ribbon Gum," found in South-Eastern New South Wales. A clear portwine-coloured kino, very friable and almost completely soluble in cold water; yields 99·22 per cent. extract and 57·76 per cent. tannin.

Bark of *Eucalyptus Sieberiana*, called "Cabbage Gum," found in all the Colonies except Queensland and W. Australia. The kino from this bark yields 95·04 per cent. extract and 36·96 per cent. tannin.

Bark of *Eucalyptus Leucoxylon*, called "Red-flowering Ironbark," found in all the Colonies except Tasmania and W. Australia; yields 67 per cent. extract and 41·9 per cent. tannin.

Eucalyptus Siderophloia, called "Red Ironbark," found in New South Wales and Queensland. The bark with adherent kino yields 68·1 per cent. extract and 26·48 per cent. tannin. The bark yields 26·56 per cent. extract and 10·4 per cent. tannin, and the kino yields 97·56 per cent. extract and 35·1 per cent. tannin.

Kino from *Euculyptus Corymbosa*, called "Bloodwood," found in New South Wales to W. Australia. In appearance this kino strongly resembles a low-grade Dragon's blood, and readily forms a powder of the colour of "Venetian red." It can be delivered in Sydney for about 3*d*. a lb., and "there is no doubt that it is a cheap and efficient substitute for the lower grades of Dragon's blood." It yields 72·28 per cent. extract and 28·44 per cent. tannin.

Part II., read Aug. 3, 1887.

The kino from *Angophora Intermedia*, called "Apple tree," found in Victoria, New South Wales, and Queensland. It is reddish-brown in colour and very friable, and yields 90·70 per cent. extract and 46·95 per cent. tannin.

The kinos from *Eucalyptus Macrorrhyncha* and *E. Haemastoma* were of a rich ruby colour, and yielded 95·53 per cent. extract and 54·12 per cent. tannin.

The barks from two varieties of *E. Gunnii*, found chiefly in Tasmania, and called "Bastard Gum" and "Red Gum," yielded 9·45 per cent. and 11·35 per cent. tannin.

The barks of *Acacia Colletoides*, *A. Rigens*, *A. Pendula*, and *A. Glaucescens*, found in South Australia, Victoria, and New South Wales, yielded from 5 to 8 per cent. of tannin.

The bark of *A. Vestita*, which is very similar in appearance to *A. Decurrens*, gave 27·96 per cent. tannin. *A. Binervata*, called "Black Wattle," is a valuable bark, and yields 30·4 per cent. tannin. *A. Longifolia*, called "Golden Wattle," yields 30·35 per cent. extract and 18·93 per cent. tannin. *A. Dealbata*, which is very similar to and has the same geographical range as *A. Decurrens*, is called "Silver Wattle," and yields 21·22 per cent. tannin.

The bark of *Fusanus Acuminatus*, called "Quandong," found in all the Colonies except Tasmania, yielded 39·46 per cent. extract and 18·84 per cent. tannin.

The results afforded by the Eucalypts prove that the barks of this genus are worthy of earnest consideration by the tanner, and the tan substance would be best sent to market in the form of extract. The desirability of looking farther afield for fresh tan-substances is illustrated by the scarcity of good wattle barks. Barks of worthless wattles, so similar in appearance to *A. Decurrens* as to deceive an expert, are often added to increase the bulk.—B. H.

The Manufacture of Novel Substances suitable for Tanning and for other Purposes. A. Bedu, Paris, France. Eng. Pat. 16,647, December 18, 1886. 6*d*.

A "tanno-sulphurous acid" is prepared, and also "tanno-sulphites" or "sulpho-tannides," and applied for tanning. The tanno-sulphurous acid is obtained by the oxidation of any of the various phenolsulphonic acids and their homologues. The oxidation can be effected in various ways, as by manganese peroxide or by pouring oxygenated water on the sulphonic body. It is better, however, to dissolve one equivalent of peroxide of barium in two of sulphonic acid, and then treat the solution with sulphuric acid. The tanno-sulphurous acid can be directly employed for tanning as a 4 per cent. solution.

The best method of forming the salts is to treat the phenolsulphonic acid with one of the following bodies:—7 per cent. permanganate, 8 per cent. bichromate, 15 per cent. aluminate, or 10 per cent. stannate, of potash or soda.

For tanning the hides or skins are immersed in 5 per cent. solution of a tri-oxyphenolsulphite, and the goods may be subsequently treated with bark or tanning extracts, or the new substances may be employed alone.—B. H.

Polish or Coating (Soluble in Water) for Leather. H. Buczkowski, Vienna, Austria. Eng. Pat. 16,832, December 22, 1886. 6*d*.

The patentee first states the objections to the various polishes in use, which contain mineral acids, waxes, resins, &c., and which are detrimental to the leather. His improved polish consists essentially of a dressing for leather, the polishing or glossing constituent of which is soluble in water. These results are obtained by variously-constituted compounds, the components of which may be divided into four groups. 1st, the polishing element, comprising tannic acid or extracts and dyewood extracts, preferably logwood. 2nd, elements for increasing the lustre, such as sugar, molasses, gum-arabic. 3rd, elements for preserving the leather, namely, oils and fats. 4th, waterproofing elements, such as caoutchouc, &c. The polish is prepared by dissolving the tannic matter in water or alcohol, and this may be mixed with a solution of saccharine matter, and to this oils or fats may be added. Different methods and proportions of ingredients are given for making polishes, and there are 18 claims.—B. H.

Improvements in Apparatus for Burring and Cleaning Hairy and Woolly Skins and for Unhairing and Softening Skins. J. Straiton, Bootle. Eng. Pat. 16,894, December 24, 1886. 8*d*.

This invention relates to the class of machines in which there is a rotating drum fitted with knives or beaters and apparatus for holding the skins in contact with the drum. It consists (1) in making the drum in segments each provided with a complete set of diagonal and transverse blades; (2) in providing a nipping roller above the carrying rollers to prevent the return of dirty water with the skins; (3) in connecting the feed rollers to the water supply; (4) in employing rollers to retain the skins against the drum, and in obtaining the desired pressure with adjustable springs or weights; (5) in providing a hinged trough below the drum fitted with a pressure piece and lever by which the skins can be held against the drum when required.—B. H.

Improvements in the Manufacture of Waterproof Leather. A. Smetham, Liverpool. Eng. Pat. 1009, January 22, 1887. 4*d*.

The tanned butts or leather are subjected to the action of melted paraffin or other similar substance in a suitable tank for from one to fifteen minutes, according to the thickness of the leather. They are then passed through petroleum spirit or solvent in a series of tanks, preferably so that the last tank contains the least spent solvent. The paraffin is removed from the surface but retained in the interior of the leather, which is restored to its original colour or as near thereto as may be desired.—B. H.

XV.—AGRICULTURE, MANURES, Etc.

Points of difference in Rape, Swede (Rübsen), Turnip, and Cabbage Seed. Wittmack. Bied. Centr. **16**, 626–627.

The importance of a ready method of distinguishing these seeds from one another rests on the fact that rape and swede seed are oil-producing, whilst turnips and cabbage seed are not. Many points of difference are noted, the most conspicuous being the following:—cabbage seeds are somewhat flat, frequently angular, and are therefore not as spherical as rape seed; they are of a grey-black colour, rape seed is brown-black, swede seed, brown-red; moreover, cabbage seed is frequently covered with small white-grey scales. When soaked in water for 24 hours the colour of cabbage seed changes to light brown-red, the water itself becoming light yellow; rape seed does not change in colour under such circumstances. When husked or cut open, rape and swede seed are golden yellow inside, whilst cabbage seed is pale yellow.

Cultivation tests are necessary to distinguish rape from turnip-rooted cabbage and swedish turnip seed; and swede seed from ordinary turnip seed.—D. A. L.

Action of Various Substances on Peronospora Viticola. C. Hughes. Bied. Centr. **16**, 631–633.

Vines were treated with various substances to study the action of these substances on Peronospora viticola, and their effect on the quality and quantity of the produce. With regard to the first object, milk of lime, sulphur containing sulphurous acid, lime powder, and some mixtures were not found completely satisfactory for combating the attacks of this pest; whereas copper sulphate solutions either alone or mixed with ammonia, or with solutions of lime, proved successful in preventing the attacks by Peronospora, without injury to the leaves. Solutions containing 2 or 3 parts of copper sulphate per 1000 are quite efficient, and are applied to the plants by means of a spray distributor, about 600–800 litres being sufficient for 1 hectare; the time for first application is the end of May or beginning of June, the second should be made in July, and the third, if necessary, in August.—D. A. L.

Experiments on the Application of Peat to Purposes of Disinfection. J. Soyka. Bied. Centr. **16**, 707–710.

Meat placed on and covered with air-dried peat in a glass jar, after exposure in a room for 6–12 weeks, had not putrefied, but had shrunk into quarter its original size to a very hard wood-like mass with the upper surface abundantly attacked by mould-fungi; these had, however, not penetrated the peat layers. In a similar experiment with gravel, meat became putrid in three days.

This action of peat may be due to its water-absorbing power; 100 parts of this dry peat absorbed 876–1245 parts of water—thus removing the water necessary for putrefaction; or it may be attributed to the acidity of the peat which is unfavourable to the development of putrefactive organisms, but does not impede growth of mould, or finally to the great quantity of mould-fungi present in peat; perhaps even the gas-absorbing power of peat exerts some influence.

With regard to the organisms in peat; when peat is put in nutritive gelatin there is such a vast and speedy growth of moulds that other organisms, even if present, can scarcely be expected to develop.

The dry peat in question yielded 3·56 of matter soluble in water, and the acidity of the solution was equivalent to 0·4 per cent. of oxalic acid. To test the action of peat-acids on lower organisms, various well-known and pathogenic microbes cultivated in nutritive gelatin were added to peat extract. The experiments included *bacterium lactis*, *b. butyricus*, the hay bacillus, *micrococcus prodigiosus*, and the bacteria of typhus and splenic fevers, of cholera, or the one accompanying it, &c. It was found that the peat extract impeded the development of the organisms in each case; so that organisms in the extract were 6 days or more later in development than other organisms in nutritive gelatin only, and, moreover, the development was not so vigorous. It will thus be seen that peat delays the development, but does not destroy these organisms, and therefore, if it is to be used as an antiseptic, it must first be impregnated with an antiseptic substance.—D. A. L.

Electric Light and Plants. Centr. für das gesammte Forstwesen, 1887. 336.

In the St. Petersburg Winter Palace it was observed that when the ornamental plants were exposed to the full electric light, even for one night, they became yellow and dry, and that this was followed by the leaves falling off. The rapidity and intensity of this action increased with the strength and height of the lights, but those plants not exposed to the direct rays did not suffer. The sudden change from the dull light of the sunless northern winter days, or of the greenhouse to the dazzling electric light, is regarded as the chief cause of this injury to the plants.
—D. A. L.

Experimental Cultivation of different kinds of Oats. Edlar. Jour. für Landw, 1887. 95–102.

Several varieties of oats were cultivated in the neighbourhood of Göttingen on the same field and under similar agricultural conditions, the manure employed being 8 centners of superphosphate (20·4 per cent.), and 3 centners of Chili saltpetre (15 per cent.) per hectare. The results were as follow:—

Kind of Oats.	Period of Vegetation, Days.	Yield in Kilos per Hectare.		
		Grain.	Straw, &c.	Albuminoïds.
Black Tartary bearded oats	131	4,200	8,600	507
Black "Rispenhafer"...	131	3,400	9,100	416
Lüneburg "Klay-hafer".	128	3,600	7,900	351
Yellow Canadian "Rispenhafer"	130	4,100	7,000	481
Yellow "Probsteierhafer"................	130	4,100	7,000	434
Archangel oats..........	119	3,800	6,800	379
Ordinary Swedish white "Rispenhafer"	120	3,100	7,200	323
New Zealand oats.......	118	3,200	6,800	364

In some cases the harvested corn proved of better quality than the seed corn.—D. A. L.

Importance of the Periodic Assimilation of Food by Cultivated Plants. G. Liebscher. Königsberger land, und forstw. Zeit. 1886. 301.

The author has constructed curves based on data from investigations on the composition of different farm plants in different stages of growth, by which it is demonstrated that each kind of plant, in taking up its various food-substances, follows a definite and characteristic course. In the author's opinion an exact knowledge of the periods of assimilation for different plants would be of great value, both from a manurial standpoint and for clearing up some of the burning agricultural questions of the day; such for instance as the large accumulations of nitrogen in some plants, which might be explained by their having a long period of assimilation extending throughout the period of most active nitrification. From a manurial point of view the knowledge that certain plants take up their food gradually during a long period, whilst some others are limited to only a very short period for obtaining their nutrition, would be of great value, inasmuch as both time of application and character of the manure could then be suitably adjusted to the circumstances.—D. A. L.

Cultivation of English Wheat. O. Beseler and F. Heine, Deutsche landw. Presse, 1887, September.

Beseler is of opinion that English wheat should be sown as early as possible, viz., at the end of September or beginning of October. Direct dressings of farmyard manure should be avoided as much as possible on warm mild soils, unless ploughed in beforehand or used in a fine and fermented condition. Nitrogenous manures are to be used in only small quantities on rich soils; after fodder crops, rape or peas, 20 kilos per hectare may be taken experimentally; after potatoes, 30 to 35 kilos per hectare may be applied; whilst 40 to 45 kilos may be put on after summer corn or unmanured turnips. When nitrogen as ammonium salts is not much cheaper than as nitrate, use the latter for small dressings, and half-and-half for large dressings; apply small dressings in the furrows before the autumn sowing, and large dressings $\frac{1}{3}$ or $\frac{1}{2}$ in the autumn, the rest in the spring, as nitrate, before vegetation has recommenced, otherwise there is a tendency in deep soils to an excessive formation of straw with weak ears. It is a great mistake to manure thin crops heavily in hopes of getting stronger plants. Phosphatic manures should only be used when shown by experiment to be required, even then only in moderate quantities and in conjunction with nitrogenous manure; the phosphatic manure should be spread in the furrows in the autumn before sowing the seed, but not previously mixed with the nitrogenous manure. The quantity of seed to be sown should be regulated by the character of the wheat, by the time of sowing, by the past and present manurial condition of soil, and by the previous cropping. The lowest allowance under favourable circumstances is 110–120 kilos per hectare, with rows 21–24 c. m. apart; the highest allowance when conditions are bad is 180–200 kilos. with rows 13 to 15 c. m. apart; for broadcasting 20 per cent. more must be allowed.

Heine remarks that wheat may be sown on poor land at the end of September, but on rich land not before October. He states that in some cases nitrogenous manures are not only useless but sometimes even harmful; after oilseeds or early potatoes he thinks not more than 10–15 kilos advisable, and then only when required. He agrees with Beseler in most other points, and recommends spring sowing of nitrate early in May; he lays special stress upon the economy of nitrogen as nitrate as compared with nitrogen as ammonium salts.—D. A. L.

A Process and Apparatus for Utilising Urine as Manure. A. W. Carlson, Stockholm, Sweden. Eng. Pat. 17,000. December 28, 1886. 8*d*.

Fresh urine is absorbed in masses of turf or peat mixed with gypsum, phosphates, &c., and dried by being placed on perforated trays in a dessicating chamber, through which a current of hot air is drawn by a fan.—C. C. H.

An Improved Fertiliser. H. H. Lake, London. From P. B. Rose, Ann Arbor, U.S.A. Eng. Pat. 14,154, October 18, 1887. 4*d*.

This invention relates to the utilisation of the nitrogenous matter in "tank water," which is produced in large quantities in the rendering of tallow and other fats, and contains 10 per cent. of solid matter. Many attempts have been made to utilise this tank water as a fertiliser, but have failed owing to the very hygroscopic nature of the residue got on evaporating off the water. The patentee causes the tank waste to be absorbed by fibrous vegetable material, such as hay, straw, sawdust, street sweepings, &c., and then dried. The best proportions to use are from two to four parts of the tank water, evaporated to the consistency of a thick syrup, to two parts vegetable material; but the patentee claims the product broadly without reference to the relative proportions used. Calcium phosphate or equivalent material may also be added.—B. H.

XVI.—SUGAR, STARCH, GUM, Etc.

The Carbohydrate Nature of Formose. C. Wehmer. Ber. **20**, 2614—2618.

This is a reply to a paper by Loew (this Journal, 1887, 446), in which he criticises the statement of Tollens and the author that formose does not belong to the sugars. In the present paper Wehmer repeats the objections to regarding formose as a carbohydrate, and supports his view by the fact that formose is not assimilated and converted into starch by etiolated leaves and shoots of plants in the same way that dextrose, levulose, maltose, sucrose, mannitose, &c., &c., are; also by the fact that no levulinic acid is formed by the action of dilute acids. He considers that Molisch's reaction is not to be relied on as a proof of its carbohydrate nature.—G. H. M.

A new Proof of the Carbohydrate Nature of Formose. O. Loew. Ber. **20**, 3039—3043.

Förster has shown that the sugars are amongst the substances which yield furfurol when their aqueous solutions are boiled. The author has applied this test to formose, and finds that this substance gives a considerable yield of furfurol: he considers to be an additional proof of the carbohydrate nature of formose.

He criticises the preceding paper at length, and considers it to be full of errors. According to him the general characteristics of a sugar are:—

1, sweet taste; 2, strong reducing power; 3, easy decomposibility by dilute alkalis; 4, formation of a saccharic acid or its lactone by the action of caustic lime; 5, power of combining with hydrogen and hydrocyanic acid to form an osazone; 6, formation of humin substances by acids.

As minor characteristics he regards:—

1, formation of furfurol or levulinic acid by dilute acids; 2, fermentability; 3, the composition of the osazone (whether it contains O_3 or O_4).

He considers that formose answers to all the former requirements, and to some of the latter. He points out that A. Meyer has shown that the different orders of plants behave differently with the various sugars, and mentions that formose constitutes a good nutritive material for certain plants, especially mould-fungi.—G. H. M.

Improvements in the Manufacture of Materials for use in Purifying and Decolorizing Liquids and Solutions. F. Candy, Bexley. Eng. Pat. 11,048, August 30, 1886. 6*d.*

The improved material which is designed principally for use in sugar refineries in place of bone-black, consists of clay which is calcined, granulated, mixed with tar, oil, or some other carbonaceous material, and finally subjected to great heat in a retort until the carbonaceous matter is completely carbonized.—A. J. K.

Improvements relating to the Treatment of Sugar Cane for the Extraction of Sugar therefrom, and to Apparatus therefor. H. H. Lake, London. From T. F. Krajewski, New York. Eng. Pat. 12,012, September 21, 1886. 8*d.*

This invention consists in a mill for cutting and crushing the sugar cane previous to its passing through the usual roller press which is used for extracting the juice. In the new mill the crushing apparatus is composed of rollers provided with teeth having a zig-zag trend in the direction of the length of the rollers. These teeth intermesh but do not come into contact with each other, and when intermeshed are equi-distant from each other.—A. J. K.

Improvements in the Manufacture of Sugar. A. Brin and L. Q. Brin, Paris. Eng. Pat. 12,535, October 2, 1886. 6*d.*

The authors bleach sugar by means of ozone; the gas is passed into the liquor, which is kept well agitated; the ozone decolorizes the liquor and passes off as oxygen, which can be re-converted into ozone.—A. J. K.

Improvements in Apparatus for the Manufacture of Refined Sugar, applicable also to the Manufacture of Glucose, Starch, and similar Products. H. Vivien, Paris, France. Eng. Pat. 16,827, December 22, 1886, 11*d.*

This invention relates to apparatus for the manufacture of refined sugar in the form of slabs or tablets by means of centrifugal machines. The apparatus consists of three parts; (1) rectangular cells with parallel sides for receiving the "masse cuite"; (2) specially designed trucks for carrying the cells. The cells are placed in the trucks for the purpose of filling, and are then conveyed in the trucks to (3) the specially constructed centrifugal machines. In these machines the cells are arranged radially from the centre, and when firmly secured the washing and purifying of the slabs of sugar is conducted in the usual manner.
—A. J. K.

Method of Extracting Foreign Substances, in particular Raffinose, from Sugar Solutions by means of Lead, either in the form of Oxide or as Electrode. C. D. Abel, London. From Messrs. Pfeifer and Langen, Cologne, Prussia. Eng. Pat. 165, January 5, 1887. 6*d.*

The substance known as "Raffinose" was first separated from refinery molasses by Loiseau in 1876. It has the following properties prejudicial to sugar manufacture:—(1.) In crystallising out it combines with cane sugar, forming sharp pillar-like porous crystals of poor appearance. (2.) It increases the viscosity of sugar solutions, retarding crystallisation and diminishing the yield of sugar. (3.) In certain processes of refining it tends to accumulate in the syrups. (4.) It has a higher specific rotatory power than cane sugar, thus invalidating the optical determination of cane sugar.

The authors propose to remove this raffinose by means of lead. Either the liquor is boiled with oxide of lead, as litharge, or the liquor is passed between two electrodes of which the anode is of lead. In either case the raffinose is precipitated, and may be filtered off. The liquor is freed from any remaining trace of lead by means of carbonic acid gas.—A. J. K.

An Improved Process for systematically Lixiviating Raw Sugar by means of Aqueous, Alcoholic, or other Saccharine Solutions. Steffen, Vienna, Austria. Eng. Pat. 7119, May 16, 1887. 8*d.*

For the purpose of lixiviating raw sugars, solutions of sugar in water, alcohol, glycerine, or acetic acid are used. The lixiviating fluid is divided into 12 portions of varying strength and purity, and the lixiviating vessels are so arranged, as a kind of battery, that the sugar is treated by each portion in a regular predetermined succession.
—A. J. K.

Apparatus for Purifying and Refining Sugar. H. W. Walker and T. L. Patterson, Greenock. Eng. Pat. 2924, July 31, 1887. 2nd edition. 8*d.*

This invention consists in certain apparatus and modifications of existing apparatus for purifying sugar by use of a mixture of steam and air in the centrifugal machine. The sugar to be treated is first reduced by a crushing and mixing machine to a uniform mass; the crushing machine is described in the specification, but it is not claimed as a part of the patent. It consists of a cast-iron cylinder about 18 inches diameter, having short tubes about 6 inches diameter at each end, and fitted with a central shaft, on which are fixed radial blades, arranged helically. The end of the shaft is made hollow, and is connected by packed glands with a valve and pipe, through which the syrup or liquid to be mixed with the sugar is supplied. As the shaft revolves, the sugar and liquid are thoroughly mixed, and the magma formed is discharged at the other end of the cylinder into a receiver placed near the centrifugals. The mixing cylinder may be placed horizontally or it may be inclined.

The improvements in the centrifugal machines are applicable to any form of machine at present in use—whether over-driven or under-driven. They consist, essentially, in closing in the cage of the machine by a suitable cover, and of the introduction of air and steam by means of a jet of high-pressure steam on the injector principle, the air being forced through the sugar along with the steam. Suitable arrangement is also made for carrying off any drops of water which result from the condensation of the steam on the ironwork of the centrifugal, and so preventing it from falling on to the sugar. In conducting operations with this improved apparatus, the sugar magma having been placed in the machine in the usual way, the machine is set in motion, and when the syrup is considered to be completely discharged, or nearly so, the steam jet is turned on. The supply of steam is kept up until the syrup from the machine is colourless, or as nearly so as is desired. If it is wished to machine the sugar hard, the machine must be rotated for about five minutes after the steam is shut off.—A. J. K.

Process for Manufacturing White Lump or Loaf Sugar directly from Boiled Refinery Mass. C. H. J. Franzen, Cologne. Eng. Pat. 12,596, September 16, 1887. 4*d.*

Boiled refinery or lump-sugar mass is first filled into a large suction vessel with sieve bottom in a more or less cooled condition, a suction pump is applied, and the yellow syrup is drawn off and its place supplied by pure white syrup, which is put in at the top. The pure white mass is now warmed to the usual filling-out temperature—filled into moulds where it congeals to a hard white mass, and is finally freed from liquor by centrifugal or other suitable means.—A. J. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Stalagmometer. A new Method for the determination of Fusel Oil in Alcoholic Liquids. J. Traube, Ber. **20**, 2644—2655.

In a former paper the author proposed to estimate the amount of fusel oil in alcoholic liquids by means of a capillary tube (compare this Journal, 1886, 393, 496, and 546, and 1887, 52); the method, however, required a certain amount of care in order to obtain good results, and was therefore unsuited for technical use. He has now constructed a dropping apparatus, which he calls a *stalagmometer*. It consists of a vessel which is filled to a given mark, and the contents then allowed to drop through a capillary tube and the numbers of drops noted. With this apparatus the greatest error does not amount to more than 0·2 drops per cent. The alcoholic liquid to be tested is diluted to about 20 per cent., and the number of drops given by the liquid to be tested is compared with that given by pure ethylic alcohol of the same strength. An increase of 1·6 drops per cent. corresponds to 0·1 per cent. fusel oil, of 3·5 drops per cent. to 0·2 per cent. fusel oil, and so on. 0·05 per cent. fusel oil can readily be determined in this way.

In cases in which it is desired to determine the fusel oil in an alcoholic liquid containing mixed ethers and ethereal oils, the author recommends the addition of a certain amount of ammonium sulphate to the diluted liquid. The fusel oil separates from the alcoholic solution, which can be drawn off, and the fusel oil is then dissolved in water, distilled and estimated with the stalagmometer. That the mixed ethers exercise an influence on the drop-number is shown when a liquid containing these substances is examined before and after distillation with potash; the former number is higher than the latter. Experiments with spirit of various degrees of purity showed that the method can be employed to detect the smallest impurity in the spirit.—G. H. M.

Improvements relating to the Treatment of the Waste Products of Breweries for the Production of Alcoholic Liquor. W. Gerdes, Dortmund, Prussia. Eng. Pat. 17,059, December 29, 1886. 6*d.*

The inventor proposes to utilise the sugars remaining in the cooler sediments, the deposits from the store-vats, and the residue below the filtering bottom of the mashing-tuns to obtain alcohol. He treats these products with rye flour and sulphuric acid in order to obtain complete conversion, then ferments, preferably with *Saccharomyces ellipsoïdeus*, and finally distils in the usual way. A very pure spirit is obtained.—G. H. M.

Improvements in Treating Brewers' Wort and Apparatus therefor. W. Adlam, Bristol, and F. Faulkner, Oldbury. Eng. Pat. 1516, January 31, 1887. 8*d.*

Wort from the mash-tun is heated to boiling in a multitubular vessel by means of a steam jacket, then cooled by passing through a similar vessel, surrounded by cold water, and again sparged on to the "goods" in the mash-tun. An improved wort with an increased per-centage of dextrin is claimed to be thus obtained. The multitubular vessel forms a part of the invention.—G. H. M.

Improvements in Brewing. C. Clinch, Leeds. Eng. Pat. 2005, February 8, 1887. 11*d.*

This consists in raising the temperature of the grist before mashing in order to prevent or lessen the reduction of the temperature of the hot water during the process of mashing. This is effected by passing heated air through the grist whilst in the hopper above the mash-tun. Drawings of the apparatus employed accompany the specification.—G. H. M.

Improved Apparatus for Regulating the Surface Flow of Wort from Coolers used in the Manufacture of Beer. R. Ranger, Maidstone. Eng. Pat. 11,232, August 17, 1887. 8*d.*

An arrangement by means of which the top surface of wort in the cooler is drawn off, and which acts automatically as the level is lowered. The apparatus consists of a valve working like a telescope, and being lowered and raised by means of a wheel with a double groove; to one groove is fixed a chain, the other end of which terminates in a float; in the second groove runs a chain connected at one end with the valve and at the other with a weight to counterbalance the float and valve.—G. H. M.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

Improvements in the Manufacture of Cheese and in Apparatus therefor. T. B. Brodbelt, Tatenhall. Eng. Pat. 15,674, December 1, 1886. 8*d.*

Milk is coagulated in the usual way. The curd is separated from the whey in a centrifugal machine, and then moulded in any suitable way; the drying of the moulded cheese may be facilited by rotating the cheese thus formed in a centrifugal machine, which itself revolves on an axis parallel to the axis of rotation of the basket of the machine.—C. C. H.

An Improved Method of Preserving Fruit, Vegetables, and other Articles of Food. L. and C. Stollwerck, Cologne, Germany. Eng. Pat. 9950, July 15, 1887. 4*d.*

The fruit, or other vegetable product, in a hot state, is placed in jars or vessels, or it is cooked in the vessels themselves. Whilst hot the vessel is closed by means of a solid plate of non-porous material, *e.g.*, glass, and when cool cemented down.—C. C. H.

Improvements in Preserving Milk. J. Jensen, London.—From R. G. Duhl, Drammen, Norway. Eng. Pat. 10,903*, August 26, 1886. 8*d.* (Amended specification.)

The inventor now restricts his claim to "Improvements in preserving milk," deleting the words "and in vessels or containers thereof," from the original title of the specification. Compare this Journal, 1887. 877.

An Improved Process for Condensing Milk and other Fluids containing Protein, and Preserving the same in Glass or other hermetically closed Vessels. E. Scherff, Wendish Buchholz, Prussia, and C. Drenckhau, Stendorf Holstein, Germany. Eng. Pat. 14,744, Oct. 29, 1887. 8*d.*

If milk be heated above 75° C. the protein coagulates and forms a coating round the casein, so that its power of swelling, and subsequent solution in liquids, is entirely lost. If heated between 60° C. and 75° C. in closed bottles for the purpose of preservation by the destruction of putrefactive germs there is so great an evolution of vapour that the bottles burst. The new process provides for heating the milk in vacuo between 60° C. and 75° C., during which time it is condensed, and afterwards can be hermetically sealed in vessels and heated to the higher temperature with impunity. The specification shows a special form of vacuum evaporator, the construction of which the patentees claim as novel.—C. C. H.

(*B*)—SANITARY CHEMISTRY.

Improvements in the Desiccation, Incineration, and Carbonisation of Precipitants or Solids resulting from Sludge or other Substances liable to Putrify, and in Means or Apparatus employed therein. R. de Soldenhoff, Cardiff. Eng. Pat. 12,259, September 27, 1886. 11*d.*

This specification describes improvements upon the furnace described in Eng. Pat. 2721, 1886 (this Journal, 1887, pp. 557–558). The modifications aim at the possibility of drying and incinerating sewage sludge by means of the heat evolved in the coking of coal. For details the original specifications and drawings must be consulted.—C. C. H.

Improvements in the Treatment and Purification of Sewage and other Impure Liquids, and in the Obtaining of Fertilisers therefrom. T. B. Wilson, Manchester. Eng. Pat. 16,244, December 11, 1886. 6*d.*

The sewage is defecated by the addition of solutions of sulphate of alumina, and either or both calcium and magnesium chlorides. The quantity of each re-agent varies with the impurity of the sewage; but with a typical impure sewage six grains per gallon of the first re-agent and an equal weight of either, or a mixture of the latter re-agents, gave good results.—C. C. H.

An Improved Method of Treating Sewage and Apparatus for the Purpose. F. D. Brown, London. From A. Howatson, Brussels, Belgium. Eng. Pat. 16,461, December 15, 1886. 8*d.*

The sewage is treated with lime water and a deodorant, and then run into precipitating tanks holding $2\frac{1}{2}$ to 3 hours' flow of the sewage. The bottom of each tank has a series of conical bottoms into which the sludge settles, from whence it is drawn off by a valve or cock. Such an arrangement enables the tank to be worked continuously.—C. C. H.

Improvements in the Treatment of Sewage and the Recovery of Valuable Products therefrom. J. C. Butterfield and H. H. Mason, Barking. Eng. Pat. 13,007, October 12, 1887. 8*d.*

Excreta collected by the pail system, and sewage sludge obtained in the usual manner by the defecation of water-carried sewage, are dried by filter-pressing or otherwise, and submitted to destructive distillation in cast-iron retorts placed vertically in a furnace. Mixed with about 3 per cent. of lime, and distilled at 315 to 480° C., ammonia and paraffin oils result, and these are condensed and collected in the usual manner.—C. C. H.

(*C*)—DISINFECTANTS.

Improvements in the Method of Applying and Manufacture of Antiseptic, Disinfecting, Curative, and Healing Agents. H. G. Harris, London. Eng. Pat. 14,685, November 12, 1886. 6*d.*

This invention applies to that class of antiseptics, &c. which are vaporised by heat or produced by the combustion of other substances. Any such agent may be incorporated in pastilles, matches, vesuvians, &c., and burned in the atmosphere it is desired to purify. If liquid, they may be burned in cups or tubes. Sponge, wood, asbestos, or pumice may be employed to absorb them prior to combustion. —C. C. H.

Improvements in the Production of Solutions for Use as Antiseptics, Disinfectants, Deodorants, Oxidants, and General Sanitary Re-agents. C. T. Kingzett, London. Eng. Pat. 276, January 7, 1887. 6*d.*

In the preparation of disinfectants by the oxidation of some member of the terpene series it has been customary to use earthenware vessels. The patentee finds vessels lined with pure tin equally suitable, and, as a consequence, they can be used of any size. The second part of the invention consists in the use of sea water, or fresh water in which the saline constituents of sea water have been dissolved, in place of fresh water; by this means the peroxide of hydrogen produced in the process of oxidation in the methods referred to is better preserved from change. The third part of the invention relates to the use of one or more of several antiseptic substances specified added to the solution before or after oxidation.—C. C. H.

An improved Disinfectant and Oxidising Agent. J. C. Stevenson and J. G. Tatters, South Shields. Eng. Pat. 381, January 10, 1887. 4*d.*

The improved disinfectant is made by mixing, in a perfectly dry state, six parts, more or less, of sodium manganate with three parts, more or less, of bleaching powder.—C. C. H.

New or Improved Combination of Ingredients, and the Production of "Powders" therefrom, for Disinfecting and Deodorising Purposes. R. V. Tuson, London. Eng. Pat. 451, January 11, 1887. 4*d.*

Such powders are made by mixing, in a perfectly dry state, the sulphites or bisulphites of the alkalis or alkaline earths with one or more of the bisulphates of the alkalis, and sometimes the addition of a soluble salt of zinc, copper, or mercury. A powder for ordinary use may consist of 50 parts each, by weight, of calcium sulphite and sodium bisulphate, and 15 parts of zinc sulphate.—C. C. H.

An Improved Disinfecting and Curative Device and Composition or Powder to be used therewith. J. H. Harford and W. W. Reeves, Cincinnati, U.S.A. Eng. Pat. 2831, February 23, 1887. 8*d.*

The medicated powder adapted for inhalation through the nostrils in the treatment of certain diseases consists of liquorice root, 2 parts; white hellebore, 8 parts; slippery elm, 12 parts; camfrey, 8 parts; yellow root, 1 part (by weight). These substances mixed in a fine state of division are enclosed in a bag of porous material and held in the hand; at the same time the side of the bag is rapped by a steel spring snapper which causes the powder to escape in a fine state of division, and it is thus inhaled.—C. C. H.

Improvements in the Preparation of Disinfectants, Deodorants, and Antiseptics. A. Duprè and C. N. Hake, London. Eng. Pat. 4283, March 22, 1887. 6*d.*

The use of manganates of the alkalis in conjunction with a free acid for the purpose of disinfection is well known, and it has been proposed to avoid the defects of such a mixture by substituting acid sodium sulphate for the free acid. This mixture, however, deliquesces, and this is, of course, objectionable. The patentees propose to use in its place magnesium sulphate or kieserite, calcium sulphate, zinc sulphate, or boracic acid; the manganate and one of these re-agents are mixed together in a dry fine state of division, and used in the usual manner.—C. C. H.

XIX.—PAPER, PASTEBOARD, Etc.

On the Influence of Gas-lighting on the rapid Discoloration of Wood-made Papers. J. Wiesner. Dingl. Polyt. J. **266**, 181—184.

The author has already shown (Dingl. Polyt. J. 261, 386) that papers containing woody fibre rapidly became yellow under the influence of light, owing to oxidation chiefly induced by the more refrangible rays; and that wood-made papers would thus be still more liable to this discoloration. The advantages of gas-lighting over electric illumination in this respect are evident from the comparative absence of actinic rays in the former. But as many critics have since urged that the gas acts unfavourably upon the paper in other ways, and is therefore not to be recommended for lighting libraries, the author has made other experiments to determine the truth of these assertions. He had before demonstrated that a wood-paper, after four months' exposure at a distance of 0·75 m. from an 8 candle-power gas-flame, exhibited a discoloration equal only to that produced in two hours' exposure to direct sunlight; he accordingly now exposed paper to such other conditions as might be found in badly arranged rooms illuminated by coal gas. The wood-paper used was that of the *Neues Wiener Tageblatt*, and for comparison a non-woody paper (Swedish filter-paper) was simultaneously subjected to like conditions. After an experiment of 5,400 hours' duration, during which the temperature never exceeded 21°, it was found that the gases contained in ordinary illuminating gas (unburnt), whether alone or mixed with a fair proportion of oxygen, are absolutely without action on the paper.

Strips of paper were next placed in a dark room and in a shaded position within a chamber so badly ventilated that the luminosity of the gas flame was distinctly diminished; others at the same time were placed in open glass tubes exposed to the light of the flame. After about twenty weeks, it was seen that the exposed papers, both woody and otherwise (in common with the glass window of the chamber), had received an equal depth of a light-brown sooty deposit, whilst those shielded by the glass tubes from deposition of solid matter, but open to the atmosphere, were practically unaltered. The woody paper alone had taken the faintest yellowish tinge, due to its exposure to light. During the whole time the range of temperature was never greater than from 19° to 30°. Discoloration is therefore not attributable in any marked degree to the products of combustion even when mixed with oxygen. Other experiments in regard to the influence of heat showed that at the temperature of 35° to 40° discoloration proceeds rapidly in the presence (and only in the presence) of oxygen. A distinct yellowish shade was observed on the wood-paper after 300 hours, and was very strong after 1,000 hours. The action at 30° to 35° was much weaker. The author finally sums up by asserting his belief that gas-lighting may be used without fear of deteriorating woody paper in libraries properly warmed and well ventilated.—W. G. M.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Amount of Caffeïne in Different Kinds of Coffee. Paul and Cownley. Pharm. Jour. Trans., 1887, 565.

The authors have made estimations of caffeïne in different coffees by a new method, and found the following percentages: Coorg coffee, 1·10 per cent.; Guatemala coffee, 1·18; Travancore coffee, 1·16; Liberian coffee, 1·20–1·28. They moreover find the amount of caffeïne is the same after as before roasting, although it apparently increases in proportion to the water evaporated.—D. A. L.

Chemical Properties of different Extracts. A. Kremel. Pharm. Post, **20**, 673.

Extract of Opium.—If a drop of iron perchloride solution be added to an aqueous solution of the extract, the latter turns red, on account of the presence of meconic acid. If an opium solution be treated with potassium ferricyanide, containing a trace of iron perchloride, the mass turns blue, owing to the formation of Turnbull's blue. A good extract ought not to contain less than 20 per cent. of morphia.

Extract of Punica Bark.—1 to 2 grammes of the extract are dissolved in water containing a few drops of sodium hydrate. The solution is shaken with chloroform, the latter separated, and after evaporation a yellow residue is left behind, which, treated with concentrated sulphuric acid, turns at first reddish and ultimately green. For estimating the quantity of alkaloids present, 7·5 grammes of the powdered extract, 15 grammes of calcium hydrate, and 150 cc. of 90 per cent. alcohol are digested for 24 hours, shaking from time to time. The mass is filtered, and 100 cc. of the filtrate are diluted with 25 cc. of water. Tartaric acid is added until the reaction is decidedly acid, and the alcohol driven off on the water-bath. The remaining liquid is diluted with water, made alkaline with sodium hydrate, and shaken with chloroform. On evaporating the latter, the pure alkaloids are left behind.

Extract of Ratany.—2 to 3 grammes of the extract are treated with ether in a small extractor. The solution is evaporated, and the residue taken up with hot water. One or two drops of iron perchloride are added to it, also a little sodium bicarbonate, and, after shaking, the mass is filtered. Owing to the presence of pyrocatechol, the filtrate has a violet colour.

Extract of Rhubarb.—The extract dissolved in water which contains a little ammonia turns red. If this solution be acidified a yellow-brown precipitate of chrysophanic acid is obtained, which can be recrystallised from ether or benzene.—S. H.

XXIII.—ANALYTICAL CHEMISTRY.

On the Estimation of Phosphoric Acid. A. Isbert and A. Stutzer. Zeits. Anal. Chem., **26**, 583—587.

The authors show that the use of pure cold water instead of an ammonium nitrate or an ammonium molybdate solution for washing an ammonio-phospho-molybdate precipitate is not accompanied by any serious loss, and that the use of cold water offers the further advantage that any silica which may be present (*e.g.*, in the analysis of crude phosphates) need not be previously removed, for it forms an ammonio-molybdate compound which is perfectly and easily soluble in cold water. The phosphate (5 grs.) is treated with hydrochloric acid or aqua regia, the solution cooled, diluted up to ½ lit., shaken up, filtered, and ammonium molybdate solution added to 50 cc. The precipitate is allowed to settle at 60°—70°. The precipitation is complete in 15 minutes. The precipitate can then be filtered immediately, washed with cold water by decantation and on the filter (about ¼ lit. of wash water is used). In a previous communication (Chem. Zeit. 16) the authors have given a simplification of the method for estimating the phosphoric acid direct from the molybdenum precipitate. They now amplify the observations then made. The modification is as follows :—

The precipitate, obtained as described above, is transferred, filter and all, to a ¾ lit. Erlenmeyer flask, soda lye added in excess, and the ammonia distilled off into a sulphuric acid solution and determined in the usual way. Baryta water is used for titration, and rosolic acid is the indicator.

They find the relation of $N:P_2O_5$ to be 1:1·654. (They prepare their rosolic acid (corallin) themselves, the commercial substance not being pure enough.)

The results obtained are accurate. They do not, however, advocate the method in cases where absolute accuracy is required, and where differences of 0·1 per cent. may not be exceeded. The gravimetric method should then be resorted to.—F. W. T. K.

Volumetric Determination of Boric Acid in Borates and Phosphoric Acid in Phosphates. C. Schwarz. Pharm. Zeit. **32**, 562.

If hydrochloric acid be added very gradually to a solution of a pyroborate, coloured with a few drops of congo-red, the liquid is not turned blue until the whole pyroborate is converted into sodium chloride and boric acid, and free hydrochloric acid is present. If a normal phosphate, or a hydrogen-dibasic phosphate, coloured with congo-red, be titrated with hydrochloric acid, the change of colour takes place when all the phosphate has been converted into dihydrogen-monobasic phosphate, and free hydrochloric makes its appearance.

(1.) $Na_2B_4O_7, 10\,H_2O + 2\,HCl = 2\,NaCl + 4\,H_3BO_3 + 5\,H_2O.$

(2.) $NH_4NaHPO_4\,4\,H_2O + HCl = NH_4Cl + NaH_2PO_4 + 4\,H_2O.$

(3.) $Na_3PO_4 + 2\,HCl = 2\,NaCl + Na_2HPO_4.$

If the hydrates and carbonates of alkalis be absent, borates and phosphates may thus be titrated with normal hydrochloric acid, using congo-red as an indicator.—S. H.

Detection of Oil of Sesame in the Presence of other Oils. M. Merkling. Arch. de Pharm. **10**, 440.

If 2 cc. of oil of sesame be treated with 1 cc. of hydrochloric acid of 1·18 spec. grav. containing about 0·07 grm. of cane-sugar, the oil assumes a red colour. If oil of sesame be digested with glacial acetic acid it is only partially dissolved, a resinous body going in solution, which same body gives the reaction with hydrochloric acid and sugar. Neither the matter left behind, nor other oils, like olive-oil, almond-oil, or castor-oil, show a similar reaction, and this change of colour therefore forms a ready means for detecting oil of sesame in mixtures. The reagent must always be freshly prepared, as it turns brown in a very short time. —S. H.

On Kjeldahl's Method of Estimating Nitrogen. Leop. Lenz. Zeits. Anal. Chem. **26**, 590—592.

Dr. P. Kulisch has shown (Zeit. Anal. Chem. **25**, 149) that in estimating the nitrogen in must, wine, or yeast by Kjeldahl's method, it is important to add a little potassium permanganate towards the end of the decomposition with sulphuric acid, in order to complete the oxidation of the organic matter. Lenz has carried out experiments with a number of other substances to see whether in these cases too, the use of potassium permanganate is advisable. Comparative experiments show that in all cases a slightly larger quantity of nitrogen is obtained when potassium permanganate is used than when it is omitted. In a few cases the quantity is too large to be neglected.—F. W. T. K.

Estimation of Morphia in Opium. A. Kremel. Pharm. Post. **20**, 661.

Five grms. of powdered opium are digested for 12 hours with 75 cc. of lime-water. The mass is frequently shaken, and afterwards filtered through a small filter; 60 cc. of the filtrate are put into a small flask of known weight, and 15 cc. of ether and 4 cc. of ammonia are added. The flask is closed and gently shaken. It is allowed to stand for six or eight hours at a temperature of 10° to 15° C. The layer of ether is then removed, another addition of 5 cc. of ether is made, and after gentle shaking the ether is again removed. The crystals of morphia which have separated are collected on a small filter, while the crystals remaining in the flask are washed with 5 cc. of water. Both filter and flask are then dried at 100° C., the crystals on the filter added to those in the flask, and the latter is dried until its weight remains constant. The crystals are pure morphia. If extract of opium has to be tested, the method of proceeding is the same; one part of extract and 20 parts of lime-water are employed for the test. Tincture of opium is first evaporated on the water-bath, and the residue treated with an amount of lime-water equal to the quantity of tincture originally used.—S. H.

New Books.

Die Chemie des Steinkohlentheers mit besonderer Berücksichtigung der künstlichen organischen Farbstoffe. Von Dr. Gustav Schultz. Zweiter Band. Die Farbstoffe. *Erste Lieferung.* 1887. Braunschweig: Druck und verlag von Friedrich Vieweg und Sohn.
London: H. Grevel & Co., 33, King Street, Covent Garden.

This volume of the above still uncompleted work commences with the 22nd Chapter and concludes with part of the 26th Chapter. Still, the volume commences with page 1 and ends upon page 192.

It forms a paper-covered book, treating principally of the Coal-tar Dyes and Colouring Matters, and not the least important feature in it is that it contains the valuable Tables, giving a full Compendium of the Azo-colours, which recently appeared in the "*Chemische Industrie.*" These extend from pages 154 to 177. Chap. XXII. contains an Introduction, an article on the Relationship between Constitution and Colour, &c. The various uses of the Coal-tar Colours. Chap. XXIII. The Nitroso colouring matters, Nitro-colours, and Az-oxy colours. Chap. XXIV, is devoted to the Azo-colours, their history, and German patents on processes for preparing the Azo-colours. In Chap. XXV. the Constitution and Formation of the Azo-colours is described, together with the nomenclature, behaviour, and use. Here also the Tables of the Azo-colours already referred to commence, and are completed. (*See* this Journal, 1887, 653—659). The volume ends upon Chap. XXVI., in which the Mono-azo compounds, including Amido-azo-benzene, &c., Chrysoidine, Bismarck-brown, Acid Yellow, Brilliant Yellow, &c., are described.

A Course of Quantitative Analysis for Students. By W. N. Hartley, F.R.S., Professor of Chemistry, Science and Art Department, Royal College of Science, Dublin, &c. London and New York: Macmillan and Co. 1887.

Small 8vo volume, bound in cloth and containing Preface and subject matter covering 239 pages. There is no alphabetical index, but the text is sharply divided and grouped, so that apparently the necessity for indexing is overcome. Following the preface is a small chapter devoted to the "Weights and Measures of the Metrical System" adapted to Quantitative Analysis; next follows an Introduction, in which the preliminary operations of the analyst are described, as also the apparatus and materials. A series of simple introductory analytical examples are now given, with weighings recorded and modes of deducing precise composition; other chapters of methods entitled "Estimations of Mineral Constituents," "Methods of Volumetric and Technical Analysis," "Methods of Analysing Alloys and Complex Minerals."

The work terminates with tables of Atomic Weights, and of Per-centage Compositions with corresponding Specific Gravities, of Sulphuric, Hydrochloric, and Nitric Acids.

Gas Engineer's Pocket Almanack and Lighting Table, for the Year 1888. Issued by William Sugg and Co., Limited, Engineers, Charing Cross, London, S.W.

Small 8vo pocket-book, bound in morocco and gilt; price 2*s.* 6*d.* It contains calendar for 1888, and data in tabulated form, determining the times for lighting and extinguishing street lamps for every month in the year, followed by ruled pages for each month, in which may be recorded the hours of lamp-light in a year, together with the carbonising and gas accounts. A list of apparatus made and supplied by W. Sugg and Co., Limited, follows, and this again by the notification of the Metropolitan Gas Referees: (i.) As to the times and mode of testing for illuminating power; (ii.) As to the times and mode of testing for purity; (iii.) As to the mode of testing the pressure at which gas is supplied; (iv.) As to the maximum amount of impurity in each form allowable in illuminating gas. Illustrations of the apparatus required, with descriptive accounts, are given, of all the methods for testing illuminating power and purity, also testing strength of ammoniacal liquor. At the end of the book is a set of blank pages for memoranda for the different months of the year, followed by blank accounts to be filled up each month, showing the working results of a gas plant. After a few more tables, of interest to gas managers and chemists, the pocket-book concludes with Sugg's Lighting Table, extended and made applicable to all parts of the world, by

Mr. Jas. T. Brown. The table gives at a glance the times for lighting and extinguishing public lamps on various days of the year, and applicable to places within certain latitudes north and south of that of London.

A TEXT BOOK OF PAPER MAKING. By C. F. CROSS and E. J. BEVAN. E. and F. N. Spon, 125, Strand, London; 35, Murray Street, New York. 1888.

8VO VOLUME, bound in cloth, with frontispiece representing micro photographs of Cotton, Linen, Esparto, Mechanical Wood Pulp and Chemical Wood Pulp Fibres, a Preface, Table of Contents, Introductory Note, and text covering 232 pages. The work ends with a copious Alphabetical Index. With the text are interspersed 81 wood-cut illustrations and two large folded plates showing views of the Fourdrinier Paper Machine. The Chapters treat of the following leading subjects:—CHAP. I. Cellulose, Chemical Properties, and Natural History. II. Physical Structure of Fibres, Microscopical Examination. III. Chemical Analysis of Plant Substances. IV. Characteristics of Principal Raw Materials. V. and VI. Treatment of various Fibres. VII. Bleaching. VIII. Beating. IX. Loading, Sizing, Colouring, &c. X. Paper Machines, &c. XI. Calendering, Cutting, &c. XII. Caustic Soda, Recovered Soda, &c. XIII. and XIV. Testing of Paper, &c. XV. Site for Paper Mill. XVI. Willesden Paper. XVII. to XIX. Statistics, Bibliography, and Addenda.

REPORT ON INDIAN FIBRES AND FIBROUS SUBSTANCES EXHIBITED AT THE COLONIAL AND INDIAN EXHIBITION, 1886. By C. F. CROSS, E. J. BEVAN, and C. M. KING, in association with E. JOYNSON. With Notes of Methods of Treatment and Uses prevalent in India, by Dr. GEORGE WATT, C.I.E., M.B., C.M. Published by authority of the Secretary of State for India. E. and F. N. Spon, 125, Strand, London; 35, Murray Street, New York. 1887.

8VO VOLUME, bound in cloth, with Preface, Table of Contents, and Subject-matter, nearly covering 71 pages, and including a wood-cut illustration of a micro-photographic apparatus for the representation of microscopic fibre preparations. At the end of the book are five sheets of well-executed micro-photographs of general types of fibrous structure, &c.

The text is divided into and treated in three Parts: PART I. being devoted to a DESCRIPTION OF LABORATORY METHODS. (*a*) Chemical, and (*b*) Microscopical. PART II. to a special account of Fibre-plants and Fibres, with Introduction by Dr. Watt. PART III., including Seed Hairs, Flosses, and miscellaneous matters. In this group, then, come the Cottons and Cotton Silks.

The authors are inclined by their observations to regard the fibre substances as compound celluloses, which thus divide themselves into pecto-celluloses and ligno-celluloses. They find the most characteristic of the celluloses isolated from the fibres are those of *Calotropis* and *Marsdenia*. For softness and silky lustre these surpass all others examined, and deserve more attention from technologists than they have yet enjoyed. In the Jute class, *Sida rhombifolia* is the most conspicuously deserving of notice and of probable commercial value, whilst of the Monocotyledonous fibres, the only one likely to win a place in the higher classes of textile industries the authors consider to be the Pine-apple fibre.

THE INCREASE IN THE PRODUCE OF THE SOIL THROUGH THE RATIONAL USE OF NITROGENOUS MANURE. By Prof. PAUL WAGNER, Ph.D., Director of the Agricultural Research Station, Darmstadt. Translated by GEORGE G. HENDERSON, M.A., B.Sc., Assistant to the Professor of Chemistry, University of Glasgow. *With photographs of various experiments on the cultivation of plants.* London: Whittaker and Co, 2, White Hart Street, Paternoster Square, E.C. 1888.

8VO. VOLUME in pamphlet form, with Preface, Contents, and subject-matter of 72 pages. The book concludes with two tables: Table I. Photographs of some experiments with summer-rye, &c.; and Table II. Photographs of some experiments on the power of different plants to use up nitrogenous manure.

In the text the following principal questions are attempted to be answered:—

1. Does the application of nitrogenous manure produce an increased yield of all field crops?
2. Are there conditions of the soil under which an extra yield of peas, vetches, and all kinds of clover can be obtained by the use of nitrogenous manure?
3. In what way does an increased yield result from manuring with nitrogenous salts?
4. How large are the extra crops which can be obtained by the use of a fixed quantity of nitrogenous manure?
5. To what extent are the increased yields which, according to calculation, can be obtained by help of a definite quantity of nitrogenous manure, obtainable in practice?
6. Obtaining results from use of nitrogenous manure.
7. Quantity of nitrogen in manure for plants.
8. Failures explained in manuring with nitrate of soda.
9. Large manurings with phosphoric acid and injurious effect. Is this obviated by means of nitrogenous manure?
10. Is fertility in the soil diminished by excessive absorption of phosphoric acid and potash after manuring with nitrate of soda?
11. Explanation of difference of action on plants of ammoniacal nitrogen from nitric nitrogen.
12. By what means can the farmer avail himself of the store of nitrogen in the air?

Trade Report.

(From the Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

FRANCE.

The Statistical Tax on Sumac in Bark, Leaves, or Twigs.

According to the *Moniteur Belge* for the 17th December last, the following decision was given by the French Government on the 5th November last:—

"The benefits of the decision of the 15th September 1879, by the terms of which the statistical tax on sumac in powder is levied at the rate of 10 centimes per 1,000 kilogrammes, are extended to sumac in bark, leaves, or twigs."

Impending New Duty on Heavy Oils.

Mr. J. A. Crowe, Her Majesty's Commercial Attaché for Europe, in a memorandum on an impending new duty on heavy oils, dated the 19th December last, says:—

"I would draw attention to the 24th Article of the Budget resolution as drafted by the chairman of the French Budget Committee, which declares:—

"'Heavy oils and residues of petroleum, schists, and other mineral oils (excepting coal tar and coal oils), shall be charged on import into France and Algeria with the following duties:—

"'Heavy oils and *goudrons* of petroleum, of schists, and other mineral oils (*a.*) of the country of import, 12 francs per 100 kilos. net; (*b.*) of other origin, 17 francs per 100 kilos. net.'

"The present duty on these oils is 6 francs per 100 kilos."

Prolongation of the Surtax on Sugar.

According to a circular of the *Direction Générale des Douanes*, dated the 20th December last, the surtax of 20 per cent. imposed on all sugars, of whatever origin, a notification of which appeared on page 13 of the *Board of Trade Journal* for July last, which should have expired on the 1st January of this year, is prolonged to the 31st of March next.

UNITED STATES.

Drawbacks on Copper.

On the exportation of ingot copper extracted from imported sulphur ores, which ores pay duty at the rate of 75 cents per ton on the total weight, and 2½ cents per pound on the pure copper contained therein, drawback can only be paid at the single rate of 2½ cents per pound on the pure copper, less the legal retention of 10 per cent., and no return of any portion of the duties of 75 cents per ton should be made.

NEW CUSTOMS TARIFF OF SOUTH AUSTRALIA.

Note.—The following rates of Customs duty do not apply to the Northern Territory, where the old duties still remain in force.

Articles.		Rates of Duty.		
		£	s.	d.
Acetic acid:—				
Containing not more than 33 % of acidity	per lb. or pt.	0	0	3
For every extra 10 % or part of 10 % of acidity	„	0	0	1
Acids, nitric, sulphuric, and muriatic	per cwt.	0	5	0
Soap (other than fancy)	per lb.	0	0	1
Soap (extract of), soap and washing powders	„	0	0	2
Cement	per barrel	0	2	0
Glucose	per cwt.	0	6	0
Naphtha, turpentine, and varnish	per gallon	0	0	6
Opium, morphia	per lb.	1	0	0
Paints (mixed ready for use)	per cwt.	0	4	0
Soda crystals	per ton	2	0	0
Spirits and spirituous compounds, the strength of which cannot be ascertained by Sykes' hydrometer	per liq. gall.	0	14	0
Spirits, methylated	„	0	3	0

Free List.

- Antifouling composition.
- Antimony (in ingots).
- Artists' colours.
- Blasting powder and dynamite.
- Brimstone, crude, and flowers of sulphur.
- Copperas.
- Crucibles.
- Detonators.
- Dry plates, photographic.
- Dyestuffs, aniline dyes, bichrome, &c.
- Guano and other manures.
- Gutta-percha.
- India-rubber articles.
- Ink and ink powder.
- Leather.
- Limejuice in bulk.
- Ores.
- Paper (except faint - lined writing paper).
- Pearl ash.
- Phosphorus.
- Platinum or porcelain chemical apparatus.
- Potash (Canadian).
- Rock salt.
- Saltpetre.
- Scientific instruments and balances.
- Sensitized paper.
- Soda ash, caustic, nitrate, silicate.
- Strychnine.
- Sumac and valonia.
- Sulphate of copper.
- Tartaric acid.
- Waterproof materials containing india-rubber.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

IMPORTS INTO THE UNITED KINGDOM FROM SPAIN.

PRINCIPAL ARTICLES.		Nov. 1886.	Nov. 1887.
Chemical products unenumerated	Value £	6,373	4,383
Copper ore and regulus	Tons	3,933	5,034
	Value £	72,539	86,010
Manganese ore	Tons	..	..
	Value £	..	..
Pyrites of iron and copper	Tons	45,807	25,078
	Value £	83,174	44,017
Quicksilver	Lbs.	..	..
Rags, Esparto	Tons	5,197	5,490
	Value £	30,166	32,548
Total Value		1886.	1887.
November		£884,052	£918,304
December		£867,183	£1,160,441

EXPORTS OF BRITISH AND IRISH PRODUCE FROM THE UNITED KINGDOM TO SPAIN.

PRINCIPAL ARTICLES.		Nov. 1886.	Nov. 1887.
Alkali	Cwts.	22,848	23,434
	Value £	8,004	7,523
Caoutchouc manufactures	Value £	1,415	2,327
Cement	Tons	625	939
	Value £	1,025	1,618
Coal, products of, including naphtha and paraffine	Value £	318	1,801
Glass manufactures	Value £	511	700
Manure	Value £	11,875	16,160
Painters' colours and materials	Value £	2,264	3,586
Paper of all sorts	Cwts.	545	364
	Value £	1,386	682
Soap	Cwts.	996	351
	Value £	881	283
Total Value		1886.	1887.
November		£242,815	£272,223
December		£253,238	£232,493

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

PROPOSED REWARD FOR A PRACTICAL METHOD OF TESTING PURITY OF ALCOHOL IN FRANCE.

Mr. J. A. Crowe, Her Majesty's Commercial Attaché for Europe, writing under date of the 12th December last, says that a law has recently been passed enacting that a prize is to be given to the discoverer of any simple and practical method of ascertaining the presence in spirits and alcoholic beverages of substances other than pure and ethyllic alcohols. The Academy of Science of the French Institute will be charged with the duty of determining the conditions under which the rewards are to be given.

BRAZIL.

Chemicals and Drugs.

The *Handels-Archiv.* says that the six spinning and weaving mills at Rio de Janeiro consume a fair quantity of chemicals and dye wares, but neither in these nor in drugs does Germany supply any considerable part of the import.

CHILI.

Kerosene, Paint, &c.

The British Consul of Valparaiso in his report says that kerosene is a very large item. It is quite an American monopoly. Paint is imported chiefly from England, and candles from Germany.

CAPE.

Candles and Soap.

The French Consul at Cape Town thinks that the fine candles of France would find a favourable outlet in the Cape market, though Germany, profiting by the advantage which a direct line between Hamburg and the Cape affords her, is seeking to monopolise the trade. The Consul believes that if the French could reduce the cost of transport they could compete on at least equivalent terms with Germany.

The same Consul says that the only articles manufactured in the country to any extent are soap and candles, and adds that, as grease is at an almost nominal price there, it is useless to think of competing. While, however, this is true in relation to ordinary qualities, there is a large import of better kinds of soap, chiefly from England, but also from America and Australia. The Consul advises French makers to compete.

GREECE.

Drugs and Chemicals.

The official *Handels-Archiv* asserts that Germany has materially improved her position during 1886 in drugs and chemicals, which hitherto have been mainly imported from England and France. Quinine, which is admitted duty free under the Greco-German treaty, is preferred of German make. Drugs come from Trieste, acids from Marseilles, and soda from England, the latter at the low freight of 7*s.* per ton. In mineral colours Germany has during 1886 taken a good position. White lead, vermilion, and ultramarine blue, which formerly were entirely imported from England, France, and Belgium, now come in considerable quantities from the Rhine country. Ochre was until recently sent from Marseilles, but now comes only from Germany. German printers' ink is very popular, and German varnish and blacking are also in good demand.

HOLLAND.

India-rubber.

The *Moniteur Officiel du Commerce* states, on the authority of the Belgian Secretary of Legation at The Hague, that a few years ago there existed no india-rubber manufactory in all Holland, and that the Dutch merchants were obliged to buy all their goods either in Germany or in England. At the present time two manufactories exist, but they are far from satisfying the requirements of the country, for there are still imported annually into Holland a value of 60,000 florins in articles of india-rubber and gutta-percha. The Belgian Secretary recommends the Belgian manufacturers of these goods to make their products known in Holland.

ITALY.

Chemicals, &c.

The export of chemicals and glass goods from Germany to Italy declined in 1886, but the export of dyes and dye and tanning stuffs increased by 58,000 lire compared with the previous year.

Japan.

Glass Goods and Salicylic Acid.

Handels-Archiv states that 13,276 yen is the estimated value of the glass goods imported from Germany to Hiogo-Osaka. Salicylic acid, which is largely employed in the *sake* breweries of Japan, was also imported from the same country to a considerable extent in 1886.

Imports of Dyes.

Aniline dyes were supplied by Germany to the value of 139,680 yen, against 93,018 yen in the previous year. Prussian blue came, as usual, in the largest quantities from the Rhine provinces.

Madagascar.

Drugs, &c.

Madagascar depends upon us for most of her drugs. Sulphate of quinine, iodide of potassium, and salts of mercury are in chief request. The official statistics only give 17,000 francs as the amount of the imports of drugs, but it is really much larger, the English Protestant missionaries, who maintain hospitals for the natives, having obtained the privilege of importing their drugs duty free. Perfumery and soap are almost entirely imported from France. —*Brit. and Col. Druggist.*

Portugal.

The Chemical Trade.

During the year 1885 Portugal imported 805,180*l.* worth of colonial produce, and 85,894*l.* of chemical products. Of the former 676,640*l.* and of the latter 83,102*l.* were for home consumption. The remainder was re-exported. The Portuguese exports of colonial produce in the same year were worth 19,930*l.*, and of chemicals 74,852*l.* The following figures denote the respective shares of Great Britain, France, and Germany in the Portuguese colonial produce and chemical trade:—

—	Imports.		Exports.	
	Chemicals.	Colonial Produce.	Chemicals.	Colonial Produce.
	£	£	£	£
Great Britain ...	63,506	206,042	17,882	4,852
France..........	9,524	15,774	25,442	40
Germany	8,760	173,742	1,064	128

—*Chemist and Druggist.*

MISCELLANEOUS.

Picric Acid.

Picric acid, picrates, and mixtures of picric acid with certain other substances being "under certain conditions specially dangerous to life and property by reason of their explosive properties," an Order in Council has been issued under the provisions of the Explosives Act, 1875, declaring—

"(1.) Picric acid when in process of manufacture or storage shall (for whatever purpose used or manufactured) be deemed to be an explosive within the meaning of the said Act for all the purposes of the said Act, subject to the exceptions following:—(*a*) Picric acid when wholly in solution shall be exempt from being deemed to be an explosive within the said Act; and (*b*) picric acid which does not fall within the exemption above set forth, but which is being manufactured or stored in a factory, building, or place exclusively appropriated to the manufacture or storage of picric acid, and in such manner as effectually to prevent any picric acid from coming into contact (whether under the action of fire or otherwise) with any basic metallic oxide or oxidising agent, or other substance capable of forming with picric acid an explosive mixture or explosive compound, or with any detonator or other article capable of exploding picric acid, or with any fire or light capable of igniting picric acid, shall be exempt from being deemed to be an explosive within the said Act. (2.) Picrates and mixtures of picric acid with any basic metallic oxide, or any oxidising agent, or with any other substance capable of forming with picric acid an explosive mixture, or an explosive compound (for whatever purpose used or manufactured), shall be deemed to be an explosive within the meaning of the said Act for all the purposes of the said Act unless such picrates or mixtures be wholly in solution."—*Chemist and Druggist.*

Picric Acid as an Explosive.

At the sitting of the Academy of Sciences held on December 12, Professor Berthelot read a paper on the various modes of explosive decomposition of picric acid. Prefacing with an exposition of the general belief in the explosive property of the chemical, and alluding to Colonel Majendie's report on an explosion of recent occurrence in England, he related the following experiments. When a certain quantity of picric acid is heated in an open flask or capsule it first melts, then volatilises, giving out fumes which burn with a smoky flame, but no explosion takes place. But when a test-tube, about one inch in diameter, is heated over a gas jet so as to produce a visible red, but without melting the glass or deforming the tube, on dropping into it some crystals of acid weighing only a few milligrammes a sharp detonation occurs, with a bright white light and characteristic noise. When the experiment is performed in nitrogen gas, a few flakes only of carbon are deposited; in ordinary air the result is the same, but no carbon is left. On increasing the quantity of picric acid, without, however, exceeding a few centigrammes, the addition may cool the bottom of the tube sufficiently to prevent immediate detonation, but the chemical is at once volatilised, and soon an explosion with flame occurs, occupying a great part of the tube. This explosion is not so sharp as the more local detonation, and more carbon is apparently deposited. An explosion of the nature may be produced with a few milligrammes of material by using a glass tube coated with the carbon of a previous explosion. With a decigram of acid and a new tube the reaction will be slower still, yet a series of deflagrations with red flame will be observed, while the vapours will catch fire at the mouth of the tube. Finally, with larger quantities, the acid is decomposed, there being abundant fumes and partial volatilisation, but without deflagration. Other nitrogenised bodies, less oxygenated than picric acid, such as nitro- and bi-nitrobenzine, nitronaphthalines, &c., were experimented with, and afforded concordant results, leading to the conclusion that the mode of decomposition of all these nitrated bodies depends on the initial decomposition temperature. Respecting picric acid more especially, M. Berthelot's conclusions are as follows:—"Should a nitro-compound, such as picric acid, while burning in the air in large masses, happen to heat the sides of the containing enclosure to a degree sufficient to induce incipient deflagration, the deflagration might contribute to further increase the temperature of the enclosure, and the phenomenon might occasionally be transformed into a detonation. It would even suffice that the detonation should occur in an isolated point, either during a fire, or owing to the local overheating of a boiler or apparatus, to enable it to originate the explosive wave and propagate itself by influence throughout the whole mass, causing a general explosion."—*Chemist and Druggist.*

Paint for Vessels' Bottoms.

The American Navy Department has recently published an exhaustive report on a series of tests that have been made to demonstrate the value of anti-corrosive and anti-fouling paints for the protection of ships' bottoms. These tests, which have been going on for two years past, have cost between 8,000 dollars and 9,000 dollars, and over 200 samples of paint have been tried. The result, as summed up by the Construction Bureau, is that pure white zinc is the best paint that can be generally applied to vessels' bottoms, while a mixture of two-thirds red lead and one-third white zinc is next in order of merit. The paint recommended by the Naval Advisory Board for use on the cruisers came out ninth in the competition.—*Brit. and Col. Druggist.*

Progress of the Basic or Thomas Gilchrist Process during the Twelve Months ending 31st October 1887.

The total make of steel and ingot iron from phosphoric pig during this period amounts to 1,702,252 tons, being an increase over the make for the previous 12 months of about 388,621 tons.

It will be noticed that of this make no fewer than 1,222,732 tons were ingot iron containing under ·17 per cent. of carbon.

The makes of the various countries for the 12 months ending 31st October 1886 and 31st October 1887 respectively are as follows:—

—	1886.		1887.	
	Total.	With under ·17 % carbon.	Total.	With under ·17 % carbon.
	Tons.	Tons.	Tons.	Tons.
England................	258,466	161,908	364,526	233,358
Germany, Luxemburg, and Austria	883,859	651,523	1,102,496	826,609
France..................	122,711	77,141	174,271	123,049
Belgium and other Countries..................	48,595	36,712	60,959	39,716
Totals......	1,313,631	927,284	1,702.252	1,222,732

FOREIGN TRADE IN DRUGS AND CHEMICALS.

IMPORTS.

—		December 1885.	December 1886.	December 1887.	Year 1882.	Year 1883.	Year 1884.	Year 1885.	Year 1886.	Year 1887.
Drugs, unenumerated.	Value £	63,081	61,267	72,653	840,800	1,135,038	789,224	788,882	670,525	650,440
Chemical manufactures and products, unenumerated	„	120,953	104,081	119,718	1,518,728	1,544,694	1,502,668	1,351,777	1,284,275	1,316,853
Chemicals and dye-stuffs, unenumerated	„	204,020	152,672	214,106	2,162,598	2,487,615	2,328,740	2,364,313	2,121,180	2,005,020
Oils, not enumerated..	„	112,539	111,641	118,851	1,274,827	1,337,243	1,376,508	1,281,211	1,137,954	1,184,481
Alkali	Cwt.	3.249	4,330	7,618	67,029	60,239	66,989	63,641	78.797	64.172
	Value £	3,142	3,246	4,605	87,901	81,641	70,201	53,699	55,602	47,809
Brimstone	Cwt.	47,835	39,985	48,119	945,561	877,646	759,398	726,048	636,596	661.158
	Value £	11,459	9,885	12,307	292,462	241,026	193,577	184,678	157,917	157,188
Nitrate of soda	Cwt.	83,325	197,049	136,124	1,915,138	2,049,270	2,030,944	2,247,685	1,497,725	1,736,802
	Value £	42,577	89,277	59,617	1,270,352	1,168,088	979,261	1,114,982	744.513	832,541
„ of potash	Cwt.	40.241	24,057	36,101	322,232	284.466	333,756	324.406	271,322	393,918
	Value £	33,377	20,979	30,059	351,319	285,158	306,133	272,765	240,486	261.526
Quicksilver	Lbs.	127,420	30,000	165,000	3,444,065	4,088,982	4,497,748	4,136,519	4,422,478	4.590,907
	Value £	10,425	2,875	23,880	279,291	299,689	333,918	326,959	369,779	439.208
Cinchona bark	Cwt.	19.467	16,503	10,141	138,763	117,325	105,957	129,606	145,519	143,833
	Value £	128,878	78,354	44,480	1,781,482	1,429,261	906,954	885,241	773,643	665,457
Gum Arabic	Cwt.	10,053	3,259	7,833	115,956	80,577	57,493	93,105	75,399	46,443
	Value £	38.137	16,382	34,420	252,475	179,803	173,714	324.687	294,683	214,159
Lac, seed, shell, stick, and dye	Cwt.	5,998	8,594	11,508	113,378	115,309	112,967	119,915	107,307	114,685
	Value £	17,485	24,500	32.250	514,120	490,274	464,185	384.312	306,075	299,114
Bark (for tanners' or dyers' use)	Cwt.	17,113	13,831	10,682	271,527	365,346	430,794	349,629	390,793	346,583
	Value £	5,586	3,449	3,207	126,989	181,256	195,208	144,207	173,066	147,104
Aniline	Value £	19,099	19,365	23,300	414,685	383,584	275,686	239,216	247,293	282,332
Alizarine	„	17,963	27,523	23,240			244,435	243,882	259,795	254,565
Other coal-tar dyes	„	87	37	662			33,734	3,721	1,623	5,913
Cochineal	Cwt.	1,606	1,517	1,879	24,934	21,144	14,100	13,930	14,710	9,961
	Value £	9,288	9,409	11,975	244,894	151,438	80,100	83,640	94,285	61,987
Cutch and gambier	Tons	1,750	2,348	3,541	30,164	26,803	32,215	26,258	28,369	27,258
	Value £	39,332	52,213	86,827	695,040	709,579	820,402	562,389	654,438	658,364
Indigo	Cwt.	6,374	4,983	4,190	95,488	100,713	104,432	94,556	84,754	76,698
	Value £	150,799	109,401	105,013	2,610,003	2,467,083	2,484,012	2,133,246	1,890,965	1,673,475
Madder, madder-root, &c.	Cwt.	2,311	2.791	1,495	23,162	21,574	23,208	40,829	21,325	19,397
	Value £	3,833	2,846	2,037	33,050	28,197	31,070	45,021	26,710	24,207
Cocoa-nut oil	Cwt.	19,826	10,621	36,969	136,087	210,874	245,695	185,971	156,667	183,766
	Value £	28,324	14,219	50,151	214,236	365,716	398,488	276,841	214,211	251,989
Olive oil	Tuns	2.062	1,156	767	23,190	30,935	17,201	24,223	20,692	20,756
	Value £	82,768	42,001	28,229	937,601	1,193,797	715,752	979,749	790,788	757,010
Palm oil	Cwt.	70,803	99.044	85,457	801,545	743,512	825,822	898,481	993,091	966,536
	Value £	87,969	107.624	80,233	1,220,817	1,304.385	1,385,345	1,209,722	1,038,208	941,622
Petroleum oil	Gals.	8,267,745	9,514,331	7,106,278	59,135,384	70,185,563	52,898,436	73,869,787	71,026,962	77,158,062
	Value £	261,310	272,578	186,306	1,704,753	2,156.235	1.705,773	2,284,510	2,079.406	2,105.146
Oil seed	Tons	1,646	1,185	2,544	14,620	10,513	12,546	13,029	16,327	15,609
	Value £	44.308	27,822	61,721	478,208	365,855	384,509	367,902	396,322	375.952
Turpentine	Cwt.	22,747	39,940	35,167	357,878	350,138	462,134	308,442	294,914	359,202
	Value £	29,401	52,052	46,870	630,085	555,902	559,972	387,986	392,259	472.013

FOREIGN TRADE IN DRUGS AND CHEMICALS—*continued.*

EXPORTS.

—		December 1885.	December 1886.	December 1887.	Year 1882.	Year 1883.	Year 1884.	Year 1885.	Year 1886.	Year 1887.
British and Irish produce—										
Drugs and medicinal preparations, unenumerated	Value £	82,572	72,648	82,530	935,293	922,649	892,046	842,725	814,213	864,768
Sundry chemicals	„	342,938	333,867	402,492	4,307,016	4,262,281	4,105,100	3,672,567	3,590,683	3,826,469
Painters' colours and materials	„	88,233	100,285	103,665	1,340,472	1,277,913	1,293,578	1,222,888	1,266,103	1,346,376
Alkali	Cwt.	510,254	504,318	620,535	6,735,800	6,947,000	6,567,326	6,661,800	6,242,800	6,163,684
	Value £	154,491	143,266	165,450	2,067,806	2,124,962	2,090,573	1,955,790	1,788,078	1,743,599
Bleaching materials .	Cwt.	127,305	121,687	142,563	1,604,100	1,600,600	1,611,698	1,507,600	1,550,400	1,577,661
	Value £	41,965	43,453	53,887	340,303	480,278	661,797	507,080	502,919	593,556
Seed oil.............	Tons	4,693	5,723	7,303	14,041,900*	20,151,700*	16,050,200*	66,295†	70,676†	75,058†
	Value £	105,135	119,086	152,639	1,144,071	1,863,520	1,465,935	1,534,747	1,502,346	1,567,664
Soap................	Cwt.	32,662	36,228	36,935	409,437	391,788	476,721	402,112	426,904	451,961
	Value £	39,629	38,073	36,039	458,477	449,804	517,854	472,438	446,710	451,246
Foreign and Colonial merchandise:										
Chemicals, unenumerated	Value £	17,012	12,030	53,167	217,668	309,829	226,183	241,715	149,078	283,625
Cinchona bark	Cwt.	12,528	16,522	7,021	80,014	69,371	102,853	112,440	117,994	131,377
	Value £	73,026	73,376	22,398	903,332	555,678	679,336	621,411	547,819	481,636
Cochineal...........	Cwt.	1,222	803	782	15,508	13,120	11,252	12,144	11,301	8,113
	Value £	8,334	5,520	1,704	137,106	83,103	64,166	81,144	76,749	51,713
Cutch and gambier .	Tons	512	766	534	11,218	11,385	10,972	8,981	10,192	9,620
	Value £	11,978	17,445	15,088	274,899	319,424	292,420	206,161	255,145	251,818
Gum Arabic	Cwt.	6,450	2,492	3,767	41,554	51,411	39,236	51,858	43,288	41,958
	Value £	24,044	9,894	15,197	90,535	127,618	128,263	186,591	174,086	168,012
Indigo..............	Cwt.	2,244	2,187	1,712	66,617	67,830	70,768	71,464	53,959	53,085
	Value £	46,832	48,716	35,800	1,774,809	1,677,134	1,708,080	1,536,017	1,170,242	1,179,879
Lac, seed, shell, stick, and dye	Cwt.	7,204	4,779	4,850	61,737	72,336	62,526	73,152	71,949	67,574
	Value £	23,784	13,033	13,687	295,629	301,782	238,239	240,960	207,758	179,379
Cocoa-nut oil	Cwt.	5,450	5,011	5,545	134,568	184,492	168,530	113,171	98,450	84,712
	Value £	8,086	7,485	8,440	205,688	321,521	274,767	168,692	138,270	117,287
Olive oil	Tuns	188	143	197	3,657	4,495	2,203	2,877	2,510	2,769
	Value £	8,382	6,656	8,412	166,309	201,356	106,869	132 913	110,516	114,643
Palm oil	Cwt.	31,129	56,038	29,399	428,139	356,538	361,027	388,885	489,084	517,169
	Value £	38,317	59,368	28,955	642,216	618,771	616,956	547,127	511,518	508,734
Petroleum oil	Gals.	56,203	45,806	59,780	822,125	771,337	786,545	1,078,719	575,092	472,000
	Value £	1,992	2,260	2,700	37,965	38,923	35,276	37,859	25,764	20,971
Quicksilver.........	Lbs.	288,870	289,341	171,053	3,031,784	3,674,789	3,936,881	3,661,663	4,956,020	4,685,678
	Value £	23,071	25,558	20,885	242,752	272,030	285,995	287,168	414,687	439,246
Nitrate of potash ...	Cwt.	7,903	281	5,325	22.081	33,027	29,801	38,223	24,575	32,856
	Value £	6,197	232	4,616	25,588	33,714	28,297	31,506	21,146	28,924

* Gallons

† Tons.

—*Chemist and Druggist.*

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

1887.

17,370. J. S. Sawrey and H. Coleet, London. Apparatus for separating liquids from solid matters suspended therein. December 17.

17,430. M. C. Bannister, Liverpool. Pumps for gases and vapours. December 19.

17,576. W. Varrall, London. An improved filter. December 21.

17,614. A. L. Chance, Birmingham. Means for economising fuel and consuming smoke. December 22.

17,648. A. Pople, London. An improved composition for preventing and removing incrustation in boilers. December 22.

17,659. J. Cooke, Stockton-on-Tees. Means for promoting combustion and economising fuel. December 23.

17,712. J. S. Sawrey and H. Coleet, London. Separating liquids from solid matters suspended therein. December 24.

17,799. H. Hutchinson, London. Apparatus for generating gas. December 27.

17,880. B. E. R. Newlands and J. B. Alliott, London. Improvements in means for effecting or facilitating the separation or deposit of solid matter from water or other liquids. December 29.

17,898. G. F. Redfern.—From E. Jolicard, France. Heat generating apparatus for use as a blowpipe, and in metallurgical operations, &c. December 29.

1888.

109. C. D. Abel, London.—From F. C. Glaser, Germany. Regenerative gas furnaces with gas producers. January 3.

214. R. Morris, London. Filters. January 5.

243. H. T. Yaryan, London. Vacuum evaporating and distilling apparatus. Complete specification. January 5.

256. J. C. Sawer, London. High-pressure tap. January 6.

445. T. P. Sims, Swansea. Machine for making scorifiers, cupels, and crucibles. January 11.

606. W. A. Nicholl, Halifax. Improvements in the construction of filters, mainly designed for the filtration of water for manufacturing purposes, but applicable generally to the filtration of water in quantities. January 14.

871. A Crossley, W. Prodham, P. P. Mosley, and W. H. Haynes, London. Apparatus for effecting the evaporation of ferrous sulphate solution and other solutions. January 19.

*COMPLETE SPECIFICATIONS ACCEPTED.**

1887.

2099. J. A. Drake. Furnaces applicable to steam boilers, gas retorts, and the like. December 21.

2747. J. Gray. Centrifugal machines for separating fluids of different specific gravity. December 31.

2983. G. F. Marshall. *See* Class XVI.

3045. G. F. Belling. High-pressure tap. December 31.

3224. H. E. Newton.—From E. Theisen. Condensing apparatus. January 7.

3274. J. C. Stitt, Liverpool. Generation of steam and economy of fuel employed therefor. January 14.

3443. E. Wilson. Improved disintegrator. January 14.

4749. A. M. Clarke.—From P. Oriolle, fils. Preventing emission of flame and smoke from chimneys worked with forced draught. December 31.

5379. J. R. Alsing. Construction of triturating cylinders. December 31.

5982. L. A. Enzinger. Filter presses. January 7.

15,575. C. T. J. Vautin. Apparatus for separation of solutions of metallic salts from pulverized material mixed therewith. December 31.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

1887.

17,315. L. A. Brode, Glasgow. An improvement in the manufacture of bricks or blocks from coal dross or waste, to enable the same to be used as fuel. December 16.

17,401. W. Phelps and W. Sirrell, London. Improved means for securing increased radiation and rarefaction in the consumption of gas and air for heating, cooking, illuminating, and other purposes. December 17.

17,408. B. F. Elderton, London. An improved construction or arrangement of regenerative and carburetting apparatus for burning coal gas. December 17.

17,558. W. H. Bennett.—From J. Lamy, Paris. Improvements in the mixture and treatment of materials for enriching coal gas, and in removing or preventing stoppages in ascension pipes. December 21.

17,629. W. King and G. K. Jones, jun., London. Improvements in the production of light from hydrocarbon or other inflammable fluids. December 22.

17,676. R. S. Lawrence, London. Improvements in carburettors or apparatus for enriching or producing gas. December 23.

17,804. W. B. Wicken, London. Improvements in or connected with incandescent gas lighting. December 27.

17,898. G. F. Redfern.—From E. Jolicard, France. See Class I.

17,938. E. Rider Cook and J. W. Ingham, London. Retorts for use in making charcoal or for like operations. December 30.

1888.

14. M. L. Honnaij, London. Means by which peat or turf is turned into a substance which can be agglomerated when submitted to desiccation, and which can agglomerate every substance known to-day as combustible if mixed with those substances, and if the mixture be submitted to desiccation. January 2.

120. G. H. Goodman, London. An improved preparation of carbonaceous fuel, applicable for open grates and general heating purposes. January 4.

145. H. G. Radford, London. An improved manufacture of block fuel. January 4.

282. J. Enright, London. An improved method of gas-lighting, and apparatus therefor. January 7.

723. J. West, London. Improvements in machinery or apparatus for charging and drawing gas retorts. January 17.

737. E. Schoop.—From M. Jouannique and Co., France. A new agglomerated fuel. January 17.

788. H. Tipping, Greenwich. The more rapid production of oxygen and nitrogen gases from atmospheric air. January 18.

857. E. B. Ellice-Clark and L. Chapman, London. Improvements in apparatus for the production of oxygen and nitrogen gases from atmospheric air. January 19.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

1479. A. G. Meeze. Method and apparatus for manufacturing gas from fluid hydrocarbons. December 24.

1551. J. Torkington, J. A. Ewins, and C. Torkington. Means for economising gas for heating and lighting purposes. January 7.

2092. L. A. Brode. Utilising the waste or dross of coal in the manufacture of briquettes for fuel. January 14.

4381. R. Anton. Manufacturing briquettes of artificial fuel or other material, and apparatus therefor. January 7.

16,600. A. G. Browning and M. R. Waddle. Means of securing the lids of gas retorts and other similar covers. January 7.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

1887.

17,378. J. Jameson, Newcastle-on-Tyne. Improvements in apparatus for recovery of by-products in the manufacture of hard coke. December 17.

1888.

607. C. Rave, Liverpool. Improvements in or relating to the treatment of the acid residuums or tars resulting from the refining of mineral oils by concentrated acids. January 14.

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* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

1887.

17,463. R. Worms, London. New or improved dyes, and process for the production thereof. December 19.

17,511. J. Y. Johnson.—From the Farbenfabriken vormals F. Bayer & Co., Germany. Improvements in the manufacture of induline dyes for printing on textile fabrics. December 20.

17,551. J. Frost, Huddersfield, and G. E. Sutcliffe, Mirfield. Improvements in producing colouring matters, and in dyeing and printing textile fibres and fabrics. December 21.

17,583. O. Imray.—From R. Nietzki, Switzerland. Improvements in the production of yellow and brown colouring matters or dyestuffs. December 21.

17,811. O. Imray.—From the Farbwerke vormals Meister, Lucius, and Bruning, Germany. An improved manufacture of colouring matters for dyeing. December 27.

17,925. L. A. Groth.—From C. Collin and L. Errani, Paris. Black liquid prepared from aniline, nitrobenzine, and from their derivatives, for dyeing, printing, painting, and varnishing on all kinds of materials. December 30.

17,952. C. D. Abel.—From the Actiengesellschaft für Anilin Fabrikation, Germany. A manufacture of new azo-dyestuffs. December 30.

1888.

170. C. D. Abel.—From the firm of G. C. Zimmer, Germany. Process for the production of sulpho-acids of diphenylamine. January 4.

676. L. Paul, London. Process for the production of disulpho- and dicarbo-acids of the diamidoazo-benzidines. January 16.

687. C. D. Abel.—From the Actien Gesellschaft fur Anilinfabrikation, Berlin. Process for separating the so-called β naphthylamine-δ-sulphonic acid from the so-called β-naphthylamine-β-sulphonic acid. January 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

3991. H. H. Lake.—From A. Leonardt & Co. Manufacture of colouring matters.

15,459. S. Forel. Manufacture of yellow colouring matters by the reaction of tetrazodiphenyl or tetrazoditolyl on phenol or orthocresylol. January 14.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATION.

1887.

17,337. C. J. Cox, London. An improved method of applying stiffening substance (dress) or dye colour to lace gauzes and other fabrics. December 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

3680. H. E. Ludbrook. Machine for dressing and cleaning piassava and other vegetable fibres. January 14.

3715. J. Longmore and W. L. Watson. Treatment of exogenous fibrous plants, flax, jute, rhea, &c. January 14.

15,178. C. Robeson. Apparatus for cleansing or scouring wool. December 24.

15,364. D. Mason.—From A. Schlamm and F. à Brassard. Improvements in treating wool. January 21.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

1887.

17,551. J. Frost and G. E. Sutcliffe. *See* Class IV.

17,586. C. D. Abel.—From Messrs. R. Koepp & Co., Germany. Improvements in the use of chromium compounds in dyeing and printing. December 21.

17,878. W. P. Thompson.—From W. Hampe, jun., Helmstedt. Improvements in apparatus for mordanting, dyeing, and steeping fibrous or textile fabrics. December 29.

17,921. H. Finch, Marple. A new reagent for use in bleaching, and for other purposes. December 30.

1888.

102. H. H. Lake.—From C. Weldon, United States. Improvements in apparatus for dyeing textile and other materials. Complete specification. January 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2354. A. J. Boult.—From H. K. de Pawlowski. Process and apparatus for bleaching vegetable and animal matter and scouring wool. December 28.

3389. F. Towlson and E. Weldon. Dyeing and printing aniline blacks. January 7.

3561. A. Birch. Rollers for dyeing, washing, soaping, bleaching, and otherwise treating fabrics. January 14.

7550. E. B. Petrie and R. Wild. Means and method for washing, scouring, boiling, and bleaching fibres and textiles, and stripping fibres from hides and skins. December 24.

11,664. F. Munier and N. Salvaire. Process for colouring or staining wood. December 28.

15,432. J. Grunhut. Dyeing. January 14.

17,106. J. Grunhut. Process and means for dyeing cotton, &c. in aniline black. January 14.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

1887.

17,347. E. Meyer, London. Improvements in or relating to the production of ammonia and oxalic acid, and alkaline salts from the residue of molasses, without carbonisation. December 16.

17,412. H. H. Lake.—From C. Netto, Germany. Improvements in the manufacture of sodium and potassium, and in apparatus therefor. December 17.

17,536. W. Atkinson and G. A. J. Schott, Bradford. Improvements in apparatus used for holding, passing, or otherwise coming in contact with acids and other corrosive fluids. December 21.

17,612. F. L. Teed, Westminster. Improvements in the purification of sulphuric acid. December 22.

17,657. W. W. Staveley, Liverpool. Improvements in the manufacture of alkaline carbonates. December 23.

17,772. J. Plummer, jun., Edinburgh. Process to obtain hydrochloric acid from calcium chloride. December 27.

17,908. M. D'Andria, Liverpool. Improvements in separating arsenic from hydrochloric acid. December 30.

17,909. M. D'Andria. *See* Class X.

17,969. E. Hermite, E. J. Paterson, and C. F. Cooper, London. The manufacture of bleaching and disinfecting liquor. December 31.

17,970. E. W. Parnell and J. Simpson, Liverpool. Improvements in the treatment of sulphide of ammonium solutions with carbonic acid gas for the purpose of obtaining carbonate of ammonia and strong sulphuretted hydrogen. December 31.

1888.

43. J. Pfeiffer, London. Process and apparatus for the manufacture of dry calcium hydroxide. Complete specification. January 2.

119. R. Williams, Manchester. Improvements in the manufacture of cyanides. January 4.

156. W. P. Thompson, Liverpool. Improvements in or relating to the manufacture of super-heated steam, and in utilising the same for obtaining carbonic acid, evaporating brine, or heating or evaporating other solutions, and in apparatus therefor. January 4.

173. E. Solvay, London. Improvements in the manufacture of sodium bicarbonate, and in apparatus therefor. January 4.

305. J. R. Wylde, M. J. Hammill, and H. Auer, Liverpool. Improvements in or appertaining to the separation of chlorate of potash (and if desirable the chloride of calcium or magnesium or other similar salt in the mother-liquor) from solutions thereof. January 7.

700. C. F. Claus, Mumbles. An improved process for the treatment of Redonda and similar phosphates of alumina. January 17.

728. H. Grimshaw, Manchester. Improvements in and relating to the recovery of sulphur from black-ash waste and from similar products, and the utilisation of the residue. January 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

3144. H. L. Pattinson, jun. Manufacture of hydrates of barium and strontium. January 7.

3301. T. Lockerbie. Pipes for conducting and raising liquids, such as alkalis, acids, beer, paraffin, &c. January 21.

5109. J. Hauff. Producing basic sulpho-cyanides of aluminium, iron, and chromium for dyeing and printing. January 14.

10,346. J. F. Peasgood. Manufacture of vinegar. December 24.

15,295. A. Feldmann. Production of the fluorides of magnesium, strontium, and barium. December 24.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

1887.

17,530. J. Armstrong, Birmingham. Blowing and moulding glass, and apparatus and appliances therefor. December 20.

17,656. G. A. Marsden, Liverpool. Improved decorative tiles or other ceramic ware, and process for manufacturing the same. December 23.

17,763. E. Leak, London. Improved apparatus for supporting pottery ware in kilns or ovens. Complete specification. December 24.

17,892. M. E. Norris, London. Improved prepared glass in imitation of gilt, silvered, frosted or ground glass, for decorative or advertising purposes, and for affixing to prepared glass, hand-paintings, photographs, &c., and making them transparent or opaque, and covering them in imitation of gilt, silvered, frosted, or ground glass, for decorative or advertising purposes. December 29.

17,950. F. Wright and M. W. W. Mackie, London. Improvements in apparatus for working heated glass. December 30.

17,951. F. Wright and M. W. W. Mackie, London. Improvements in apparatus for working heated glass. December 30.

17,967. B. Gregory, Carlton. The manufacture of blue bricks, tiles, and fire-bricks. December 31.

1888.

284. M. J. Adams, York. Improvements in floor tiles. January 7.

383. E. H. Pearce and H. Besson, Birmingham. Improvements in the methods of holding plate or sheet glass while roughing, smoothing, or polishing. January 10.

482. T. Grimbleby, Barrow Haven. An improved roofing tile, called "A stop drift and grab roof tile." January 12.

622. A. Jones, London. An improved method of ornamenting vitreous surfaces. January 14.

636. W. S. Simpson, London. An arrangement of movable crucible for conveying molten glass to moulds for making glass bottles. January 14.

669. W. Ide and J. Love, London. Improvements in machinery for rolling, moulding, bevelling, and figuring glass. January 16.

679. J. Haley, London. Improvement in the manufacture of glass tiles and other glass articles. January 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

120. W. H. Turner. Printing on or decorating earthenware, china, &c., and preparation of materials therefor. December 21.

2920. D. Rylands and R. Potter. Regenerative gas furnaces specially applicable to the manufacture of glass. January 21.

3518. A. D. Brogan and A. M. Malloch. Method of producing rippled, chequered, and other patterns on rolled plate and sheet glass, and apparatus therefor. January 14.

4485. A. M. Clark.—From C. J. Brunetti. Process for ornamenting articles of glass, porcelain, and other ceramic or vitrifiable materials. January 7.

13,688. H. Gross. Treatment of bricks, tiles, &c., while burning, and apparatus therefor. December 28.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

1887.

17,483. A. J. Boult.—From A. L. Barber, United States. Improvements in concrete pavements. Complete specification. December 20.

17,814. P. L. Quarante and V. d'Escalonne, London. An improved process for preserving wood and other vegetable matters. December 27.

1888.

417. J. H. Darby, London. Improvements in burning lime, cement, iron ore, and analogous materials. January 10.

667. M. Mackay, London. An improved composition for fusible cements. January 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

315. G. G. M. Hardingham.—From P. G. Grouvelle. Manufacture of "iron cement." January 14.

2482. W. Tuffee. Manufacture of Portland cement, and apparatus therefor, applicable for making bricks, &c., and for burning lime. December 21.

3568. G. G. Girling. Manufacture of artificial stone. January 7.

7381. J. Dudley and J. Hamilton. Concrete and artificial stone mantle-pieces. January 14.

17,483. A. J. Boult.—From A. L. Barber. Concrete pavements. January 21.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

1887.

17,316. H. Aitken, Glasgow. Improvements in treating ores containing gold and other metals. December 16.

17,356. A. E. Barthel and J. C. J. Möller. Process for providing metallic objects with a coating of molten tin. Complete specification. December 17.

17,453. M. Scott, London. Improvements in casting ingots or other masses of metal, and apparatus for that purpose. December 19.

17,494. J. H. Pollok, Glasgow. Improvements in the wet method of extracting gold from crushed ores or other finely divided auriferous material. December 20.

17,495. J. H. Pollok. Improvements in the wet method of extracting gold from crushed ores or other finely divided auriferous material. December 20.

17,532. H. H. Lake.—From C. Netto. Improvements in the manufacture of aluminium, and apparatus therefor. December 20.

17,548. M. Settle, Manchester. Improvements in magneto-electric machines employed for firing explosive charges for mining and other purposes. December 21.

17,574. S. Freeman, London. Improvements in means or apparatus to be employed in or connected with the coating of plates with tin or terne metal or the like. December 21.

17,589. R. M. Lloyd, London. Improvements in apparatus for coating metal plates with tin or other metal. December 21.

17,658. J. Radcliffe, Manchester. An improvement in miners' safety lamps. December 23.

17,754. J. Westgarth and W. Charnock, London. Improvements in or connected with the coating of metals with other metals or alloys. December 24.

17,770. J. Lysaght, London. Improvements in apparatus for coating metal plates. December 24.

17,809. F. Rigaud. Improvements in furnaces for smelting zinc and other ores. December 27.

17,909. M. D'Andria, Liverpool. Improvements in treating liquid acid residues from galvanising works to obtain products therefrom. December 30.

17,966. O. Y. Rhodes, Halifax. *See* Class XI.

1888.

19. C. M. Pielsticker.—From J. S. Williamson, United States. An improved method for the production of compound steel plates and other steel articles. January 2.

36. R. R. Gubbins, London. Improvements in the manufacture of bar iron. January 2.

181. H. Kenyon, Clayton, Manchester. Improvements in treating iron saturated with sulphur, ammonia, cyanogen, and other matters containing sulphur and nitrogen. January 5.

191. J. M. Bennett, Glasgow. Improvements in smelting and refining furnaces. January 5.

377. J. Park, Glasgow. Improvements in obtaining chromium. January 10.

401. H. A. Harvey, London. Improvements in the treatment of low steel. Complete specification. January 10.

418. J. H. Darby, London. Improvements in the manufacture of steel or iron. January 10.

421. H. R. Lewis and C. B. Phillips, London. Improvements relating to the extraction of metals from refractory, complex, or other ores. January 10.

542. F. J. Shand, Glasgow. Improvements in the manufacture of safety fuse for blasting and analogous operations. Complete specification. January 13.

587. W. Becker, London. Improvements in or pertaining to the casting of metal ingots. January 13.

652. F. Herbert, J. E. Jordan, and C. G. Jordan, Newport. Improvement in the manufacture of cast iron, steel, and other spigot and flange pipes. January 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12,295. G. J. Atkins. Means and apparatus for separation of gold and other metals from their ores. December 28.

13,590. J. Macnab. Safety lamp for mines. December 24.

16,682. S. Adams. Universal mill for rolling iron and steel plates bars, and the like. December 21.

1887.

2697. E. Patterson and W. H. Strype. Miners' safety lamps. December 24.

2834. H. Gardner.—From R. J. Henderson. Special method of manufacturing metal from iron ores, and apparatus therefor. December 24.

2909. L. A. Brode. Preparing briquettes of ironstone waste or dust for smelting. December 28.

3294. S. Alley and J. A. MacLellan. Apparatus for making moulds for casting. January 7.

3340. J. H. Wicksteed. Arrangement of shearing machines for cutting hot blooms or cogged ingots. December 28.

3362. J. W. Swan. Apparatus for the detection of explosive gases in mines. January 7.

3409. F. R. Schweizer and C. F. Mühlmann. Casting metals and alloys. December 31.

3670. F. H. Lloyd and H. White. Manufacture of cast steel, and apparatus therefor. January 7.

15,257. W. B. Middleton. Improved method of welding steel. December 21.

15,574. C. T. J. Vautin. Apparatus for extraction of gold from crushed or other finely divided auriferous material. December 21.

16,669. M. Bailey and J. Warner. See Class XI.

2134. A. Schanschieff. Miners' safety lamps, and galvanic batteries specially therefor. January 14.

8006. D. McCorkindale. Preparing malleable iron for making tubes, &c. January 21.

9313. A. Mann. Manufacture of alloys of aluminium with other metals. January 14.

11,142. H. H. Lake.—From B. Atha. Casting metal ingots or bars, and apparatus therefor. January 21.

16,497. B. H. Thwaite and J. Noble. Manufacture of steel and plant therefor. January 21.

16,745. J. Noble and B. H. Thwaite. Ingot and crucible heating arrangement. January 21.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

1887.

17,599. R. E. B. Crompton and J. Swinburne, Chelmsford. Improvements in dynamo-electric machines. December 22.

17,631. J. C. Lemmens, London. Improvements in electric batteries. December 22.

17,837. P. M. Justice.—From E. G. Acheson, United States. Improved means of generating electricity from heat. Complete Specification. December 28.

17,905. C. Gassner, jun., London. Improvements in or relating to the manufacture of galvanic dry elements. December 29.

17,936. O. Y. Rhodes, Halifax. Improvements in electric batteries and in the application thereof to the lighting of miners' safety lamps. December 31.

17,926. W. E. Hayne, London. Safety fuses for electrical circuits. December 30.

1888.

39. E. Tyer, London. An improvement in voltaic batteries. January 2.

41. E. Tyer. An improvement in voltaic batteries. January 2.

100. H. H. Lake.—From W. Humans, United States. Improvements in and relating to apparatus for generating electricity. Complete Specification. January 3.

208. O. C. D. Ross, London. Improvements in the utilization of waste products from electrical batteries. January 5.

225. H. Abbott and J. Douglas, London. An improved portable electric battery for miners' and other lamps. January 6.

293. T. Parker, Manchester. Improvements in alternating current dynamo-electric machines. January 7.

390. E. H. M. Andreoli, London. Electrical production of halogens and their compounds and utilization thereof. January 10.

472. W. Webster, jun., London. Improvements in apparatus for treating sewage and other impure liquids by electrolysis. January 11.

531. H. Edmunds, London. Improvements in and means or apparatus for and connected with the generation, distribution, measurement, and control of electricity. January 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

16,661. R. P. Sellon, W. M. Mordey, and C. E. Webber, Self-regulating dynamo-electric generators. December 21.

1887.

563. H. H. Leigh.—From J. L. Clerc. Improved dynamo-electric machines. January 21.

702. S. Z. de Ferranti. Dynamo-electrical machines. January 21.

1654. W. Kingsland. Closing or sealing secondary battery cells. January 7.

2390. H. Liepmann. Electrolytical treatment of ores for facilitating the extraction and recovery therefrom of gold, silver, and copper, and apparatus therefor. January 21.

3197. Sir D. L. Salomons, Bart., T. Parker, and P. B. Elwell. Separating the plates in secondary batteries. January 7.

9725. W. P. Thompson.—From G. Westinghouse, jun. Dynamo-electric machines. January 14.

11,448. J. S. Sellon. Secondary batteries. January 7.

11,923. C. L. R. E. Menges. Manufacture of plates or electrodes for primary or secondary batteries, and apparatus therefor. January 21.

15,588. J. Y. Johnson.—From W. C. Rechniewski. Dynamo-electric machines. January 14.

16,120. E. Tyer. Voltaic batteries. December 24.

16,669. M. Bailey and J. Warner. Secondary battery combined with a miners' safety-lamp. Jan. 7.

17,157. H. H. Lake.—From J. O. Whitten. Galvanic batteries. January 21.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

1887.

17,593. J. Taylor, Leith. An improved method of extracting oil from the oil-yielding parts of fish. December 22.

17,982. J. W. C. Doyne, Gorey, Wexford. Doyne's patent waterproof grease. December 31.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

16,979. A. W. MacIlwaine. Apparatus for extracting oils by volatile solvents. December 28.

1887.

1033. S. S. Sugden. Treatment of fatty and oily matters for the production of glycerine, lead compounds, and soap. December 24.

1057. R. Hunt and E. S. Wilson. Treatment of cotton-seed to obtain oil feeding cake and resin-like matter. December 28.

3410. A. Smith. Process for deodorizing cocoa-nut oil. December 24.

3617. A. F. Craig, A. Neilson, and J. Snodgrass. Apparatus for separating mineral or other oils from oils or substances of different specific gravities. January 7.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

1887.

17,470. W. S. Somers, Liverpool. An improved preparation for use in paints and varnishes and as a gum solvent. December 20.

17,546. J. M. Bennett and J. Telfer, Glasgow. Improvements in the manufacture of white lead. December 21.

17,732. H. M. Steinthal, London. The manufacture of a novel elastic substance. December 24.

17,925. L. A. Groth.—From C. Collin and L. Errani, Paris. *See* Class IV.

17,958. W. F. Harndall, Liverpool. Improvements in paints applicable for painting iron or steel work, and the insides and outsides of boilers and other structures. December 30.

17,972. S. E. Statham, Manchester. The improvement of the vulcanization of objects made of pure india-rubber sheet without any admixture of sulphur. December 31.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2261. R. E. Donovan and J. McKenny. Utilisation of a natural product in the manufacture of blacking, Japan black paint and outsides varnish, &c. December 21.

2694. A. M. Clark.—From M. P. E. Gérard. A new composition, capable of being formed into threads, films, sheets, &c., or used as a varnish. December 24.

2695. A. M. Clark.—From M. P. E. Gérard. Manufacturing textile threads from viscous or pasty matters. December 24.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

1887.

17,307. J. Taylor, Rochdale. Gristle tanned raw hide. December 16.

1888.

465. E. J. T. Digby, London. Improved means and process for manufacturing a substitute for leather. January 11.

COMPLETE SPECIFICATION ACCEPTED.

1887.

3860. H. Golding. Improvements in treating leather. January 24.

XV.—AGRICULTURE, MANURES, Etc.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2459. A. Campbell. A method of treating and mixing or compounding phosphatic compounds for artificial manures. December 21.

3292. T. McMurray. *See* Class XVIII.—C.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

1887.

17,696. J. W. Bailey and J. A. R. Greaves. London. The production of a new or improved saccharum for the use of brewers, distillers, and vinegar makers. December 23.

17,793. W. P. Thompson.—From J. H. Mau, United States. Improvements in apparatus for extracting the juice from cane, sorghum, and other like substances. Complete specification. December 27.

18,025. G. Adant, London. Improvements in the method of, and apparatus for, grinding and aërating sugar, grain, and the like. December 31.

1888.

245. W. H. Stead, Liverpool. Improved gums, and improvements in the manufacture or purification of gums. January 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2297. A. Brin and L. O. Brin. Treating saccharine and saccheriferous matters for decolouring, purifying, or refining them. January 14.

2298. A. Brin and L. Q. Brin. Treating saccharine and saccheriferous matters for decolouring, purifying, or refining them. January 14.

2983. G. F. Marshall. Manufacture of an improved carbon for filtering and decolorizing purposes. December 28.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

1887.

17,696. J. W. Bailey and J. A. R. Greaves. *See* Class XVI.

17,946. A. J. Walker, London. A new or improved apparatus for oxidising or aërating yeast or other solutions used in brewing. December 30.

18,022. L. Briant and G. A. Clowes, London. A new and improved yeast food for the use of brewers, distillers, vinegar makers, and yeast manufacturers. December 31.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4271. A. Walker. Manufacture of yeast. January 14.

5337. I. A. F. Bang and M. C. A. Ruffin. Process and apparatus for purifying crude spirit and regenerating the purifying agent. January 14.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

1887.

17,313. J. M. Dowden, London. Enriching and preserving milk. December 16.

17,316. A. J. Boult.—From I. B. Lehmann, Switzerland. Improvements in or relating to the preservation of animal and vegetable substances. December 16.

17,633. O. Krueger. London. Improvements in and relating to compounds of chocolate, coffee, and tea, and other substances for the preparation of beverages. Complete specification. December 22.

17,746. J. B. Guérin, London. Improvements in the method and apparatus for preserving milk by congelation. December 21.

17,750. B. Rigwert, London. A substitute for coffee. December 24.

17,756. W. L. Williams and S. Puplett, London. Improvements in the mode of applying mechanical refrigeration for the preservation of alimentary and other substances, and in apparatus or means employed therein. December 24.

1888.

434. A. W. Shaw, Limerick. Chilling, curing, or preserving carcases of hogs, and other goods of a perishable nature, by means of an improved system of refrigeration. January 11.

B.—Sanitary Chemistry.

1887.

17,381. C. H. Roeckner and R. L. Roeckner, Tynemouth. The utilisation of certain waste liquids or bye-products. December 17.

17,630. J. B. Alliott, London. Improvements in or pertaining to the disposal of refuse of towns and the like by burning, utilising heat generated therefrom, and apparatus therefor. December 22.

1888.

177. B. D. Healey and B. H. Thwaite, Bamber Bridge. The application of gaseous fuel for treating towns' refuse and the fumes therefrom, and apparatus therefor. Complete specification. January 5.

472. W. Webster, jun. *See* Class XI.

530. J. Arnold, London. An improved apparatus for use in disinfecting sewer gases and deodorising sewage. January 12.

C.—Disinfectants.

1887.

17,969. E. Hermite, E. J. Paterson, and C. F. Cooper. *See* Class VII.

1888.

314. F. A. Ducat, Birmingham. An improved manufacture of a discolouring and disodorising product. January 7.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1887.

2519. H. W. Hart. Treating coffee to prevent loss of its valuable constituents and preserve the aroma. December 21.

3284. C. A. Sahlström. Preserving fish, &c., and apparatus therefor. December 28.

3461. G. Bischof. Process and apparatus for purifying water. January 7.

3592. H. N. Hillman and G. B. Kleinpass. Manufacture of margarine, oleomargarine, and similar substances. January 14.

4203. T. Kerfoot. Preparing a dry saccharated extract of tea. January 21.

B.—Sanitary Chemistry.

1887.

3352. G. Gehring. Process and apparatus for the separation and disinfection of fœcal and other matters. January 14.

C.—Disinfectants.

1887.

3292. T. McMurray. Compounds for deodorising, filtering, and manuring purposes. December 24.

XIX.—PAPER, PASTEBOARD, Etc

APPLICATION.

1888.

346. J. R. Thame, London. Improvements in barrels and other articles made from paper or like pulp, and in apparatus employed in their manufacture. January 9.

COMPLETE SPECIFICATION ACCEPTED.

1886.

15,942. C. Kellner. Process for the manufacture of cellulose. January 7.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

1887.

17,391. T. G. Hart, London. Improvements in and upon the manufacture of smokeless gunpowder. December 17.

17,409. C. A. McEvoy, London. Improvements in electrical primers or fuses. December 17.

17,498 C. G. Harris, Glasgow. Improvements in or relating to wax matches, or matches of an analogous kind, to keep the head from falling off, and to obtain other advantages. December 20.

17,506. G. Quick, Westminster. Improvements in and applicable to cartridges for ordnance, part of which is applicable to gunpowder generally. December 20.

17,522. M. Vogelsang, London. An improved explosive substance, and combination of materials used for the same. December 20.

17,834. J. Johns, London. Improvements in the manufacture of cigar lights or fusees. December 28.

1888.

86. F. von Dechend, London. A process or processes for the reduction of nitro-compounds. January 3.

370. S. H. Emmens, London. Improvements in the manufacture of explosives. January 10.

487. A. Orr, Glasgow. Improvements in forming solutions and compounds of nitro-cellulose. January 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

783. L. Cornet and L. Yonck. A new or improved explosive compound. December 24.

2628. H. S. Maxim. Manufacture and treatment of dynamite blasting-gelatine and similar explosive compounds, and apparatus therefor. December 21.

3554. J. Fraser. Method and apparatus for manufacturing lucifer matches. January 14.

6022. J. H. Johnson.—From F. Engel, Germany. Manufacture of explosives. December 31.

16,116. E. Grune. Manufacture of kieselguhr dynamite. December 24.

XXIII.—ANALYTICAL CHEMISTRY.

COMPLETE SPECIFICATION ACCEPTED.

1887.

3859. J. W. Lovibond. Apparatus for estimating or comparing colour, texture, and appearance of liquid or solid bodies viewed by transmitted or reflected light. January 21.

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LIST OF MEMBERS.

A

Abbott, John, Braemar House, Lancaster Gate, Hyde Park, W.
Abel, Sir F. A., Royal Arsenal, Woolwich, London, S.E.
Abney, Capt. W. de W., Willeslie House, Wetherby Road, South Kensington, S.W.
Abraham, A. C., 87, Bold Street, Liverpool.
Acland, Sir H. W., Radclyffe Library, Oxford.
Adam, A. Learmouth, 40, Sir Michael Street, Greenock, N.B.
Adam, J. B., 172, Leith Walk, Edinburgh.
Adams, M. A., Ashford Road, Maidstone, Kent.
Adams, J. W., 74, Oxford Street, Regent Road, Salford, Manchester.
Addie, J., Langloan Ironworks, Coatbridge, N.B.
Adkins, H., Chemical Works, Smethwick.
Adriance, John S., 1, East 55th Street, New York, U.S.A.
Affleck, J., Mill House, Woolton, near Liverpool.
Aikman, Charles M., 183, St. Vincent Street, Glasgow.
Aitken, Dr. A. P., 8, Clyde Street, Edinburgh.
Aitken, J. B., Gerard's Fold Chemical Works, Widnes.
Akitt, Thomas, 3, Victoria Road, Lenzie, N.B.
Albright, G. S., The Elms, Park Road, Edgbaston.
Albright, W. A., Mariemont, Birmingham.
Allbright, W. B., c/o Halstead & Co., 196-202, Forsyth St., New York, U.S.A.
Alexander, J. O., 4, Belhaven Terrace, Kelvinside, Glasgow.
Alexander, W. T., 20, Booth Street, Moseley Street, Manchester; and Crumnock Bank, Victoria Crescent, Eccles.
Allan, Jno., 2, Blythwood Villas, Crouch Hill, N.
Alldred, C. H., 35, Crisp Terrace, Upper Park Road, Plumstead Common, Kent.
Allen, A. H., Sydenham Cottage, Park Lane, Sheffield.
Allen, J., 164, Upper North Street, Poplar, London, E.
Allen, J. Fenwick, Newham, Whalley Range, Manchester.
Allen, Walter S., 13, Beacon St., Boston, Mass., U.S.A.
Allen, Wm., Edenholme, Bournemouth, Hants.
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Allender, G. M., Stammerham, Horsham, Sussex.
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Allhusen, Wilton, 102, Quay Side, Newcastle-on-Tyne.
Allibon, G. H., Seaview, Litherland Park, near Liverpool.
Alliott, J. Bingham, Messrs. Manlove, Fryer, Alliott, and Co., Nottingham.
Alsberg, M. (Sondheim, Alsberg, & Co.), P.O. Box 2437, New York, U.S.A.
Anderson, Geo. B., Victoria Square, Felling-on-Tyne.
Anderson, John, Workington Ironworks, Workington, Cumberland.
Anderson, J. M. T., Explosives Co. Ld., Stowmarket, Suffolk.
Anderton, G. H., Howendyke, Howden, Yorks.
Andrew, W. B., Gavinburn, Old Kilpatrick, Dumbartonshire.
Angell, J., The Grammar School, Manchester.
Angus, James, Thorncliffe Collieries, Chapeltown, Sheffield.
Angus, John, Ingram House, 165, Fenchurch St., London, E.C.
Angus, W. Mathwin, St. John's Leather Works, Newcastle-on-Tyne.
Annandale, J. H., Polton, Midlothian, N.B.
Annison, R. H., 16, Water Lane, Tower Street, London, E.C.
Ansdell, G., 45, Courtfield Road, South Kensington, S.W.
Ansdell, T. C., Kearsley Cottage, Farnworth, Bolton.
Archbold, Dr. George, Laboratory, Phœnix, Oswego Co., N.Y., U.S.A.
Archbutt, L., Argyle Terrace, Rose Hill, Derby.
Armstrong, Dr. H. E., Central Institution, Exhibition Road, London, S.W.
Armstrong, Rt. Hon. Lord, Newcastle-upon-Tyne.
Ash, T. E., 4, Saltram Place, Citadel Road, Plymouth.
Ashwell, H., Woodthorpe Grange, Sherwood, Nottingham.
Ashwell, J. H., Woodthorpe Grange, Sherwood, Nottingham.
Ashwell, Jno. R., Midanbury Lodge, Bentinck Road, The Forest, Nottingham.
Ashworth L., The Barlows, Radcliffe, near Manchester.
Atcherley, Dr. R. J., 80, Elsham Road, Kensington, W. (for Journals), and 23, Bucklersbury, E.C.
Atkins, S. R., Market Place, Salisbury.
Atkinson, A. J., 44, Loudoun Square, Cardiff.
Atkinson, R. W., 44, Loudoun Square, Cardiff.
Attfield, Dr. J., Ashlands, Watford, Hertfordshire.
Aubrey, W. H., 121, Burrage Road, Plumstead, S.E.
Auer, H., Lathom House, Halebank, near Widnes.
Auerbach, C. G., Farbenfabriken vorm. F. Bayer & Co., Elberfeld, Germany.
Austen, Peter T., New Brunswick, N.J., U.S.A.
Austin, E., 126, Bermondsey Street, London, S.E.

B

Babington, F. W., School of Practical Science, Toronto, Canada.
Bailey, Edwin M., Royal Bank of Scotland, Ardrossan, Ayrshire; and 38, Berkeley Street, Glasgow.
Bailey, Wm., The Terrace, Oaken, near Wolverhampton.
Bailey, Dr. G. H., Owens College, Manchester.
Bailey, Thos., 25, High Street, Hull.

Bailey, Walter P., British Alizarine Works Co., Silvertown, E.
Bainbridge, Herbert A., Malvern Hall, Solihull, near Birmingham.
Baker, E., Stoneleigh, Eastern Avenue, Reading, Berks.
Baker, Harry, 262, Plymouth Grove, Manchester.
Baker, W. G., Garden Wharf, Church Road, Battersea, London, S.W.
Baker, Theodore, Clifden, Overcliff, Gravesend.
Bald, J. H., Braddock, Pa., U.S.A.
Ball, T. B., 12, Edmund Street, Rochdale.
Ballard, E. G., 1, Eversley Park, Chester.
Ballard, J. F., Somerby Villa, Norfolk Park, Maidenhead.
Bamber, H. K., 5, Westminster Chambers, Victoria Street, London, S.W.
Banister, H. C., 31, Dale Street, Liverpool.
Banks, Arthur J., 229, Wavertree Road, Liverpool; and c/o Jas. Morrell & Co., Limited, Morpeth Dock, Birkenhead.
Banner, Samuel, 4, Ivanhoe Road, Liverpool.
Bannister, R., The Laboratory, Somerset House, London, W.C.
Bannister, W., Victoria Lodge, Cork, Ireland.
Barber, Geo., 23, Studley Road, Forest Gate, E.
Barbour, T. F., Chemical Laboratory, University of Edinburgh.
Barclay, H., Rose Hill, Harrington, Cumberland.
Barclay, Thos., 17, Bull Street, Birmingham.
Bardsley, Robt., c/o Jewsbury and Brown, 44, Downing Street, Manchester.
Barlow, E., 2, Old Palace Yard, Westminster, S.W.
Barnes, H. J., Phœnix Chemical Works, Hackney Wick, E.
Barnes, J., 37, Avenue Parade, Accrington, Lancashire.
Barnes, Jonathan, Buckton Vale, near Stalybridge.
Barnes, R. L., Phœnix Chemical Works, Hackney Wick, E.
Barr, J., Dinting Vale, Glossop.
Barret, E. L., 53, Springfield Road, St. John's Wood, London, N.W.
Barrow, J., Beech House, Folly Lane, Swinton, near Manchester.
Barrow, Jos., Oldham Road, Failsworth, Manchester.
Bartholomew, G., Halstow, 2, Cranbrook Lane, Ilford Park, E.
Bassett, H., 26, Belitha Villas, Barnsbury, N.
Bateson, Percy, Emsworth, Wavertree, Liverpool.
Battershall, Dr. Jesse P., 402, Washington Street, New York, U.S.A.
Batty, R. B., Drayton Villa, Erdington, near Birmingham.
Baxter, Henry, The Tower, Rainhill, Lancashire.
Baxter, W. H., The Lawn, Brixton Hill, London, S.W.
Bayley, F. S., 88, King Street, Manchester.
Bayley, Thos., 7, West End Chambers, Broad Street Corner, Birmingham.
Baynes, J., jun., Royal Chambers, Scale Lane, Hull.
Beadle, Clayton, Beadon Well, Belvedere, Kent.
Beanes, E., Moatlands, Paddock Wood, Brenchley, Kent.
Beardmore, Wm., Parkhead Forge, Glasgow.
Beaumont, F. J., 42, Trinity Square, Borough, S.E.
Beaven, E. S., 5, Boreham Terrace, Warminster, Wilts.
Bechler, M., The Manbrè Saccharine Co., Limited, Fulham, Road, Hammersmith, London, W.
Beckett, G. H., 37, St. Andrew's Place, Listerhills, Bradford, Yorks.
Beckett, J. H., Wilmslow Park, Cheshire.
Beckingham, J. H., Messrs. Scott Brothers, Dean Street, Newcastle-on-Tyne.
Bedford, J., Woodhouse Cliff, Leeds.
Bedingfield, C. H., 4, Tichborne Street, High Fields, Leicester.
Bedson, Prof. P. P., Durham College of Science, Newcastle-on-Tyne.
Beilby, G., St. Kitts, Slateford, N.B.
Belcher, J. C., c/o Sanitas Co., Ld., Letchford's Buildings, Three Colts Lane, Bethnal Green, E.
Bell, C. Lowthian, Middlesbrough on-Tees.
Bell, G., Runcorn Soap and Alkali Co., Runcorn.
Bell, H. S., 2, St. Anne's Park Villas, Wandsworth, S.W.
Bell, Jno., 118, Southwark Street, London, S.E.
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Bellingham, Wm., Dalston Distillery, London, E.
Bendix, D., The British Alizarin Co., Limited, Silvertown, Victoria Docks, London, E.
Benger, F. B., 7, Exchange Street, Manchester.
Benjamin, M., 43, East 67th Street, New York, U.S.A.
Bennett, James M., 12, Hamilton Drive, Hillhead, Glasgow.
Bennett, Thos., Birch Vale, near Stockport.
Bennie, J. W., Guaranteed Manure Works, Cubitt Town, E.
Bentley, J. W., Stakehill Works, Castleton, Manchester.
Benton, W. E., Littleworth House, Hednesford, Staffordshire.
Berdoe, Walter, 51, South John Street, Liverpool.
Beringer, J. J., 10, South Terrace, Camborne, Cornwall.
Beringer, C., 293, Vauxhall Bridge Road, London, S.E.
Bernays, J., 96, Newgate Street, London, E.C.
Berry, E. E., 76, George Street, Gower Street, London, N.W.
Best, T. T., 4, Weisse Herzstrasse, Erlangen, Bavaria.
Bevan, A., Bryn Chemical Works, Llanelly, S. Wales.
Bevan, E. J., 4, New Court, Lincoln's Inn, London, W.C.
Bevan, I., Llanelly Chemical Works, Llanelly, S. Wales.
Bevan, J. Williams, Southview House, Shirehampton, near Bristol.
Bevan, Thos., 122, Cheshire View, Broad Street, Pendleton, Lancashire.
Beveridge, J., Main Street, Frodsham, Cheshire.
Bewick, T. Burrell, Hebburn-on-Tyne.
Bibby, E. V., Garston Copper Works, Garston, near Liverpool.
Bickerdike, W. E., Clayton Grange, Wilpshire, near Blackburn.
Bickerton, C. W., Torkington Fold, Norbury, near Stockport.
Bickett, J. H., Medical College, London Hospital, E.
Biggart, J. Wm., 29, Cathcart Street, Greenock, N.B.
Biggs, B., 3, Lawrence Pountney Hill, London, E.C.
Bihn, G. F., Pennsylvania Salt Manufacturing Co., Philadelphia, U.S.A.
Billing, H. S., Messrs. Burnard, Lack, & Alger, Plymouth Chemical Works, Plymouth.
Bindschedler, R., Société pour l'Industrie Chimique, Basle, Switzerland.
Bingley, J., Chemical Laboratory, Northampton.
Binks, J. B., 4, Criffel Street, Silloth, Cumberland.
Binney, H. A., Ravenhead, St. Helens.
Bird, Henry, South Down House, near Devonport.
Bird, R., Ellerslie, Roath, Cardiff.
Birley, R. K., Messrs. Chas. Macintosh & Co., Cambridge Street, Manchester.
Birch, R. W. Peregrine, 5, Queen Anne's Gate, Westminster, S.W.
Bischof, Gustav, 4, Hart St., Bloomsbury, London, W.C.
Bishop, Frank, 6, Holly Terrace, West Hill, Highgate, N.
Bishop, Fred, 12, Charles Street, Edinburgh.
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Bishop, A. Conway, Three Mills Lane, Bromley-by-Bow, London, E.
Bishop, G. A., Royal Bank House, Coatbridge, N.B.
Black, Wm., St. Bede Chemical Co., Newcastle-on-Tyne.
Black, Wm., Stanrigg, Airdrie, N.B.
Blackwell, G. G., 26, Chapel Street, Liverpool.
Blades, C. M., Bay Villa, Chester Road, Northwich, Cheshire.
Blagden, W. G., 1, Fenchurch Avenue, London, E.C.
Blair, J., Irvine Bank Chemical Works, Kilmarnock, Ayrshire.
Blair, John, 18, Old Mill Road, New Hendon, Sunderland.
Blake, C. A., 47, Piccadilly, London, W.
Blake, F. C., Mansfield Valley, Allegheny Co., Pa., U.S.A.
Blake, Jas., Thames Sugar Refinery, Silvertown, London, E.
Blenkinsop, W., Garden Wharf, Battersea, London, S.W.
Bles, A. J. S., 32, Chorlton Street, Manchester.
Blinkhorn, W. J., 31, Grove Park, Liverpool.
Bloomfield, R., Thurma Factory, viâ Darbhunga, Tirhoot, India.
Blount, Bertram, Chemical Laboratory, Broadway, Westminster, S.W.

Blundstone, E. R., 10, Wellington Mansions, North Bank, Regent's Park, N.W.
Blythe, F. C., Newholme, Victoria Park, Manchester.
Blythe, H. F., Holland Bank Chemical Works, Church, near Accrington.
Blyton, J., 12, Cromford Court, Market Street, Manchester.
Boa, Peter, 119, George Street, Edinburgh.
Boake, A., Southwood Lawn, Highgate, London, N.
Boake, Edmund J., Caius College, Cambridge.
Board, J. T., Distillery, Cheese Lane, Bristol.
Bogle, Wm., Wappinger's Falls, Duchess Co., N.Y., U S.A.
Bolas, Thos., 8, Grove Terrace, Chiswick, W.
Bolton, G. H., Widnes Alkali Co., Limited, Widnes.
Bonn, J. Edwin, High Street, Brading, Isle of Wight.
Booth, Geo., Irk Vale Dyeworks, Middleton, near Manchester.
Borland, John, Etruria, Kilmarnock, N.B.
Borland, W. D., 35, Petherton Road, Highbury New Park, N.
Boston, H. G., Nunthorpe Crescent, Bishopthorpe Road, York.
Bothamley, C. H., Yorkshire College, Leeds.
Böttinger, H. T., Elberfeld, Germany.
Bottle, Alex., 4, Godwyne Road, Dover.
Boulton, H. E., 64, Cannon Street, London, E.C.
Boulton, S. B., 64, Cannon Street, London, E.C.
Boulton, T. S.,
Boundy, Chas., 127, The Albany (North Corridor), Oldhall Street, Liverpool.
Bourcart, Dr. R., 18, Chaussée de Dornach, Mulhouse, Alsace.
Bow, R. H., 7, South Gray Street, Edinburgh.
Bowen, S. B., Brickfield Chemical Works, Llanelly, South Wales.
Bower, G., St. Neots, Huntingdonshire.
Bower, H., P.O. Box 946, Philadelphia, Pa., U.S.A.
Bowler, G. S., Crystal Palace District Gas Co., Limited, Lower Sydenham, S.W.
Bowley, Jos. John, Wellington Works, Battersea Bridge, London, S.W.
Bowly, Capt. J. E., 54, Trinity Road, Aston, Birmingham.
Bowman, F. H., West Mount, Halifax.
Bowman, R., Eglinton Chemical Works, Irvine, N.B.
Bowrey, J. J., Kingston, Jamaica, West Indies.
Boyd, Pythagoras, Box 77, North Adams, Mass., U.S.A.
Boyd, W., Tharsis Works, East Moors, Cardiff.
Boyd, W., c/o Messrs. Tennant & Co., St. Rollox, Glasgow.
Bracewell, Wm., Brinscall, near Chorley.
Bradburne, J. A., Quince Street, Geddes, Syracuse, N.Y., U.S.A.
Bradbury, A., Mason's Buildings, Exchange Street East, Liverpool.
Bradbury, W. A., Steetley Chemical Works, Worksop.
Bradley, N., 49 and 51, Chapman Street, Hulme, Manchester.
Bramham, W., 82, Bow Road, London, E.
Bramley, Wm., 18, Clarence Street, Middlesbro'-on-Tees.
Bramwell, E., Charlwood House, Huyton, near Liverpool.
Bramwell, Sir F., 5, Great George Street, Westminster, London, S.W.
Bramwell, G. H., Cowley Hill, St. Helens, Lancashire.
Bramwell, Samuel, 4, St. Ann's Square, Manchester.
Branson, F. W., 14, Commercial Street, Leeds.
Bray, Geo., Blackman Lane, Leeds.
Brayne, Francis W., Bow Pottery, Three Mills Lane, Bromley-by-Bow, E.
Breckon, J. R., 32, Fawcett Street, Sunderland.
Breen, George, Irvine Chemical Co., Limited, 204, Vincent Street, Glasgow.
Breffitt, Wm., Glasshoughton, Castleford, Yorks.
Brenemann, Dr. A. A., 97, Water Street, New York, U.S.A.
Brewis, E. T., 111, Great Brunswick Street, Dublin.
Briant, L., 24, Holborn Viaduct, London, E.C.
Briggs, T. Lynton, c/o Read, Holliday & Sons, 7 Platt Street, New York, U.S.A.
Briggs, W., Springfield Terrace, Arbroath, N.B.
Brinjes, J. H., Whitechapel Engine Works, Fieldgate Street, London, E.
Bristow, G. W., Worcester House, 35, Eastcheap, London, E.C.
Broad, Jas., 66, High Street, Lewes, Sussex.
Broadbent, H., c/o Goodall, Backhouse, & Co., Sovereign Street, Leeds.
Brock, J., British Alkali Works, Widnes.
Brooke, Edwd., Oakley House, Edgerton, Huddersfield.
Brookes, E. A., 15, Withington Road, Whalley Range, Manchester.
Brotherton, E. A., Fern Cliffe, Ilkley, Yorkshire.
Brown, Prof. A. Crum, 8, Belgrave Crescent, Edinburgh.
Brown, Arthur E., Morden Cliff, Lewisham, S.E.
Brown, D., 93, Abbey Hill, Edinburgh.
Brown, D., Donaghmore, Tyrone, Ireland.
Brown, H., Royal Oak Brewery, Stockport.
Brown, Dr. J. Campbell, 27, Abercrombie Square, Liverpool.
Brown, J. T., 46, Kilmaine Road, Fulham, London, S.W.
Brown, Oliphant A., Lennoxmill, Lennoxtown, N.B.
Brown, T., The Chemical Works, King's Lynn.
Brown, Horace T., 47, High Street, Burton-on-Trent.
Brown, Walter, c/o Jas. H. Dennis and Co., Widnes.
Brown, F. W., 17, Walterton Road, St. Peter's Park, London, W.
Brown, W. A., Overton Paper Mills, Greenock, N.B.
Browning, W., Broad Oak, Accrington.
Bruce, Edw. M., Union Pacific Railroad, Omaha, Nebraska, U.S.A.
Brundrett, A., Rhymney Ironworks, Monmouthshire.
Brunner, H., Holly Mount, Tarbock Road, Huyton, near Liverpool.
Brunner, J. F. L., Trinity Hall, Cambridge.
Brunner, J. T., M.P., Winnington, Northwich.
Brunner, J. P., 28, Exchange Street East, Liverpool.
Bryan, E., Gas Works, Beverley, East Yorkshire.
Bryce, A. S., Glenpark Oil Works, East Nelson Street, Glasgow.
Bryce, A. S., jun., 8, Broompark Terrace, Dennistown, Glasgow.
Bryce-Smith, N. J., Oakfield, Barrow, Whalley, near Blackburn.
Buch, Carl Von, 12, Buckingham St., Strand, London, W.C.
Buchan, A., 13, Willowbank Crescent, Glasgow.
Buchanan, J. Y., 10, Moray Place, Edinburgh.
Buckeridge, Herbert L., Leighton Villa, Cheverton Road, Hornsey Lane, N.
Buckley, W., Brookside Printworks, West Leigh, Lancashire.
Budden, E. R., Camelot, Netherhall Terrace, South Hampstead, N.W.
Bullock, J. L., 3, Hanover Street, Hanover Square, London, W.
Bumby, H., Solway Ironworks, Maryport, Cumberland.
Bunker, H. E., 24, Great Cheetham Street West, Lower Broughton, Manchester.
Burdekin, G., jun., Sutton Lodge Chemical Co., St. Helens.
Burghardt, Dr. C. A., Bridgwater Club Chambers, 110, King Street, Manchester; and Owens College, Manchester.
Burgmann, C. F., 41, Warwick Gardens, Kensington, W.
Burnard, R., Plymouth Chemical Works, Plymouth.
Burnett, E. E., 118, Huddleston Road, Tufnell Park, London, N.
Burrell, B. A., Bank Chambers, 70, South Mall, Cork.
Burroughs, S. M., Bell Lane, Wandsworth, S.W.
Burton, F., 2, Green Street, Bethnal Green, E.
Bury, J. H., Church Chemical Works, near Accrington.
Bush, R. A., 20, Artillery Lane, London, E.C.
Bush, W. E., 20, Artillery Lane, London, E.C.
Bush, W. J., 20, Artillery Lane, London, E.C.
Butt, E. N., 25, Sussex Gardens, Hyde Park, London, W.
Butler, Samuel, Compton, Wolverhampton.
Butler, W. W., Crown Brewery, Broad Street, Birmingham.
Butterfield, J. C., Westbury Cottage, Barking.
Button, H., Faraday Chemical Works, Rainham, Essex.
Byard, A. G., 70, Fisher Street, Canning Town, E.
Bythway, M., 43, Lloyd Street, Albert Street, Manchester.

C

Cabot, Godfrey L., 82, Water Street, Boston, Mass., U.S.A.
Calderwood, J., Gowanlea, Spencer Park, Wandsworth, S.W.; and Price's Patent Candle Co., Battersea.
Caley, A. J., Chapel Field, Norwich.
Callard, S., Pontamman Chemical Works, Ammanford, Carmarthen.
Calvert, J. H., Oakenshaw Printworks, Clayton-le-Moors, Accrington.
Cameron, Ian, Nickel Co., Kirkintilloch, N.B.
Cameron, R., 31, Westbourne Gardens, Kelvinside, Glasgow.
Cammack, J., 8, Salisbury Street, St. Helens.
Campbell, A., 42, Whittaker Road, Upton Park, Essex.
Campbell, Andrew, Linlithgow Oil Co., Linlithgow, N.B.
Campbell, John, 25, New Chambers Street, New York, U.S.A.
Candlish, J. J., Bottle Works, Seaham Harbour, co. Durham.
Cannon, M., Beaufoy's Chemical Works, Lavender Hill, London, S.W.
Carey, E., Widnes, Lancashire.
Carlile, T., 27, St. Vincent Place, Glasgow.
Carmody, Patrick, Laboratory, Somerset House, London, W.C.
Carnelly, Dr. Thos., University College, Dundee.
Caro, Dr. H., Mannheim, Germany.
Carpenter, H. S., 32, Holborn Viaduct, London, E.C.
Carpenter, R. F., Bent Terrace, Prestwich, near Manchester.
Carpenter, W. L., 36, Craven Park, Harlesden, London, N.W.
Carran, T. W., Girton House, Shiel Road, Liverpool.
Carrick, H., Holly House, Gateshead-on-Tyne.
Carruthers, J. G., Burnbrae House, Milngavie, N.B.
Carter, W. C., 2, Weech Road, Burgess Hill, Hampstead, N.W.
Carteighe, M., 180, New Bond Street, London, W.
Casthèlaz, Chas., 19, Rue Ste. Croix de la Bretonnerie, Paris.
Castner, Hamilton Y., 23, Cecil Street, Strand, London, W.C.
Cawley, G., 3, Lansdowne Road, Didsbury, Manchester.
Cawley, J., 278, Passaic Street, Newark, New Jersey, U.S.A.
Chadwick, Edmund, Witton Mill, Blackburn.
Chadwick, L. N., Ivy Lawn, Ponders End, Middlesex.
Chaloner, G., 30, Weston Park, Crouch End, N.
Chamberlain, J., Gas, Light & Coke Co., Beckton, North Woolwich, E.
Chambers, J. M., Te Mata, Havelock, Hawkes Bay, New Zealand.
Chance, A. M., Alkali Works, Oldbury, near Birmingham.
Chance, J. F., Alkali Works, Oldbury, near Birmingham.
Chandler, Dr. C. F., School of Mines, Columbia College, New York.
Chaney, Harry, North Mexican Silver Mining Co., Cusihuiriachic, Chihuahua, Mexico.
Chapman, S., 84, Eccleston Square, London, S.W.; and 36, Mark Lane, E.C.
Chapman, W., Crescent Road, Ipswich.
Charlton, Jno., 42, Blackfriars Street, Manchester.
Charlton, Jas., c/o Levinstein & Campbell, 25, New Chambers Street, New York, U.S.A.
Cheetham, F. W., Carlton Bank, Hyde, Manchester.
Cheyne, A. M., c/o Messrs. Burgoyne, 16, Coleman Street, London, E.C.
Chisholm, M. E., 8 Kennington Park Road, London, S.E.
Christie, J., Messrs. John Orr-Ewing & Co., Alexandria Works, Dumbartonshire.
Christopher, G., 5, Shoe Lane, E.C. (for Journals); and 6, Barrow Road, Streatham Common, S.W.
Christy, Thos., Malvern House, Sydenham, S.E.; and 25, Lime Street, London, E.C.
Chrystal, W. J., Shawfield Works, Rutherglen, near Glasgow.
Chubb, Harry, 21, Lansdowne Place, Brighton.
Church, A. H., Shelsley, Kew, Surrey.
Claisen, Dr. L., Sophienstrasse, 6/0, München, Bavaria.
Clanahan, H. C., 88, King Street, Manchester.
Clark, E. B., Rangoon Oil Co., Rangoon, Burmah.
Clark, Dr. J., 138, Bath Street, Glasgow.
Clark, John, 80, Great Brook Street, Birmingham.
Clark, H. G. D., Brewery, Twickenham, Middlesex.
Clark, R. Ingham, 2, Park Prospect, Queen Anne's Gate, Westminster, S.W.
Clarke, Arthur, St. Ann's Hill Factory, Nottingham.
Clarke, Wm. Randal, 23, Vine Street, Widnes.
Claudet, A. C., 6, Coleman Street, London, E.C.
Claudet, F. G., 13, Townley Park Villas, Dulwich Rise, S.E.
Claus, C., 24, Merton Road, South Wimbledon, S.W.
Claus, Carl F., jun., 9, Nassington Road, Hampstead, N.W.
Clayton, E. G., Chemical Laboratory, 54, Holborn Viaduct, London, E.C.
Clayton, F. C., 18, St. James' Road, Edgbaston, Birmingham.
Clayton, Jas. S., Ewbank House, Accrington.
Clemes, J. H., Penrhyn Lodge, Woodberry Down, Finsbury Park, N.
Cleminshaw, E., Alkali Works, Oldbury, near Birmingham.
Clemons, G. H., Cudbear Street, Hunslet Road, Leeds.
Clerk, Dugald, Driffold Villa, Sutton Coldfield, near Birmingham.
Cliff, D. Y., 7, Wellington Street, Leeds.
Cliff, J., Nisbet Hall, Fulneck, Leeds.
Cliff, Stephen, Wortley, near Leeds.
Clift, J., Kemp Field House, Knottingley, Yorks.
Clifton, C. D., Royal Oak Brewery, Stockport.
Cloud, T. C., Wallaroo Smelting Works, Wallaroo, South Australia.
Clowes, Dr. F., University College, Nottingham.
Clowes, G. A., Needham Market, Suffolk.
Coates, John, 106, Cannon Street, London, E.C.
Cochrane, Wm. P., Holmhurst, The Park, Middlesbro'.
Cockburn, J., 43, Camden Square, London, N.W.
Coghill, P. de G., 47, Derby Lane, Old Swan, Liverpool.
Cogswell, W. B., Syracuse, New York, U.S.A.
Cohen, Dr. J., Owens College, Manchester.
Colby, W. H., Oakley, Ruthin Road, Denbigh.
Coleman, Jas. B., University College, Nottingham.
Coleman, J. J., Ardarroch, Bearsden, near Glasgow.
Collens, E., Vinegar Works, Stourport, Worcestershire.
Collett, J. M., 7, Brunswick Square, Gloucester.
Collins, J. H., 4, Clark Terrace, Dulwich Rise, S.E.
Collins, John, Bradford Chambers, Mawdsley Street, Bolton-le-Moors.
Collins, H. S., Messrs. Langton & Co., 230, Upper Thames Street, London, E.C.
Collyns, C. S. A., 47, Park Street, Greenheys, Manchester.
Colquhoun, D., c/o Chas. Tennant & Co., Ld., Carnoustie, N.B.
Colson, A., Gas Office, Millstone Lane, Leicester.
Connor, C. C., Notting Hill House, Belfast, Ireland.
Conrad, E. C., Paraparap, Portland Road, Gravesend, Kent
Constable, W. H., Hale Bank, Widnes, Lancashire.
Cook, E. M., 154, East 37th Street, New York, U.S.A.
Cook, E. Rider, East London Soap Works, Bow, London, E.
Cook, H. J., East London Soap Works, Bow, London, E.
Cook, Robt., Atlas Chemical Works, Widnes.
Cooke, Leonard, Horwich Vale, near Bolton-le-Moors.
Cookson, N. T., Newcastle-on-Tyne.
Coomber, Thos., 9, Osborne Road, Clifton, Bristol.
Cooper, A., North-Eastern Steel Co., Middlesbrough-on-Tees; and The Laurels, Linthorpe, near Middlesbrough-on-Tees.
Cooper, Claude H., The Towers, Old Sneinton, Nottingham.
Cooper, H. P., 15, Haringey Road, Hornsey, N.
Corbett, E., Plaskynaston Chemical Works, Ruabon, North Wales.
Corbett, Jno., M.P., Stoke Works, near Bromsgrove, Worcestershire.
Cornett, Jas. P., Ford Paper Works, Hylton, near Sunderland.
Coste, F. H. Perry, Laboratory, 17, Tower Street, London, E.C.
Cottam, J. C., 39, Lombard Street, London, E.C.

Cottell, O. D., 101, Long Lane, Bermondsey, S.E.
Cotterell, Rocke, 35a, Ann Street, Glasgow.
Cotterill, Thos., Lombard Street West, West Bromwich.
Cotton, J., Church Street, St. Helens.
Couper, W. G., 1, Fenchurch Avenue, London, E.C.
Cowan, A. B., Tudhoe Ironworks, Spennymoor, Newcastle-on-Tyne.
Cowburn, W. H., 3, Clarence Street, Albert Square, Manchester.
Cowell, Peter, Free Public Library, Liverpool.
Cox, Dr. J., Dersingham Hall, Dersingham, Norfolk.
Cox, Walter J., Rock House, Basford, Nottingham.
Crabb, W., Border Counties Chemical and Manure Works, Silloth, Cumberland.
Crabtree, Thos., Spring Valley Dyeworks, Failsworth, near Manchester.
Craig, G., Lugar Iron Works, Cumnock, N.B.
Craig, Jno., Clippens Villa, by Johnstone, N.B.
Crake, William, Corrall Quemado, Andacollo, Coquimbo, Chili.
Crapper, J. R., Lime House, Walsall.
Craw, John, Meadowbank, Greenock Road, Paisley, N.B.
Crawford, D., Langdale's Manure Works, Newcastle-on-Tyne.
Crawford, D., Glengowan Printworks, Caldercruix, by Glasgow.
Cresswell, C. G., 20, Colinett Road, Putney Park, S.W.; and 9, Bridge Street, Westminster, S.W.
Cresswell, C. N., 1, Hare Court, Temple, E.C.
Crichton, Donald G., Mount Albion, by Herberton, Queensland.
Crompton, Percy R., Dearden's House, Bury, Lancashire.
Crookes, W., 7, Kensington Park Gardens, Notting Hill, London, W.
Crosfield, A. L., c/o Richardson Bros. and Co., Short Strand, Belfast.
Cross, C. F., 53, Eaton Terrace, London, S.W.; and 4, New Court, Lincoln's Inn, London, W.C.
Cross, C. J., Brentford, Middlesex.
Cross, J., Widnes.
Crossley, R., Bentcliffe House, Accrington.
Crow, J. K., 2, Colham Villas, West Drayton, Middlesex.
Crowder, W., 271, Evering Road, Upper Clapton, London, N.
Crowther, Horace W., Messrs. Chance Brothers, Alkali Works, Oldbury, near Birmingham.
Crowther, W. M., Field House, Gomersal, near Leeds.
Cruikshank, G. M., 62, St. Vincent Street, Glasgow.
Crum, A., Thornliebank, Glasgow.
Crumbie, W. D., U.S. Govt. Laboratory, 402, Washington Street, New York.
Cuming, James, jun., Chemical Works, Yarraville, Melbourne, Australia.
Cunliffe, E. T., The Parsonage, Handforth, near Manchester.
Curphey, W. S., 268, Renfrew Street, Glasgow.
Curry, W. A., Giltbrook Chemical Works, Awsworth, Notts.
Cathbert, H. W., 88, Bishopsgate Street Within, London, E.C.
Cuthbert, R. M., 27a, Ashley Place, London, S.W.
Cuthbertson, Sir J. N., 29, Bath Street, Glasgow.
Cuthbertson, William, Caroline Park, Edinburgh.

D

Dacie, J. C., Soap Works, Putney, London, S.W.
Dagger, J. H. J., 3, West Bank Road, Edge Lane, Liverpool.
Dale, Jas., 182, Lordship Road, Stoke Newington, N.
Dale, R. L., 1, Chester Terrace, Chester Road, Manchester.
Dalziel, Samuel, Smyrna, Asia Minor.
Daniell, Louis C., Standard Brewery, Elizabeth Street, Sydney, New South Wales.
Darby, J. H., Pen-y-Garth, near Wrexham.
Darling, W. H., 126, Oxford Street, Manchester.
Dauber, H., jun., Kenmore, Waterloo Park, near Liverpool.
Davenport, Dr. B. F., 161, Tremont Street, Boston, Mass., U.S.A.
Davidson, G., c/o W. & H. M. Goulding, Limited, The Glen, Cork, Ireland.
Davidson, J. E., 16, Hawthorne Terrace, Newcastle-upon-Tyne.
Davidson, R., c/o Fiji Sugar Co., Tamanoa, Navua River, Fiji.
Davidson, R. H., c/o Messrs. Goulding, Davis, & Co., Marsh Alkali Works, Widnes.
Davies, A. E., 6, Rumford Place, Liverpool.
Davies, Meurig L., 77, Everton Terrace, Everton, Liverpool.
Davies, R. H., Apothecaries' Hall, London, E.C.
Davis, A. R., 9, Ebor Terrace, Woodhouse Hill, Leeds.
Davis, Chas., 10, Oakfield Cottages, Oakfield Road, East Ham, E.
Davis, G. E., South Cliff House, Higher Broughton, Manchester.
Davis, H. W., The Laboratory, Somerset House, London, W.C.
Davis, J. F., 554, Quincey Street, Brooklyn, New York, U.S.A.
Davis, R. H. (Messrs. Goulding, Davis, & Co.), Widnes.
Davis, T. S., 199, South Lambeth Road, London, S.E.
Dawson, B., York House, Malvern Link, Worcestershire.
Dawson, C. A., 127, Church Street, Runcorn.
Dawson, Jno., Kirkheaton Coal-Tar Colour Works, Huddersfield.
Dawson, Thos., Stonecroft House, Milnsbridge, near Huddersfield.
Dawson, W. E., Pretoria, Transvaal, South Africa.
Dawson, W. Haywood, British Alizarin Co., Limited, Silvertown, Victoria Dock, E.
Day, St. John V., 115, St. Vincent Street, Glasgow.
Deacon, H. W., Appleton House, Widnes.
Deakin, E., Belmont Bleach and Dyeworks, near Bolton.
Deakin, H., Ryecroft Dyeworks, Belmont, near Bolton.
Deans, J. A., Oxalic Acid Manufactory, Morriston, Swansea.
Dearden, Thos., 12, Heywood Street, Bury, Lancashire.
De Deken, A., 18, Rue Villette, Liège, Belgium.
Deering, W. H., Chemical Department, Royal Arsenal, Woolwich, S.E.
De La Rue, Dr. W., 73, Portland Place, London, W.
Dempsey, Geo. C., P.O. Box 49, Lowell, Mass., U.S.A.
Dempster, A., Rosemount, Elland, Yorkshire.
Demuth, Dr. L., Wharfdale, Church Road, Edgbaston, Birmingham.
Dent, W. Y., Royal Arsenal, Woolwich, London, S.E.
Denton, E. Bailey, Palace Chambers, 9, Bridge Street, Westminster, S.W.
Dewar, Prof. J., Royal Institution, Albemarle Street, W. (for Journals); and 1, Scroope Terrace, Cambridge.
Dey, Preo Lall, 4, Beadon Street, Calcutta.
Dibdin, W. J., Metropolitan Board of Works, Spring Gardens, London, S.W.; and Mayfield, Grange Road, Sutton, Surrey.
Dick, A., 110, Cannon Street, London, E.C.
Dicketts, William, 9, Mincing Lane, London, E.C.
Dickinson, A. J., Neptune Tar and Chemical Works, Deptford, London, S.E.
Dickson, Jno., 16, Dale Street, S.S., Glasgow.
Dittmar, Prof. W., Anderson's College, Glasgow.
Divers, Dr. E., Imperial College of Engineering, Tokyo, Japan.
Dixon, Jos., Spring Grove, near Sheffield.
Dixon, M. T., 5, Brandling Park, Newcastle-on-Tyne.
Dixon, Wm., 102, Spring Street, Bury, Lancashire.
Dixon, William, 3, Belle Vue Park, Sunderland.
Dobbie, Dr. J. J., University College of North Wales, Bangor.
Dobbin, Dr. L., Chemical Laboratory, University, Edinburgh.
Dobson, Geo., Grange Alkali Works, near Cardiff.

Doidge, H., 22, Alberta Terrace, Sherwood Rise, Nottingham.
Domeier, A., 13, St. Mary-at-Hill, London, E.C.
Donald, George, Arnold Printworks, North Adams, Mass., U.S.A.
Donald, Jas., 5, Queen's Terrace, Glasgow.
Donald, W., 29, Eglinton Street, Saltcoats, N.B.
Donald, W. J. A., 2, Belgrave Terrace, Glasgow.
Doolittle, Orrin S., Altoona, Pa., U.S.A.
Dott, D. B., 24, Castle Street, Edinburgh.
Dougall, A., Gasworks, Sculcoates, Hull.
Dougall, Archibald, Gasworks, Kidderminster.
Douglas, William, Diamond Plantation, Demerara.
Doulton, Sir Henry, Lambeth Pottery, London, S.E.
Doux, Jules, jun., 55, Bleecker Street, Utica, New York, U.S.A.
Dowling, Edmund, 83, Cable Street, London, E.
Down, F. J., 13, Victoria Road, Charlton, S.E.
Down, T., Willington-upon-Tyne.
Dowson, J. Emerson, 3, Great Queen Street, Westminster, S.W.
Drake, Chas. A., Three Mills Distillery, Bromley-by-Bow, E.
Dreaper, W. P., 8, Albert Square, Clapham Road, London, S.W.
Drew, D., Lower House Printworks, near Burnley.
Dreyfus, C., Clayton Aniline Co., Limited, Clayton, Manchester.
Driffield, V. C., Farnworth, Widnes.
Drinkwater, T. W., Chemical Laboratory, 41, Chambers Street, Edinburgh.
Drown, Thos. M., Mass. Inst. of Technology, Boston, Mass., U.S.A.
Dryden, J.,
Duckworth, C. W., Garner's Buildings, North Road, Clayton, Manchester.
Duckworth, William, 93, Corporation Street, Manchester.
Dudley, Prof. W. L., Vanderbilt University, Nashville, Tenn., U.S.A.
Duffield, Dr. Saml. P., 2, Market Building, Detroit, Mich., U.S.A.
Duffy, B., Sutton Alkali Works, St. Helens.
Duggan, T. R., 32, Narford Road, Upper Clapton, E.
Duncan, And., Dawsholm Gasworks, Maryhill, Glasgow.
Duncan, Archibald, 1, Teneriffe Street, Higher Broughton, Manchester.
Duncan, J., 9, Mincing Lane, London, E.C.; and Clyde Wharf, Victoria Dock, E.
Duncan, James, Cleland, Lanarkshire.
Dunn, J., 53, Brown Street, Manchester.
Dunn, J. T., The School, Gateshead-on-Tyne.
Dunn, P., 53, Brown Street, Manchester.
Dunn, S., 50, Upper Park Road, Haverstock Hill, N.W.
Dunscombe, M. W., St. Augustine's Parade, Bristol.
Dunstan, W. R., 17, Bloomsbury Square, London, W.C.
Dupee, H. D., Walpole, Mass., U.S.A.
Dupré, Dr. A., Westminster Hospital Medical School, Caxton Street, London, S.W.
Durrant, Reg. G., Marlborough College, Wilts.
Dyer, B., 17, Great Tower Street, London, E.C.
Dyson, C. E., Flint, North Wales.
Dyson, Geo., Hurworth, Darlington.
Dyson, G., 231, Wilton Terrace, Cheetham, Manchester.
Dyson, H., Calder Vale, Wakefield.
Dyson, John, Derby Court, Long Millgate, Manchester.

E

Earp, W. R., Halton Road, Runcorn, Cheshire.
East, Walter, Speen Cottage, Oil Mill Lane, Kingston-on-Thames.
Eastick, J. J., Chemical Laboratory, Plaistow Wharf, North Woolwich Road, London, E.
Eastick, C. E., Chemical Laboratory, Plaistow Wharf, North Woolwich Road, London, E.
Eastlake, Thos. L., 23, Great George Street, Westminster, S.W.
Eastwood, Edward, Tunnel Soap Works, Wapping, E.
Eaton, W. H., Chemical Works, Lostock Hall, near Preston.
Edge, Anthony, Readville, Mass., U.S.A.
Edgell, G. E., 4, Hardwick Terrace, Gateshead-on-Tyne.
Edmands, H. R., 337, East 27th Street, New York, U.S.A.
Edwards, A. J., The Gasworks, Taunton.
Ekman, C. D., Dieppe, France.
Elborne, W., The Owens College, Manchester.
Elborough, T., 59, Mark Lane, London, E.C.
Elkins, G. W., 423, Walnut Street, Philadelphia, Pa., U.S.A.
Elliott, A. H., "Anthony's Bulletin," 59, Broadway, New York, U.S.A.
Ellis, C. J., Young Laboratory of Technical Chemistry, 60, John Street, Glasgow.
Ellis, G. E. R., The County College, Hereford.
Ellis, H., 112, Regent Street, Leicester.
Elmore, A. S., Tweed Mill, Cockermouth.
Elworthy, H. S., Rosa, N.W.P., India.
Emmens, S. H., corner of Prospect Avenue and 165th Street, New York, U.S.A.
Endemann, Dr. H., 33, Nassau Street, New York City U.S.A.
England, R. J., c/o Farmer and Co., Dunster House, Mark Lane, London, E.C.
Ermen, F., jun., Nassau Mills, Patricroft, Manchester.
Ernst, Adolf, Oberlangenbielau, Schlesien, Germany.
Eschellman, Dr. George, Dyar Terrace, Winnington, Northwich, Cheshire.
Esilman, A., North Road, Clayton, Manchester.
Estcourt, C., 20, Albert Square, Manchester.
Evans, Dr. John, Nash Mills, Hemel Hempstead.
Evans, Enoch, 181, Herbert Road, Small Heath, Birmingham.
Evans, W. N., 66, Stackpole Road, Bristol.
Everett, H. H., c/o The Borneo Co., Limited, 28, Fenchurch Street, London, E.C.
Everitt, F. Douglas, Finstall House, Bromsgrove.
Evershed, F., Atlas Works, Hackney Wick, London, E.
Evershed, Wallis, c/o Whitwell & Co., Limited, Kendal, Westmoreland.
Ewing, H. M. R., Alexandria Works, Alexandria, Dumbarton.

F

Fahlberg, Dr. C., Saccharin fabrik, Salbke-Westerhüsen, a/Elbe, Germany.
Fairley, T., 16, East Parade, Leeds.
Fairlie, H. C., 2, University Gardens, Glasgow.
Fairweather, W., 62, St. Vincent Street, Glasgow.
Fallowfield, T., Clayton-le-Moors, near Accrington.
Farrant, N., 2, Lawnside, Bearwood Road, Smethwick, near Birmingham.
Farries, T., 16, Coleman Street, London, E.C.
Farrington, T., 4, Waterloo Place, Cork, Ireland.
Fasnacht, A. E., Sandy Lane Chemical Works, Clayton, Manchester.
Faulkner, F., Crosswells Brewery, Oldbury, near Birmingham.
Fawsitt, C. A., Atlas Chemical Works, East Nelson Street, Glasgow.
Fearfield, Jno. P., Stapleford, Notts.
Fellows, A., Hebburn-on-Tyne.
Felton, Thos., 364, Romford Road, Forest Gate, E.
Fenner, N. J., The Cedars, Mazehill, Blackheath, London, S.E.
Ferguson, Prof. J., The University, Glasgow.
Fergusson, H., Prince Regent's Wharf, Victoria Docks, E.

Ferrie, And., Crown Chemical Works, Harpurhey, Manchester.
Field, E. W., The Brewery, Nottingham.
Field, S. E., Thorpe End Brewery, Melton Mowbray.
Field, S. S., Eagle Villa, Westcombe Park, S.E.
Field, J. K., Lombard Road, Battersea, London, S.W.
Fielding, A., 22, Dantzic Street, Manchester.
Filcock, P., Chester Road, Macclesfield.
Finch, Herbert, The Aqueduct, Marple, near Stockport.
Findlay, J. T. J., Silvertown, London, E.
Fisher, W. W., 5, St. Margaret's Road, Oxford.
Fitzbrown, G., Broughton Copper Works, Manchester.
Fitzhugh, R., 21, Long Row, Nottingham.
Fletcher, A. E., 57, Gordon Square, London, W.C.
Fletcher, F., North London Chemical Works, Holloway, N.
Fletcher, R. Jopling, Vine Cottage, Hazel Grove, near Stockport.
Fletcher, R. Steele, Misterton, Gainsboro', Lincolnshire.
Fletcher, T., Thynne Street, Warrington.
Fletcher, T., 99, Great Hampton Street, Birmingham.
Flower, Major Lamorock (Lee Conservancy Board), 12, Finsbury Circus, E.C.
Flynn, T. J., 2, Dorset Villas, Herbert Road, Wimbledon, S.W.
Foord, Geo., Royal Mint, Melbourne, Victoria, Australia.
Foote, H. C., 37, Arlington Court, Cleveland, Ohio, U.S.A.
Forbes, J., Chemical Works, Old Ford, London, E.
Ford, Alex. E., 4, Orme Square, Hyde Park, W.
Formoy, J. Arthur, 12, Railway Approach, London Bridge, S.E.
Forrest, A., Holt Town, Manchester.
Forrester, J., 87, Cannon Street, London, E.C.
Forster, Ralph C., c/o Messrs. Bessler, Waechter & Co., Newcastle-on-Tyne.
Forshaw, C. F., 8, St. Andrews, Listerhills, Bradford, Yorks.
Forster, W. G., Lonesome Chemical Works, Streatham Common, London, S.W.
Forth, Henry, Beech Avenue, Sherwood Rise, Nottingham.
Foster, F., Niagara Works, Eagle Wharf Road, London, N.
Foster, H. Le Neve, Bergholt House, Jarrow-on-Tyne.
Foster, R. Le Neve, The Firs, North Road, Droylsden, Manchester.
Foster, W., Middlesex Hospital, London, W.C.
Foulis, Wm., 2, Montgomerie Quadrant, Kelvinside, Glasgow.
Fox, T., jun., Court, Wellington, Somerset.
France, G. H., Horsforth, Leeds.
France, G. T., Friar's Goose, Gateshead-on-Tyne.
France, H. C. D., Perry Hill, Quinton, near Birmingham.
Francis, E., Rock Villas, Parkside, Nottingham.
Francis, E. G., 1, Halstead Villas, Fulham Road, Hammersmith, W.
Francis, G. B., 5, Coleman Street, London, E.C.
Francis, W. H., 5, Coleman Street, London, E.C.
Frankenburg, Isidor, Greengate Rubber Works, Salford, Manchester.
Frankland, Dr. E., The Yews, Reigate, Surrey.
Frankland, H., Streonshalh House, The Crescent, Linthorpe, Middlesbro'.
Frankland, Dr. P. F., Grove House, Pembridge Square, London, W.
Fraser, W. J., 121, Adelaide Road, Haverstock Hill, N.W.
Free, R., The Elms, Mistley, Essex.
Freear, H. M., Hedgefield, Harpenden, Herts.
Freeman, A., 40, Liverpool Road, St. Helens, Lancashire.
Freestone, J. W., 33, Brownlow Road, New Ferry, Cheshire.
French, Andrew, Glanleam Villa, Bearsden, near Glasgow.
Frew, Wm., 8, Marshall Place, Perth, N.B.
Fries, Dr. Harold H., 92, Reade Street, New York, U.S.A.
Friswell, R. J., 115, Darenth Road, Stamford Hill, London, N.
Frost, Joe, Mold Green, Huddersfield.
Fryer, Dr. A. C., Cornwallis Lodge, Clifton, Bristol.
Fullarton, R., 30, Donegal Place, Belfast, Ireland.
Fuller, Chas. J. P., Laboratory, Lancashire and Yorkshire Railway, Horwich, near Bolton.
Fuller, Jno., Rookwood, Chapter Road, Willesden Park, N.W.
Fuller, W. M., Ely House, Wolverhampton.
Fulton, H. B., Limni, *viâ* Papho, Cyprus.
Fyfe, Jno., West George Street, Glasgow.

G

Gabbett, E. R., Prince Regent's Wharf, Victoria Docks, London, E.
Gadd, W. Lawrence, Bank House, High Street, Wath-upon-Dearne.
Gadsden, Capt. H. A., 6, Crosby Square, Bishopsgate Street, London, E.C.
Galbraith, William, c/o Shelton Iron and Steel Co., Limited, Stoke-on-Trent.
Gall, Henry, L'Usine de Produits Chimiques de Villers par Hermes, Oise, France.
Galt, Alexander, 9, Park Place, Rutherglen, Glasgow.
Gamble, D., Windlehurst, St. Helens.
Gamble, D., jun., Millbrook, Eccleston, Prescot, Lancashire.
Gamble, J. C., Hardshaw Brook Chemical Works, St. Helens.
Gamble, Jas. N., Messrs. Procter and Gamble, Cincinnati Ohio, U.S.A.
Gamble, W., Haresfinch, St. Helens.
Gardiner, E. le Breton, Passaic, New Jersey, U.S.A.
Garrick, Dr. A. R., Eccleston Park, near Prescot.
Garton, R. (Hill, Garton & Co.), Southampton Wharf, Battersea, S.W.
Gascoyne, Dr. W. J., Department of Agriculture, Richmond, Virginia, U.S.A.
Gaskell, H., jun., Clayton Lodge, Aigburth, near Liverpool.
Gaskell, Holbrook, Woolton Wood, Liverpool.
Gaskell, J., 1, Woodlands Road, Cheetham Hill, Manchester.
Gatheral, G., Heathfield, Hebburn-on-Tyne.
Gatine, L., 23, Rue des Rosiers, Paris.
Gatty, F. A., Elmfield Hall, Accrington.
Gaussen, W. F. A., 53, Eaton Square, London, S.W.
Gerland, Dr. B. W., Messrs. F. Steiner & Co., Church, near Accrington.
Gibbins, H. B., Holly Lawn, Beechen Cliff, Bath.
Gibbs, D. Cecil, Hanover Court, Milton Street, London E.C.
Gibbs, Harry, 73, Horton Lane, Bradford, Yorks.
Gibbs, R. D., Woodlands Cottage, Six Ways, Smethwick.
Gibbs, W. P., Inveresk Mills, Musselburgh, N.B.
Gibson, J., 29, Greenhill Gardens, Edinburgh.
Gibson, J. M., c/o Buckley Brick and Tile Co., Buckley, *viâ* Chester.
Gifford, Henry J., 16, Collingwood Road, Redland, Bristol.
Gilbert, Dr. J. H., Harpenden, near St. Albans.
Gilchrist, P. C., Palace Chambers, 9, Bridge Street, Westminster, London, S.W.
Gilchrist, Peter S., c/o Orient Guano Co., Orient, N.Y., U.S.A.
Giles, W., Clous Keagh Works, Warton Road, Stratford, London, E.
Gill, Aug. H., Mass. Institute of Technology, Boston, Mass., U.S.A.
Gilmour, Geo., c/o Dublin Whisky Distillery Co., Jones Road, Dublin.
Gimmingham, C. H., Stamford House, Northumberland Park, Tottenham, N.
Girdwood, Dr. Gilbert P., 54, Beaver Hall Terrace, Montreal, Canada.
Gladstone, Dr. J. H., 17 Pembridge Square, London, W.
Glaeser, F. A., Carpenter's Road, Stratford, E.
Glendinning, H., Dyar Terrace, Winnington, Northwich.
Glendinning, N., Merton Bank, St. Helens.
Glover, G. T., The Phospho Guano Co., Limited, Seacombe, Cheshire.
Glover, John, Rothbury Terrace, Heaton, near Newcastle-on-Tyne.
Glover, T., Messrs. Mort, Liddell & Co., Widnes.

Glover, W., 180, Hulme Hall Lane, Miles Platting, Manchester.
Goldschmidt, S. A., Columbia Chemical Works, 20–30, Jay Street, Brooklyn, U.S.A.
Goodall, Thos., Hendon Grange, Sunderland.
Goodhart, E. C., 168, Lower Addiscombe Road, Croydon.
Goodwin, C. C., Throstle Nest, Old Trafford, Manchester.
Goold, J. R. P., 68–70, Hop Exchange, Southwark, S.E.
Goppelsroeder, Dr. F., 14, Brubachstrasse, Mulhausen, Elsass, Germany.
Gordon, J. G., Landore Steel Works, Landore, R.S.O., South Wales.
Gore, Dr. G., 67, Broad Street, Birmingham.
Gossage, F. H., Widnes.
Gossling, Frank, The Patent Office, Southampton Buildings, Chancery Lane, W.C.
Gow, Dr. James, High School, Nottingham.
Gow, R. J., Pittville Terrace, Ditton, near Widnes.
Gowland, W., Imperial Mint, Osaka, Japan.
Goyder, G. A., Government Survey Office, Adelaide, South Australia.
Gracey, R., Tobacco Works, 70, Great George Street, Liverpool.
Graesser, R., Cefn, near Ruabon, North Wales; and Argoed Hall, Llangollen, North Wales.
Grafton, F. W., M.P., 91, Portland Street, Manchester.
Graham, Dr. C., University College, Gower Street, London, W.C.
Graham, C. C., c/o Blundell, Spence & Co., Beverley Road, Hull.
Graham, J. A., Sherborne Lodge, Werter Road, Putney, S.W.
Grandage, H., Thornton Road, Bradford, Yorkshire.
Gray, G. Watson, 12, Argyle Road, Garston, near Liverpool.
Gray, W., Oil Refinery, Hull.
Gray, Jno., Clippens Oil Works, by Johnstone, N.B.
Green, A. G., Atlas Works, Hackney Wick, London, E.
Green, C. H., 7, York Street, Liverpool.
Green, German, 2, Croft Terrace, Jarrow-on-Tyne.
Green, H., Tovil House, Maidstone.
Green, John, Iron, Tinplate, and Chemical Works, Abercarne, Mon.
Green, L., Riverdale, College Road, Maidstone.
Green, R., Soho Mill, Wooburn, near Beaconsfield.
Green, Upfield, Liebenheim, Clarendon Road, Watford, Herts.
Greenaway, A. J., Frognal, Hampstead, N.W.
Greenhalgh, J. Herbert, Shepherd's, Tottington Mill, near Bury.
Greenhough, D. W., 16 Mincing Lane, London, E.C.
Greenway, T. J., 378, Ecclesball Road, Sheffield.
Greenwood, H., 64, King Street, Accrington.
Greville, H. L., 4, Moreland Villas, Lambton Road, Hornsey Rise, London, N.
Grey, W. J., Belle Vue House, Gateshead-on-Tyne.
Griess, Dr. P., Burton-on-Trent.
Griffin, Chas. J., 12, Exeter Street, Strand, W.C.
Griffin, Martin L., Holyoke, Mass., U.S.A.
Griffith, Agnew, Daisy Mount, Blundell Sands, Liverpool.
Griffith, R. W. S., Eyeworth Lodge, Lyndhurst, Hants.
Griffiths, Azariah, Elmbank, Pleasance, Falkirk, N.B.
Grime, J., Rosebank Cottage, Busby, near Glasgow.
Grimshaw, H., Thornton View, Clayton, Manchester.
Grimwood, R., 41, Lady Margaret Road, London, N.W.
Grindley, J., Upper North Street, Poplar, London, E.
Grossmann, Dr. J., Hendham Vale Chemical Works, Manchester.
Groves, C. E., 352, Kennington Road, London, S.E.
Grundtvig, C. H. W., Sunnyside, Wimbledon, S.W.
Gunn, W. L., Broad Plain Soap Works, Bristol.
Guyatt, T., Ceara Gas Co., Limited, 9, Queen Street Place, Cannon Street, London, E.C.

H

Haacke, A., Kieselguhr Wharf, Hackney Wick, E.
Habirshaw, W. M., 159, Front Street, New York City, U.S.A.
Hacking, W. H., The Grange, Clayton-le-Moors, near Accrington.
Haddow, A., 1, Keith Place, Easter Road, Edinburgh.
Hadfield, R. A., Newhall Road, Attercliffe, Sheffield.
Hadkinson, F., Pamphila Oil and Soap Works, Mitylene, Mediterranean.
Hadkinson, R., Smyrna, Asia Minor.
Haga, Tamenasa, Chemical Department, Science College, Imperial University, Tokyo, Japan.
Haig, Robert, Busby Printworks, Glasgow.
Haig-Brown, R., jun., Seymour Terrace, Old Trafford, Manchester.
Hake, C. N., 14, Great Smith Street, Westminster, S.W.
Hall, Allan T., 1, Grosvenor Terrace, Beverley Road, Hull.
Hall, Archibald D., 95, Bishopsgate Street, London, E.C.
Hall, C., 5, Bilton Road, Rugby.
Hall, Edgar, Sunny Corner Silver Mine, Mitchell, New South Wales.
Hall, G., Laboratorio, Minas de Rio Tinto, Provincia de Huelva, Spain.
Hall, J. Albert, 128, Lloyd Street, Greenheys, Manchester.
Hall, Joseph, Park Villa, Queen's Park, St. Helens.
Hall, S., East London Soap Works, Bow, London, E.
Hall, T. Farmer, Dunster House, Mark Lane, London, E.C.
Hall, W. J., c/o Wm. Lucock, Hudson Street, Tyne Dock.
Haller, Geo., 86, Leadenhall Street, London, E.C.
Hallett, Shackleton, 1, Hare Court, Temple, E.C.
Hamburger, Dr. S., 117, North Road, St. Helens.
Hamilton, David, Ash Bank, Shawlands, near Glasgow.
Hamilton, David R., 19, Graham Street, Bridgeton, Glasgow.
Hamilton, Jas. C., Kingscavil, Linlithgow, N.B.
Hamilton, Oswald, Owens College, Manchester.
Hamilton, Robert, Eglinton Ironworks, Kilwinning, N.B.
Hamlen, G. J., 162, St. Vincent Street, Glasgow.
Hammersley, Wm., Tar Works, Beckton, E.
Hammersley, W. H. L., Daisy Bank Cottage, Leek, Staffordshire.
Hammill, M. J., Dunton Green, near St. Helens.
Hammond, J., Gas Works, Eastbourne, Sussex.
Hand, T. W., Public Library, Oldham.
Handasyde, C. H., The Dean Works, Dalkeith, N.B.
Hanrez, Prosper, 9, Rue Moris, Chaussée de Charleroi, Brussels.
Hanson, A. M., Abbey Printworks, Whalley, Blackburn.
Hardie, William, The Gas Offices, Newcastle-on-Tyne.
Hardman, J., Milton Chemical Works, Stoke-on-Trent.
Hardman, Jas., Whitwood Chemical Works, Normanton.
Hardy, H. J., 163, Edmund Road, Sheffield.
Hargreaves, J., Widnes.
Harkness, W., The Laboratory, Somerset House, London, W.C.
Harland, R. H., Plough Court, 37, Lombard Street, London, E.C.
Harley, Boston, Laboratory, Carron Works, Falkirk, N.B.
Harrington, W. B., Ardsullagh, Old Blackrock Road, Cork.
Harris, Booth, jun., Clovelly House, Norwich Road, Forest Gate, E.
Harris, D., Caroline Park, Edinburgh.
Harris, Evan R., Luckwell House, Bedminster, Bristol.
Harris, T., The Union Acid Co., Runcorn.
Harrison, A., Thames Sugar Refinery, Silvertown, London, E.
Harrison, C., Anglo-American Oil Mills, Church Street, Hull.
Harrison, G. D., Netham Chemical Works, Bristol.
Harrison, G. King, Hagley, near Stourbridge.
Harrison, G. H., Hagley, near Stourbridge.
Harrison, J., 5, Magdala Terrace, Gardiner's Hill, Cork.
Harrison, Jno., 35th and Gray's Ferry Road, Philadelphia, Pa., U.S.A.

Harrison, P. W., 98, Queen Street, Exeter.
Harrison, S. M., Sutton Alkali Works, St. Helen's.
Hart, Bertram H., The Elms, Old Charlton, S.E.
Hart, E., Lafayette College, Easton, Pa., U.S.A.
Hart, P., c/o Tennants & Co., Mill Street, Clayton, Manchester.
Hart, T. G., 103, Walton Street, Chelsea, S.W.
Hartland, W. H. H., 114, Hyde Park Street, Glasgow.
Hartley, Joseph, 7, Brook Road, Gorton Hall Estate, near Manchester.
Hartley, Arthur, Cannon Brewery, Brighton.
Hartley, Prof. W. N., Royal College of Science, Dublin.
Hartmann, G., Claverley, Blackheath Park, London, S.E.
Harvey, Ernest W., c/o Mrs. Addie, 9, Main Street, Wishaw, N.B.
Harvey, J. C., Eccleston Hall, Prescot, Lancashire.
Harvey, W., 70, Gref Thuregatan, Stockholm, Sweden.
Harvey, T. H., Cattedown, Plymouth.
Hasenclever, R., Chemische Fabrik-Rhenania, Aachen, Prussia.
Hastings, C. W., 22, Buckingham Street, Adelphi, London, W.C.
Hastings, Hugh, 13, Neal Street, Bradford, Yorks.
Hastings, H. M., 54, Edith Road, West Kensington, W.
Hatfield, Jno., Windsor Road, Newton Heath, Lancashire.
Hathaway, Nath., New Bedford, Mass., U.S.A.
Hatton, Wm. P., 13, St. Quintin Avenue, North Kensington, W.
Hawkins, H., Eyeworth Lodge, Lyndhurst, Hants.
Hawliczek, Josef, 99, Ullet Road, Sefton Park, Liverpool.
Hazelhurst, C. W., Halton Grange, Runcorn.
Head, John, 12, Queen Anne's Gate, Westminster, S.W.
Healey, A. E., Willesden Junction, London, N.W.
Heap, Chas., Caldershaw, near Rochdale.
Heap, L., Stacksteads, near Manchester.
Heath, R. C., Myton Grange, near Warwick.
Heaton, Prof. C. W., Charing Cross Hospital, London, W.C.
Heaton, John, 744, Rochdale Road, Manchester.
Hedley, Armorer, Mayfield, Gosforth, Newcastle-on-Tyne.
Heer, P. Eugen, Oberutzwyl, Canton St. Gallen, Switzerland.
Heerlein, Robert, Pennsylvania Salt Manufacturing Co., Natrona, Pa., U.S.A.
Hehner, O., 11, Billiter Square, London, E.C.
Heisch, C., 79, Mark Lane, London, E.C.
Hellier, E. A., 34, Brunswick Avenue, Beverley Road, Hull.
Hellier, Walter J. G., Bristol Channel Chemical Co., Minehead, Somerset.
Hellon, R., 47, New Lowther Street, Whitehaven.
Helm, H. J., 13, St. George's Villas, Perry Hill, Catford, S.E.
Hemingway, H., 60, Mark Lane, London, E.C.
Hempleman, F. S., Wennington House, Wennington, Romford, Essex.
Henderson, G. G., Chemical Laboratory, The University, Glasgow.
Henderson, W. F., Moorfield, Claremont Gardens, Newcastle-on-Tyne.
Hendrichs, F. H., 21, Mincing Lane, London, E.C.
Henshaw, Jno., Brook Street Soap Works, Manchester.
Henning, E. C., Bow Brewery, Bow, E.
Herf, O., Main and Walnut Street, St. Louis, Mo., U.S.A.
Heriot, Wm. Scott, Pln. Leonora, Demerara.
Herman, W. D., West Park, St. Helens.
Herrmann, R. W. (Herrmann, Keller & Co.), 102, Fenchurch Street, London, E.C.
Heron, J., c/o Garton, Hill & Co., Southampton Wharf, Battersea, S.W.
Herroun, E. F., General Steam Navigation Company's Works, Deptford, London, S.E.
Herschel, Prof. A. S., 47, Lovaine Place, Newcastle-on-Tyne; and College of Science, Newcastle-on-Tyne.
Heslop, Jos., Jarrow Chemical Works, South Shields.
Hess, Dr. Adolph, Oil Works, Leeds.
Hewitt, Dr. D. B., Winnington House, Northwich, Cheshire.
Heycock, C. T., King's College, Cambridge.
Heyden, Dr. F. von, Chemische Fabrik, Radebeul, bei Dresden, Germany.
Heys, W. E., 70, Market Street, Manchester.
Heys, Z. J., Stonehouse, Barrhead, N.B.
Heys, Z. G., Springhill Villa, Barrhead, near Glasgow.
Heywood, G., Spring Vale Works, Middleton, Lancashire.
Heywood, J. G., 68, Sutherland Avenue, Maida Vale, London, W.
Heywood, J. H., Holland Street, Rochdale.
Heywood, J. S., 7, Caledonian Road, King's Cross, London, N.
Hibbert, W., 8, St. Dunstan's Road, Margravine Gardens, West Kensington, S.W.
Higgin, A. J., 5, Teneriffe Street, Higher Broughton, Manchester.
Higgin, W. H., Hall Chemical Works, Little Lever, near Bolton.
Higginbottom, E., Oakfield House, Barrow, Whalley, near Blackburn.
Higgins, C. L., c/o J. Muspratt & Co., Widnes; and 29, Falkner Square, Liverpool.
Hignett, S. C., 66, Whitechapel, Liverpool.
Hilditch, T., Cedar Grove, Heaton Chapel, near Manchester.
Hill, Dr. A. Bostock, 14, Temple Street, Birmingham.
Hill, A. Bowdler, 101, Southwark Street, London, S.E.
Hill, J. F., Bowker Bank Printworks, Higher Crumpsall, Manchester.
Hill, J. K., Waterside, Irvine, N.B.
Hills, A. F., Thames Ironworks and Shipbuilding Co., Victoria Dock Road, E.
Hills, C. H., Anglesea Copper Works, Low Walker, Newcastle-on-Tyne.
Hills, H., Chemical Works, Deptford, London, S.E.
Hills, M. H., Tower Varnish Works, Long Acre, Nechells, Birmingham.
Hills, W., 225, Oxford Street, London, W.
Hills, W. A., Great Barr, near Birmingham.
Hindle, J. H., 67, Avenue Parade, Accrington.
Hinds, James, 127, Gosford Street, Coventry.
Hislop, L., Saltney, Cheshire.
Hodges, J. F., 63, Upper Arthur Street, Belfast, Ireland.
Hodgkins, J., Childwall, Church Road, Richmond, Surrey.
Hodgkinson, J. H., Messrs. E. Potter & Co., Dinting Vale, Glossop.
Hodgkinson, Dr. W. R., 29, Pembroke Square, London, W.; and South Kensington Museum, London, S.W.
Hodgson, C., High House, Eppleby, Darlington.
Hoegger, A., Windsor Villa, Victoria Crescent, Eccles, Manchester.
Hofmann, Dr. A. W., 10, Doratheen Strasse, Berlin, Germany; and c/o C. Hofmann, 20, Oxford Mansions, W.
Hogben, W., c/o Monville Phibrolithoïd Co., Limited, Monville, Seine Inferieure, France.
Hogg, Lt.-Col. Sir James, Bart., M.P., *see* Magheramorne, Rt. Hon. Lord.
Hogg, T. W , c/o John Spencer & Sons, Newburn Steelworks, Newcastle-on-Tyne.
Hohenbansen, J. von, Yew Tree Chemical Works, 303, Collyhurst Road, Manchester.
Holden, G. H., Langley Place, Victoria Park, Manchester.
Holdich, A. H., Wigan Coal & Iron Co., Ld., Wigan.
Holdsworth, H. G., West Ham Abbey, London, E.
Holgate, S. Y., 29, Long Row, Nottingham.
Holgate, T. E., 146, Blackburn Road, Darwen, Lancashire.
Holgate, T., Corporation Gasworks, Batley.
Holland, P., 12, Talbot Street, Southport.
Holliday, R. (Read, Holliday & Sons), Huddersfield.
Holliday, T., Clifton Villa, High Street, West Bromwich, Staffordshire.
Holloway, Wm , Newlands, Middlesbro'.
Holmes, Ellwood, Wellburn, Jesmond, Newcastle-on-Tyne.
Holmes, F. G., Prince Regent's Wharf, Victoria Docks, E.
Holmes, J., 96, Holland Road, Brixton, London, S.W.
Holt, G. Crompton, c/o Hugh Hughes, 4, York Buildings, Sweeting Street, Liverpool.
Holt, J. W., North Road, Clayton, near Manchester.
Hood, R. W., 46, Sandwell Road, West Bromwich.
Hooper, E. G., The Laboratory, Somerset House, London, W.C.
Hooton, Edm., The Vinery, Burton Joyce, Notts.
Hopkin, W. K., 16, Cross Street, Hatton Garden, London, E.C.

Hore, Etsnojo, bei Frau Peetz, Karlstrasse 21 0. München, Bavaria.
Horn, W. Freeman, Grove Works, Lombard Road, Battersea, S.W.
Horner, G. F., Old Basford, Nottingham.
Horrocks, S., 28, Duke Street, Southport, Lancashire.
Houston, Robt. S., Hope Villa, Bellahouston, Glasgow.
Howard, A. G., The Green, Tottenham, London, N.
Howard, D., Rectory Manor, Walthamstow, Essex.
Howard, D. L., City Mills, Stratford, London, E.
Howard, W. D., City Mills, Stratford, London, E.
Howard, W. Crewdson, Messrs. Howard & Sons, Stratford, London, E.
Howarth, R. S., 21, Bellott Street, Cheetham, Manchester.
Hoyle, C. F., Holmeleigh, Woodlesford, near Leeds.
Hoyle, T. E., Church Terrace, Blackley, near Manchester.
Hughes, E. J., Church Street, Flint.
Hughes, J., 79, Mark Lane, London, E.C.
Hughes, R., Church Street, Flint.
Hughes, T., c/o Herb. Hughes, Lower Gornal, near Dudley.
Hulme, J., Vale Printworks, Dinting, Glossop.
Hume, William, 18, Lonsdale Terrace, Edinburgh.
Humfrey, C., The Villas, Parkgate, Cheshire.
Hummel, J. J., Cavendish Villa, Woodhouse Cliffe, Leeds.
Humphrys, N. H., Gasworks, Salisbury, Wilts.
Humphrys, F. C., Gasworks, Ilkeston, Nottingham.
Humphries, Jacob, Apothecaries' Hall, Low Moor, near Bradford.
Hunt, B., c/o W. L. Jackson, Esq., M.P., Buslingthorp Tannery, Leeds.
Hunt, C., Gasworks, Windsor Street, Birmingham.
Hunt, E., Wood Green, Wednesbury, Staffordshire.
Hunt, W., Wood Green, Wednesbury, Staffordshire.
Hunt, J. S., Appleton, Widnes.
Hunter, F. W., 4, Westmoreland Road, Newcastle-on-Tyne.
Hunter, John, Minto House Medical School, Edinburgh.
Hunter, T. G., Comestoca Printworks, Paschall Street, Philadelphia, Pa., U.S.A.
Huntington, Prof. A. K., King's College, Strand, London, W.C.
Hunzinger, Alfred, c/o E. Potter & Co., Dinting Vale, Glossop, Derbyshire.
Hurman, F. K., Ryton-on-Tyne.
Hurndall, W. F., 12, Rumford Place, Liverpool.
Hurst, G. H., 22, Blackfriars Street, Salford, Manchester.
Hurter, Dr. F., Messrs. Gaskell, Deacon & Co., Widnes.
Huskisson, P. L., 77, Swinton Street, London, W.C.
Husband, J. Cecil, Knowsley Street (and 21, Heywood Street), Cheetham, Manchester.
Huson, C. W., 5, York Buildings, Dale Street, Liverpool.
Hutcheson, J. B., The University, Glasgow.
Hutchinson, A. H., 90, Cannon Street, London, E.C.
Hutchinson, C. C., 193, Romford Road, Stratford, London, E.
Hutchinson, Chas. H., Albert Works, Church Street, Barnsley, Yorkshire.
Hutchinson, T. J., Vicarage View, Tottington Road, Elton, near Bury.
Huxley, J. H., 40, Brincliffe Edge Road, Sheffield.

I

Ikuta, M., Universitäts Laboratorium, Erlangen, Bavaria.
Imray, Harold, The Grange, Underhill, near Barnet.
Ingham, J. W., 2, Bisley Villas, Ferndale Road, Leytonstone, E.
Inglis, R. A., Arden, Bothwell, N.B.
Iriyè, Korenmasa, c/o Widnes Alkali Co., Limited, Widnes.
Irvine, R., Royston, Granton, Edinburgh.
Irvine, G. H., Cloncurry Copper & Smelting Co., Queensland, Australia.
Irving, J. M., 17A, Dickinson Street, Cooper Street, Manchester.
Irwin, W., The Grange, Polygon Road, Higher Crumpsall.
Isler, Otto, 1, Marsden Street, Manchester.
Ivey, W. E., School of Agriculture, Lincoln, Canterbury, New Zealand.

J

Jackson, A. G., The Willows, Martintown, Port Douglas, Queensland.
Jackson, Edward, Ashleigh, Beaufort Road, Edgbaston, Birmingham.
Jackson, Edgar, 106, Queen Victoria Street, London, E.C.
Jackson, F., Spring Bank, Crumpsall Lane, Manchester.
Jackson, G. B., Copthorne House, Congleton, Cheshire.
Jackson, John, 260, Dobbie's Loan, Glasgow.
Jackson, Jos., Ash Bank, Rudheath, Northwich, Cheshire.
Jackson, R. V., Ashurst, West Hill, Sydenham, S.E.
Jackson, T., Clayton, near Manchester.
Jackson, Walter, 24, Sydenham Avenue, Sefton Park, Liverpool.
Jackson, W. P., Saxilby, near Lincoln.
Jacques, G., High Street, Uttoxeter, North Staffordshire.
Jago, Wm., Science Schools, Brighton.
James, E. T., British Alizarin Co., Ld., Silvertown, Victoria Docks, E.
James, J. H., 131, Hopton Road, Coventry Park, Streatham, S.W.
James, J. Wm., Aylmer House, Weston-super-Mare.
Japp, Dr. F. R., 27, Woodstock Road, Bedford Park, Chiswick, W.
Jarmay, G., Winnington Park, Northwich.
Jarves, Deming, Michigan Carbon Works, Detroit, Mich., U.S.A.
Jayne, Dr. H. W., Chem. Lab., Bermuda Street, Frankford, Philadelphia, U.S.A.
Jekyll, H. H., 7, Carholme Road, Lincoln.
Jekyll, J., Castle Moat House, Lincoln.
Jenner, E., Arthur Villa, Murchison Road, Leyton, Essex.
Jenkins, F. C., 21, Heber Road, East Dulwich, S.E.
Jessop, W. S., Healey, Ossett, near Wakefield.
Johnson, A. E., 10, Victoria Street, Wolverhampton.
Johnson, Frank, Minas de Rio Tinto, Huelva, Spain.
Johnson, Geo., Grange Metal Works, Jarrow-on-Tyne.
Johnson, Jno., Franklin Square and Cherry Street, New York, U.S.A.
Johnson, J. E., Crown Chemical Works, Stratford, London, E.
Johnson, J. Grove, 23, Cross Street, Finsbury, London, E.C.
Johnson, J. H., 47, Lincoln's Inn Fields, London, W.C.
Johnson, S. H., West Ham Hall, Forest Gate, Essex.
Johnson, T. A., Winnington Park, Northwich, Cheshire.
Johnston, W. G., Chemical Works, Coatbridge Street, Port Dundas, Glasgow.
Johnston, W. G., Stevens' Institute of Technology, Hoboken, N.J., U.S.A.
Johnstone, Jas., Shawfield Works, Rutherglen, Glasgow.
Johnstone, L., Newbattle Collieries, Dalkeith, N.B.
Johnstone, Dr. W., City Central Laboratory, 13, Fish Street Hill, London, E.C.
Jones, A. Frederick, 15, Dawson Place, Bayswater, W.
Jones, A. F., South Arthurlie, Barrhead, Glasgow.
Jones, E. W. T., 10, Victoria Street, Wolverhampton.
Jones, E. Fielding, Dalmonach, Bonhill, Dumbartonshire, N.B.
Jones, F., Chemical Laboratory, Grammar School, Manchester.
Jones, H. Chapman, Royal Normal School of Science, South Kensington, London, S.W.
Jones, J. W., Basford House, Seymour Grove, Whalley Range, Manchester.
Jones, Lieut.-Col. A. S. (V.C.), Hafod-y-Wern Farm, Wrexham, Denbighshire.

Jones, T. Tolley, 31, Little Collins Street East, Melbourne, Victoria.
Jones, W. Arthur, Kenwith Lodge, Redland, Bristol.
Jones, W. Norris, 53, Botanic Road, Edge Lane, Liverpool.
Joüet, Cavalier H., Roselle, Union Co., N.J., U.S.A.
Joynson, F., Clock Face, near St. Helens.
Jowett, W., Lower Hall, Mellor, near Stockport.
Julien, Alfred, Cours Jullien 2A, Marseilles, France.
Justice, P. M., 14, Southampton Buildings, Chancery Lane, London, W.C.

K

Kalle, Dr. Wm., Biebrich-am-Rhein, Germany.
Kater, R. McCulloch, Nobel's Explosives Co., Stevenston, Ayrshire, N.B.
Kawakita, Michitada, Imperial College of Engineering, Tokyo, Japan.
Kay, H. A., 13, Maida Vale, London, W.
Kay, W. E., c/o W. Crum and Co., Thornliebank, Glasgow.
Kean, J., Acca House, Grant Street, Jarrow-on-Tyne.
Kearns, H. W., Baxenden, near Accrington.
Keeling, F., 52, Lansdowne Gardens, South Lambeth, S.E.
Keiser, E. H., Bryn Mawr College, Bryn Mawr, Pa., U.S.A.
Kellner, Dr. Wm., 13, Clarendon Villas, Old Charlton, S.E.
Kemp, W. J., 17, Rue des Fontaines, Dieppe, France.
Kennedy, William, 28, Royal Exchange Square, Glasgow.
Kenyon, R., Paintworks, Handforth, near Manchester.
Kerr, J., Church, near Accrington.
Kerry, W. H., Laboratory, 14, Castle Street, Liverpool.
Kershaw, J., Grease, Varnish, and Cement Works, Hollinwood, near Oldham.
Kershaw, J. B. C., Sutton Lodge Chemical Works, St. Helens.
Key, J. T., 8, Machon Bank, Nether Edge, Sheffield.
Keys, Jno. G., 1, Thynne Street, West Bromwich.
Kiddie, Thos., c/o Orford Sulphur and Copper Co., Box 44, New Brighton, New York, U.S.A.
Kilpatrick, W. S., 4, Annfield Place, Glasgow.
Kinch, E., Royal Agricultural College, Cirencester.
King, A. J., Ingersley Vale Bleachworks, Bollington, Macclesfield.
King, C. M., 63, Ferme Park Road, Hornsey, N.
King, C. M., Campsie Alum Works, Lennoxtown, N.B.
King, Sir James, 12, Claremont Terrace, Glasgow.
King, J. Falconer, Russell Place, Edinburgh, N.B.
King, J. T., Clayton Square, Liverpool.
King, J. Westall, 115, Wellington Street, Glasgow.
King, Robt., 115, Wellington Street, Glasgow.
King, Walter, Tamworth House, Mitcham, Surrey.
Kingdon, J. C., c/o Burt, Boulton, and Heywood, Selzaete, Belgium.
Kingsford, T. P., Oswego, New York, U.S.A.
Kingzett, C. T., Trevena, Amhurst Park, London, N.
Kipping, Dr. F. Stanley, 13, Lonsdale Terrace, West Meadows, Edinburgh.
Kirkham, Thos., 22, Leinster Gardens, Runcorn, Cheshire.
Kirkman, R., Landore Alkali Works, Swansea.
Kirkpatrick, A. J., 179, West George Street, Glasgow.
Kitamura, Y., c/o Mr. Goto, 4, Chitose Cho, Honyo, Tokyo, Japan.
Kitchen, Theo., Messrs. J. Kitchen & Sons, 28, Flinders Lane North, Melbourne, Australia.
Kitto, B., 26, Lancaster Road, Finsbury Park, London, N.
Knight, A. H., 18, Chapel Street, Liverpool.
Knight, Henry, 33, Faraday Street, Breck Road, Liverpool.
Knight, J. B., Silvertown Soapworks, Silvertown, London, E.
Knight, J. J., Lostiford Mill, Wonersh, Guildford.
Knights, J. West, County Laboratory, Cambridge.
Knipler, F., Silverspring Starch Works, Glanmire, Cork.
Knowles, Jno., Runcorn Soap and Alkali Co., Runcorn, Cheshire.
Knowles, Joshua, Stormer Hill, Tottington, near Bury.
Knowles, Samuel, Stormer Lodge, Crumpsall, Manchester.
Knox, E. W., Colonial Sugar Refining Co., Sydney, N.S.W.; and c/o F. Parbury & Co., 7, East India Avenue, Leadenhall Street, London, E.C.
Koechlin, Horace, Loerrach, Duché de Bade, Germany.
Koenig, Prof. G. A., University of Pennsylvania, Philadelphia, Pa., U.S.A.
Kohn, Dr. Chas. A., University College, Brownlow Street, Liverpool.
Kolb., J., Soc. Anon. des Manuf. de Produits Chimiques, Lille, France.
Kraftmeier, E., 6, Great Winchester Street, London, E.C.
Krause, Dr. G., "Chemiker-Zeitung," Cöthen, Germany.
Krause, O. H., Box 217, Jersey City, New Jersey, U.S.A.
Krohn, F. W. T., 12, Brunswick Terrace, Newark-on-Trent.
Kühl, W. H., 73, Jagerstrasse, Berlin, Germany.
Kunheim, Dr. Hugo, 23, Lindenstrasse, Berlin.
Kupferberg, Dr. H., 49, Cleveland Road, Higher Crumpsall, Manchester.
Kur, Emmanuel, 13, Bath Buildings, Huddersfield.
Kynaston, J. W., Kensington, Liverpool.

L

Lacey, T. S., Lawn House, Beckton Gasworks, North Woolwich, London, E.
Lagerwall, Dr. Ivar, c/o Messrs. Nobel Bros., St. Petersburg, Russia.
Laidler, C. P., 26, Noble Terrace, Gateshead-on-Tyne.
Laing, John, 38, Warrender Park Terrace, Edinburgh.
Lake, D. E., 36, Mark Lane, London, E.C.
Lake, G., jun., 538, Eccles New Road, Eccles, Manchester.
Lake, W. H., 11, St. Julian's Farm Road, West Norwood, S.E.
Lakeman, T., 178, Phillip Street, Sydney, New South Wales.
Lamb, Chas., 60, Mark Lane, London, E.C.
Lamond, H. B., Levenshulme Printworks, Manchester.
Lane, D., 72, South Mall, Cork, Ireland.
Landsberg, Dr. Ludwig, Offenbach à/M., Germany.
Langbeck, H. W., The Cottage, St. Leonard's Street, Bromley-by-Bow, E.
Larios, P., c/o Messrs, R. Marsden & Co., 47, Spring Gardens, Manchester.
Larkin, T., St. Bede Chemical Works, South Shields.
Larned, J. N., Young Men's Library, Buffalo, N.Y., U.S.A.
Latham, Baldwin, 7, Westminster Chambers, Victoria Street, London, S.W.
Laurie, A. P., 29, Artesian Road, Bayswater, London, W.
Lawrance, H. A., Brockweir, Grosvenor Road, Gunnersbury.
Lawrence, Jas., Standard Explosives Co., Toms River, New Jersey, U.S.A.
Laws, J. P., 3, Tyfield Road, Oxford.
Lawson, Wm., Bellshill, Lanarkshire.
Lawson, Arthur J., Marsh Soapworks, Bristol.
Lawson, Thos. A., 15, Alexandra Road, London, N.W.
Lazarus, M. J., Ashburn House, Victoria Park, Manchester.
Leathart, J., Lead Works, Newcastle-on-Tyne.
Leather, Dr. J. W., Royal Agricultural Society of England, 12, Hanover Square, W.
Lee, C. Tennant, 45, Kilby Street, Boston, Mass., U.S.A.
Lee, S. Wright, 7, Church Street, Liverpool.
Lee, J. E., Wallsend, Newcastle-on-Tyne.
Lee, H. C., Peckham Brewery, Hill Street, Peckham, S.E.
Leeds, F. H., 29, Bouverie Road, Stoke Newington, N.
Leeming, T. H., Burneston House, Barking Road, Plaistow, London, E.
Lees, Asa, 76, Duncombe Road, Upper Holloway, N.
Lees, S., jun., 4, Carlingford Road, Hampstead, N.W. (for Journals); and Park Bridge, Ashton-under-Lyne.
Lees, Thos., Know Mill Printing Co., Entwistle, near Bolton.
Leete, Jos., 71 and 73, Tooley Street, London Bridge, S.E.
Leffmann, Dr. H., 715, Walnut Street (Third floor front), Philadelphia, Pa., U.S.A.
Leith, J., Boundary Road Chemical Works, St. Helens.

Leipner, H. A. B., 8, Loftus Street, Sydney, New South Wales.
Lemon, Jas., Palace Chambers, Westminster, S.W.
Lennard, F., 165, Fenchurch Street, London, E.C.
Lennox, Jno., Cloncurry Copper and Smelting Co., Cloncurry, Queensland.
Leonard, Wm. J., Hope Chemical Works, Hackney Wick, E.
Leon, J. T., 38, Portland Place, London, W.
Leverkus, Otto, 1 and 3, Leamington Place, Princess Street, Manchester.
Levinstein, Ivan, Neuburg, Daisy Bank Road, Victoria Park, Manchester.
Lewes, Vivian B., Royal Naval College, Greenwich, S.E.
Lewinton, B., 14, Cleveland Street, Fitzroy Square, London, S.W.
Lewis, J. H., c/o Muspratt and Sons, Widnes.
Lewis, G. T., 231, South Front Street, Philadelphia, Pa., U.S.A.
Lichtenstein, Theodore, Chemical Works, Silvertown, London, E.
Liddle, W. T., 421, Blackburn Road, Accrington.
Liebermann, L., 54, Portland Street, Manchester.
Liebmann, Dr. A., 10, Marsden Street, Manchester.
Liepmann, H., The Liepmann Carbon Co., Limited, Nelson Wharf, Millwall, London, E.
Lightfoot, T. E., 3, Church Terrace, Accrington.
Lilley, H. L., Albert Works, Queen's Road, Manchester.
Lilly, Oliver M., The Croft, Spondon, Derby.
Limpach, Dr. L., 20, St. Mary's Road, Crumpsall, Manchester.
Lindley, L., Sherwood Street, Nottingham.
Lineff, A. L., West Metropolitan Tram Depôt, High Road, Chiswick, W.
Lishman, W. W. L., 36, Washington Street, Girlington, Bradford, Yorks.
Littlejohn, J., 53, Renfield Street, Glasgow.
Liversedge, A. J., c/o Watson, Laidlaw & Co., Kingston, Glasgow.
Liversidge, Prof. A., The University, Sydney, New South Wales; and c/o Trubner & Co., 57, Ludgate Hill, London.
Livesey, Frank, South Metropolitan Gas Co., 709A, Old Kent Road, London, S.E.
Livingston, W. J., Metropolitan Board of Works, Spring Gardens, London, S.W.
Lober, J. B., 3409, Race Street, Philadelphia, Pa., U.S.A.
Lodge, A. S., Spring Side, Prestwich, near Manchester.
Lomas, T., Cleveland, Minehead, Somerset.
Longmore, J., Hillside, Brentwood, Essex.
Longshaw, Jas., 7, Park Place, Cross Lane, Salford.
Longstaff, Dr. G. D., Butterknowle, Southfields, Wandsworth, S.W.
Lorenz, H., 7 and 8, Idol Lane, London, E.C.
Lorimer, J., Britannia Row, Islington, N.
Lorrain, J. G., Norfolk House, Norfolk Street, Strand, London, W.C.
Lott, F. E., The Laboratory, Bridge Chambers, Burton-on-Trent.
Louis, D. A., 77, Shirland Gardens, London, W.
Love, E. G., School of Mines, Columbia College, 50th Street, New York, U.S.A.
Lovett, W. Jesse, Jessamine Cottage, Thornes, near Wakefield.
Lovibond, J. W., 26, St. Ann's Street, Salisbury.
Lovibond, T. W., Tyne Brewery, Newcastle-on-Tyne.
Lovibond, V. L., The Hermitage, North End, Fulham, S.W.
Lowe, C. W., Summerfield House, Reddish, near Stockport.
Lowe, W. F., Cambrian View, Chester.
Lowson, J. G. F., St. Leonard's Mill, Lasswade, Midlothian, N.B.
Lucas, R. J., Mainzerstrasse 8, Wiesbaden, Germany.
Luck, A., Powder Mills, Dartford, Kent.
Luck, E., 70, Stamford Street, Blackfriars Road, London, S.E.
Luck, H. C., 70, Stamford Street, Blackfriars Road, London, S.E.
Lundberg, Alf., Bergvik, Sweden.
Lunge, Dr. G., Englishes Viertél, Hottingen, Zürich, Switzerland.
Lunn, C., Woodsome Lees, near Huddersfield.
Lupton, Sydney, The Harehills, near Leeds.
Lüthy, Otto, 2336, Fairmount Avenue, Philadelphia, Pa., U.S.A.
Lye, W. T., The Firs, Luton, Beds.
Lyle, James, Plaistow Wharf, North Woolwich Road, London, E.
Lyle, Jno., 37, Mincing Lane, London, E.C.
Lyon, J. G., The Aire Tar Works, Knottingley, Yorks.
Lyte, F. Maxwell, 60, Finborough Road, Redcliffe Square, London, S.W.
Lytle, A. M., North of Ireland Chemical Co., Belfast.

M

Mabery, Prof. Chas. F., Case School of Applied Science, Cleveland, Ohio, U.S.A.
Macadam, C. T., 116, Fenchurch Street, London, E.C.
Macadam, Dr. S., Surgeons' Hall, Edinburgh.
Macadam, W. I., Surgeons' Hall, Edinburgh.
McAlister, R., Lawes' Chemical Manure Co., Limited, Barking Creek, Essex.
McAllum, C. D., 7, Dean Street, Newcastle-on-Tyne.
Macalpine, G. W., Parkside, Accrington.
McArthur, J. B., Price's Patent Candle Co., Limited, Bromborough Pool, near Birkenhead.
Macarthur, J. G., 260, Dobbie's Loan, Glasgow.
McArthur, J. S., Cassel Gold Extracting Co., Limited, 13, West Scotland Street, Kinning Park, Glasgow.
McBeath, J. W., 38, Exeter Street, West Hartlepool, Durham.
McCallum, J. M., South Park, Paisley, N.B.
McCalman, D., 50, London Street, Irvine, N.B.
McCarnie, T. (Couper, McCarnie & Co.), 1, Fenchurch Avenue, London, E.C.
McCowan, W., Crown Brewery, Cape Hill, Birmingham.
McCubbin, Wm. A., The Elms, West Derby, Liverpool.
McCulloch, J., 2, Tyne View Terrace, Hebburn-on-Tyne.
McDaniel, J. J., Bandon, Ireland.
Macdonald, A., 3, Vale View Terrace, Langside, Glasgow.
McDonald, Donald, Invernevis, Fort William, N.B.
Macdonald, J. W., c/o Messrs. H. Tate & Sons, Love Lane, Liverpool.
McDonald, T. M., Walilabo Estate, St. Vincent, West Indies.
McEwen, T. G., 53, New Road, Commercial Road, London, E.
Macfarlane, J. A., c/o La Compañia Unida, Guanjuato, Mexico.
McFarlane, J. F., Newton Schoolhouse, Dalkeith, N.B.
Macfarlane, R. F., Grange Metal Works, Jarrow-on-Tyne.
Macfarlane, Thos., Inland Revenue Dept., Ottawa, Canada.
McFarlane, Walter, Crosslee House, Thornliebank, near Glasgow.
McGlashan, John, Woodneuk, Gartcosh, near Glasgow.
McGowan, John, Ash House, Talk-o'-th'-Hill, near Stoke-upon-Trent.
MacIlwaine, A. W., Stoneferry, Hull.
MacIndoe, G. D., Hall's House, North Woolwich Road, Victoria Docks, E.
MacIntosh, C. J., 54, Leadenhall Street, London, E.C.
McKechnie, D., Copper Works, St. Helens.
McKechnie, D. M., Olive Mount, St. Anne's, St. Helens.
McKellar, W. G., Eglinton Chemical Works, Irvine, N.B.
McKenny, C., Drogheda Chemical Manure Co., Drogheda, Ireland.
Mackenzie, Jas., 24, Shuttle Street, Glasgow.
Mackenzie, T. E., Tharsis Mines, Huelva, Spain.
Mackenzie, W. Cossar, 2, Grove Terrace, Edinburgh.
Mackey, J. A., 1 and 2, Bouverie Street, London, E.C.
McKinlay, R. W., Ameliaville, Aytoun Road, Pollokshields, N.B.
Mackinlay, Wm., Laboratory, Silicate Paint Works, Charlton, Kent.

Mackinnon, A. K., 79, Drayton Gardens, London, S.W.
Maclagan, R. C., 5, Coates Crescent, Edinburgh.
McLellan, J. Y., Cullochfaulds Chemical Works, Craig Street, Glasgow.
McLeod, H., Cooper's Hill, Staines.
MacMahon, J. H., Lancashire Alkali and Sulphur Co., Limited, Widnes.
McMillan, T. O., 4, Ardgowan Terrace, Glasgow.
McMillan, W. G., Metallurgical Laboratory, King's College, Strand, London, W.C.
Macnab, C., Lillyburn, Milton of Campsie, N.B.
Macnab, W., jun., 74, Windsor Road, Forest Gate, Essex.
Macnair, D. S., Allan Glen's Institution, Cathedral Street, Glasgow.
McRoberts, G., Nobel's Explosives Co., Stevenston, Ayrshire, N.B.
Mactear, J., 2, Victoria Mansions, Westminster, S.W.
Magheramorne, Rt. Hon. Lord, 17, Grosvenor Gardens, London, S.W.
Mahon, R. W., 110, Arch Street, Camden, New Jersey. U.S.A.
Maignen, P. A., 32, St. Mary at Hill, London, E.C.
Main, Robt., Ardeer Ironworks, Stevenston, Ayrshire, N.B.
Major, J. C., The Rhylls, Compton, Wolverhampton.
Major, L., Sculcoates, Hull.
Makins, G. H., Danesfield, Upper Latimore Road, St. Albans.
Malcolm, S., Jarrow Chemical Works, South Shields.
Mallinckrodt, Edw., Mallinckrodt Chemical Works, St. Louis, Missouri, U.S.A.
Manby, Eardley B., Lightbounds, Halliwell, Bolton-le-Moors.
Mander, S. T., 17, Gracechurch Street, London, E.C.; and Varnish Works, Wolverhampton.
Manlove, E. Alick, 3, Holtham Road, London, N.W.
Manning, F. A., 18, Billiter Street, London, E.C.
Mannington, H. T., Pentre, near Flint, North Wales.
Mansfield, Harvey M., Fairfield, Somerset co., Maine, U.S.A.
Markel, Dr. K., c/o Brunner, Mond & Co., Northwich; and 8, Castle Road, Northwich.
Markham, A. D., 18, Merrick Square, Trinity Street, Borough, S.E.
Marks, E. G., c/o Rev. R. Marks, Norton Vicarage, near Gloucester.
Marley, J. E., Hebburn-on-Tyne.
Marriott, Wm., 8, Belgrave Terrace, Huddersfield.
Marsh, W., Greenbank Alkali Works Co., Limited, St. Helens; and Ash House, Sale, Cheshire (temporary address).
Marsh, J. T., British Alkali Works, Widnes.
Marsh, T. S., Ash Lee, Litherland Park, Liverpool.
Marsh, Walter, 4, York Terrace, Northam, Southampton.
Marshall, T. R., bei Frau Reichold, 1, Spitalstrasse, Erlangen, Bavaria.
Marshall, Wm., 7, Walter Street, Nottingham.
Marshall, Wm., The Baths, St. Andrews, N.B.
Martin, H., Poole, near Wellington, Somerset.
Martin, H. R. H., Hong-Kong and China Gas Co., Hong-Kong.
Martin, N. H., 29, Moseley Street, Newcastle-on-Tyne.
Martin, W. H., 183, King's Road, Chelsea, London, S.W.
Martineau, Sydney, South Road, Clapham Park, S.W.
Martius, Dr. C. A., 28, Vosse Strasse, Berlin, Germany.
Martyn, S. E., Trevemper Bridge, New Quay, Cornwall.
Martyn, W., c/o Messrs. Tennant, Hebburn-on-Tyne.
Mason, J., Eynsham Hall, Witney, Oxon.
Mason, J. Francis, Eynsham Hall, Witney, Oxon.
Mason, W. B., 117, Derby Street, Bolton-le-Moors.
Mason, A. H., P.O. Box 1979, Montreal, Canada.
Masson, Prof. D. Orme, University of Melbourne, Victoria, Australia.
Master, C. H., Friary Brewery Co., Guildford.
Mather, J., Blaydon Chemical Works, Blaydon-on-Tyne.
Mathieson, N., Widnes.
Matthews, C. G., Laboratory, Bridge Chambers, Burton-on-Trent.
Matthews, W. C., Kerfeid Place, Albert Park, Melbourne, Victoria.
Mavor, James, 134, St. Vincent Street, Glasgow.
Maxwell, Thos., 49, Harvie Street, Bridgeton, Glasgow.
May, J., Hyde House, Old Battersea, Surrey.
Mayenfeld, Dr. E. von Salis, Verein Chemischen Fabriken, Waldhof bei Mannheim, Germany.
Mayhew, E. W. A., High Street, Freemantle, Western Australia.
Mead, Frank, Sutton Gasworks, Surrey.
Mease, G. D., 23, Killieser Avenue, Telford Park, S.W.
Meldola, Prof. R., 6, Brunswick Square, London, W.C.
Melland, Wm., c/o G. H. Milwood and Co., Bridge Street, Ardwick, Manchester.
Melliss, J. C., 232, Gresham House, Old Broad Street, London, E.C.
Mellon, W. W., Howdendyke, Howden, Yorks.
Mellor, S., Magnesium Metal Co., Patricroft, Manchester.
Melville, D., North Woburn, Mass., U.S.A.
Menzies, R. C., Inveresk Mills, Musselburgh, N.B.
Menzies, W. J., Greenbank Alkali Works Co., Limited, St. Helens.
Mercer, J. B., 322, Lower Broughton Road, Manchester.
Mercer, F. M., 89, Bishopsgate Street, London, E.C.
Merrell, Geo., Lock Box 786, Cincinnati, Ohio, U.S.A.
Merrylees, J., c/o Cassel Gold Extracting Co., Limited, 13, West Scotland Street, Kinning Park, Glasgow.
Messel, Dr R., Silvertown, London, E.
Metcalf, Jno., Moorfield, Altham, near Accrington.
Metcalf, T., Miles Platting, near Manchester.
Metcalf, W. M., Stanhill House, Oswaldtwistle, near Accrington.
Mewburn, J. C., 169, Fleet Street, London, E.C.
Meynier, J. A., 19, Rue Baudin, Paris.
Middleton, J., 179, West George Street, Glasgow.
Miest, Emile, Sté Marie d'Oignies, par Tamines, Belgium.
Miller, E. V., c/o New Zealand Sugar Co., Auckland, New Zealand.
Miller, Dr. A. K., 40, Bishop's Terrace, Fulham, S.W.
Miller, A. Russell, The Cairns, Cambuslang, near Glasgow.
Miller, H. von, Chemische Fabrik, Hruschau, Austria.
Miller, N. H., Harpenden, near St. Albans.
Miller, Robt., 79, West Nile Street, Glasgow.
Miller, W. M., Laboratory, Plu. Tuschen den Vrienden, Demerara, West Indies.
Miller, T. Paterson, The Cairns, Cambuslang, near Glasgow.
Mills, Prof. E. J., 60, John Street, Glasgow.
Milne, G. A., Welham Villa, Norton, Malton, Yorks.
Milne, Dr. J. M., Roy. Infirm. Medical School, 86, Castle Street, Glasgow.
Milner, E., Hartford Manor, Northwich.
Milnes, Edmund, Seedfield, Bury, Lancashire.
Mitchell, J. W., 63, Burnley Road, Rawtenstall, Lancashire.
Mitchell, S. W., Craigbank, Giffnock, near Thornliebank, N.B.
Mitting, E. K., 273, Clinton Street, Brooklyn, N.Y., U.S.A. (for Journals); and Faversham, Kent.
Moffatt, Thos., 5, Brandling Terrace, Felling-on-Tyne.
Mohr, Dr. B., 69A, Parliament Hill, Hampstead, N.W.
Moir, R. M., Bankside, Christchurch Road, Hampstead, London, N.W.
Molineux, J., Somerset House, London, W.C.
Mond, L., 20, Avenue Road, Regent's Park, London, N.W.
Mook, Chas., Douglashall, Westeregeln, Magdeburg, Germany.
Moon, G. Ivens, 85, Gracechurch Street, London, E.C.
Mooney, M., Chemical Works, 74, Rogerson's Quay, Dublin.
Moore, B. T., Longwood, Bexley, Kent.
Moore, Chas. C., 125, Chester Road, Hartford, Cheshire.
Moore, G. E., 69, Liberty Street, New York, U.S.A.
Moore, Lock, 28, St. Clair Street, Rochester, N.Y., U.S.A.
Moore, R. T., 134, St. Vincent Street, Glasgow.
Moore, Wm. Bailey, Cauldon House, Shelton, Stoke-on-Trent.
Moorhouse, J. B., Horton Bank, Bradford.
Moretti, Giuseppe, Via Cerretani 8, Firenze, Italy.
Morgan, Arthur F., 21, Rumford Street, Chorlton-on-Medlock, Manchester.
Morgan, E. B., 318, Nechells Park Road, Birmingham.
Morgan, O. V., M.P., 13, The Boltons, South Kensington, S.W.
Morgan, Dr. Wm., Public Analyst's Laboratory, Nelson Terrace, Swansea.

Morgans, Thos., The Guildhall, Bristol.
Moritz, E. R., 72, Chancery Lane, London, W.C.
Morley, Dr. H. Forster, University Hall, Gordon Square, London, W.C.
Morice, Jas. A., 1, Athole Gardens Place, Kelvinside, Glasgow.
Morris, Dr. G. Harris, Avondale, Alexandra Road, Burton-on-Trent.
Morris, J. H., 63 and 65, Blundell Street, Liverpool.
Morris, M. Ivor E., Ammanford, R.S.O., South Wales.
Morris, R., Doncaster.
Morrison, J., Pottery Lane, Forth Bank, Newcastle-on-Tyne.
Morrison, Jno., P.O. Box 336, North Adams, Mass., U.S.A.
Morson, T., 124, Southampton Row, Russell Square, London, W.C.
Morson, T. P., 33, Southampton Row, Russell Square, London, W.C.
Moseley, Jos., Cringle Hall, Levenshulme, Manchester.
Moss, J., Hirdir Lodge, New Thornton Heath, Surrey; and Wilson Street, New Cross Road, London, S.E.
Moul, Frank, Aldersgate Chemical Works, Southall.
Moult, J., 3, Gladstone Terrace, Gateshead-on-Tyne.
Muir, J. P., 233, Camden Road, London, N.W.
Mullard, R., 46, Drakefell Road, St. Catharine's Park, Hatcham, S.E.
Müller, Dr. H., 13, Park Square East, Regent's Park, London, N.W.
Mumford, A., 9, Westwell Street, Plymouth, Devon.
Mumford, T. W. B., 1, Glendale Villas, Sylvan Road, Wanstead, Essex.
Munro, Dr. J. M. H., College of Agriculture, Downton, Salisbury.
Munroe, Chas. E., Torpedo Station, Newport, Rhode Island, U.S.A.
Muras, T. H., H.M. Patent Office, Southampton Buildings, London, W.C.
Murdoch, H. R. M., 4, Nobel's Villas, Stevenston, Ayrshire.
Murphy, John, Kingston House, Aigburth Road, Liverpool.
Murray, H. S., Glenmayne, Galashiels, N.B.
Murrie, Jas., 103, Bishop Street, Anderston, Glasgow.
Muskett, T., 97, Walton Lane, Stanley Park, Liverpool.
Muspratt, E. K., Seaforth Hall, near Liverpool.
Muspratt, J. L., Kempton House, Rhyl, North Wales.
Muspratt, S. K., 31, Dale Street, Liverpool.
Muter, Dr. J., Winchester House, Kennington Road, London, S.E.
Muter, James, Oil Mills, Dunneedaw, Rangoon, Burmah.
Myall, A. A., 21, Cockspur Street, Charing Cross, London, S.W.

N

Naef, P., Uetikon, Zürich, Switzerland.
Nakamura, Teikichi, c/o Y. Fukuzawa, Mita-Nichome, Tokyo, Japan.
Napier, J., 1, St. Matthew's Place, Norwich Road, Ipswich.
Napier, Jas., jun., 10, Carment Drive, Shawlands, Glasgow.
Nason, Prof. H. B., Troy, New York, U.S.A.
Naylor, W. A. H., c/o Hearon, Squire, & Francis, 5, Coleman Street, London, E.C.
Neil, W., 126, Turner's Road, Burdett Road, London, E.
Neild, A., Mayfield, Manchester.
Neill, F. A. R., Bold Ironworks, St. Helens Junction, Lancashire.
Neilson, James, 107, John Street, Glasgow.
Ness, T., Black Banks Chemical Works, Darlington.
Nettlefold, E., 16, Broad Street, Birmingham.
Nettlefold, F.,
Newall, F. S., Washington, County Durham.
Newall, R. S., Ferndene, Gateshead-on-Tyne.
Newlands, B. E. R., 27, Mincing Lane, London, E.C.
Newlands, W. P. R., 40, Alkham Road, Stoke Newington, London, N.
Newman, G. J., jun., Laurel Bank, Wilmslow, Cheshire.
Newton, A. H., Belsize Court, Hampstead, N.W.
Newton, A. H., jun., Belsize Court, Hampstead, N.W.
Newton, Harry, Park Green, Macclesfield.
Newton, Jno., Park Green, Macclesfield.
Newton, H. C., Belsize Court, Hampstead, N.W.
Newton, Jno., Manor Works, Rotherhithe New Road, London, S.E.
Nichols, J. A., Spring Bank, New Mills, near Stockport.
Nicholson, E. C., Carlton House, Herne Hill, London, S.E.
Nicholson, J. C., Chemical Works, Hunslet, Leeds.
Nicholson, W. O., 12, Granville Square, London, W.C.
Nickels, B., jun., 150, Holborn, London, E.C.
Nicol, W. W. J., Mason College, Birmingham.
Nicoll, G. B., c/o Burnard, Lack, & Alger, Plymouth, Devon.
Nimmo, J., 2, Bath Villas, Portland Road, South Norwood, London, S.E.
Nishigawa, F., 14, Go Bancho Koji Machi, Tokyo, Japan.
Nixon, J., 64, Elswick Road, Newcastle-on-Tyne.
Nolting, Dr. E., Ecole de Chimie, Mulhouse, Alsace, Germany.
Norman, F. J., Messrs. Wigg Brothers & Steel, Runcorn.
Norrington, A. Reginald, Cattledown, Plymouth.
North, W. H., Ingleby Street Dyeworks, Browroyd, Bradford, Yorks.
Northing, J., 96, Tritonville Road, Sandymount, Dublin.
Norton, Prof. Lewis M., Massachusetts Institute of Technology, Boston, U.S.A.
Norton, Dr. S. A., Columbus, Ohio, U.S.A.
Norton, Dr. T. H., University of Cincinnati, Ohio, U.S.A.

O

Oates, H. H., 505, Edge Lane, Droylsden, Manchester.
O'Beirne, W. G., North British Chem. Co., Clydebank, near Glasgow.
Oddie, Jas., School of Mines, Ballaarat, Australia.
Odling, Dr. W., 15, Norham Gardens, Oxford; and 38, Ladbrooke Road, North Kensington, W.
Oehler, K., Offenbach-am-Main, Germany.
Ogilvie, T. R., Mill Lane House, Plymouth, Devon.
Ogden, J. M., Ellscope House, Sunderland.
Ogston, G. H., Junior Athenæum Club, Piccadilly, London, W.
Oldershaw, Wm., 69, Long Row, Nottingham.
Oliver, F., 70, Winchester Street, South Shields.
Ollerenshaw, S., Sutton Alkali Works, St. Helens.
O'Neill, C., Laboratory, 72, Denmark Road, Manchester.
O'Neill, E. H., Johnson's Saccharum Co., Limited, Stratford, London, E.
Orme, J., 65, Barbican, London, E.C.
Orr., A., 1, Park Terrace, Irvine, N.B.
Orr, J. B., Blantyre Lodge, Westcombe Park, London, S.E.
Orr, Robert, 79, West Nile Street, Glasgow; and Falkirk, N.B.
Ostersetzer, J., Balcarras House, Serpentine Avenue, Ballsbridge, Dublin.
O'Shea, L. T., Firth College, Sheffield.
O'Sullivan, C., 140, High Street, Burton-on-Trent.
O'Sullivan, J., 71, Spring Terrace, Burton-on-Trent.
Overbeck, Baron Gustavus de, 23, Ryder Street, St. James', London, S.W.
Owen, Thos., Hazlehyrst, Cotham Park, Bristol.
Oxland, Chas., Greystoke, Palace Park Road, Sydenham, S.E.
Oxland, Robert, 32, Portland Square, Plymouth.

P

Packard, E., jun., Bramford, near Ipswich.
Page, F. J. M., 98, Alderney Street, London, S.W.
Pagés, Albert, 34, Boulevard Henri IV., Paris.
Paine, S., 7, Exchange Street, Manchester.
Palmer, Francis R., Debden Hall, Loughton, Essex.
Palmer, I. Chalkley, 22, North Front Street, Philadelphia, U.S.A.
Palmer, Thos. C., 121, Adelaide Road, Haverstock Hill, N.W.
Panario, Thos. C., 48, Octavia Street, Battersea, S.W.
Panton, J. A., The Manor House, Watford, Herts.
Park, J., c/o Stevenson, Carlile & Co., Milburn Chemical Works, Garngad Hill, Glasgow.
Parker, Thos., 6, Crawford Street, Wolverhampton.
Parkinson, Dr. R., Sun Bridge Buildings, Bradford, Yorkshire.
Parnell, E. W., Lancashire Sulphur and Alkali Works, Widnes.
Parr, Samuel, South Sherwood Street, Nottingham.
Pass, A. C., Rushmer House, Durdham Down, Clifton, Bristol.
Paterson, John, 106, Harrington Road, Workington, Cumberland.
Paterson, Walter, jun., 178, Buchanan Street, Glasgow.
Paton, J. M. C., Messrs. Manlove, Alliott, Fryer & Co., Nottingham.
Paton, W. Grant, Greenbank Alkali Co., Limited, St. Helens, Lancashire.
Patterson, G., 85, Carleton Road, Tufnell Park, London, N.
Patterson, T. L., Messrs. J. Walker & Co., sugar refiners, Greenock, N.B.
Pattinson, H. L., jun., Heworth Lodge, Felling-on-Tyne.
Pattinson, J., 75, The Side, Newcastle-on-Tyne.
Pattison, J., 83, North Oswald Street, Glasgow, N.B.
Paul, Fred. W., c/o The Steel Company of Scotland, Limited, 150, Hope Street, Glasgow.
Pauli, Dr., Höchst, Germany.
Payne, Geo., Calder Soapworks, Wakefield, Yorks.
Payne, J. B., 15, Mosley Street, Newcastle-on-Tyne.
Payne, J. H., 17, Croft Terrace, Jarrow-on-Tyne.
Peacock, A. E., Waverley, Bridlington Quay.
Pearce, W., jun., Bow Common, London, E.
Pears, Andrew, Lanadron Soapworks, Isleworth, Middlesex.
Pearson, Wm., 30, Mellor's Buildings, Exchange Street E., Liverpool.
Peaty, Henry, Longport, near Stoke-on-Trent.
Pechiney, A. R., Salindres (Gard), France.
Pedler, A., Presidency College, Calcutta, India.
Pedler, J. R., Woodbank, Lordship Lane, Dulwich, S.E.
Pegge, J. V., c/o Nunneley & Co., Bridge Street Brewery, Burton-on-Trent.
Peile, H., Shotley Bridge, co. Durham.
Pentecost, S. J., Nottingham Road, New Basford, Nottingham.
Pentermann, H. T., 51, Clifton Crescent, Peckham, S.E.
Percy, Dr. J., 1, Gloucester Crescent, Hyde Park, London, W.
Perkin, Dr. W. H., The Chestnuts, Sudbury, Harrow.
Perkin, Dr. W. H., jun., Heriot Watt College, Edinburgh.
Perkin, T. D., Greenford Green, Harrow.
Perkin, A. G., 55, Victoria Crescent, Eccles, Manchester.
Perrett, E., 8, Victoria Chambers, Westminster, S.W.
Perry, D., Forth and Clyde Chemical Works, Kirkintilloch, N.B.
Petersen, Beatus, 69, Nyhavn, Copenhagen, Denmark.
Pettigrew, J., Varnish Manufactory, Carpenter's Road, Stratford, E.
Petty, A., Silvertown, London, E.; and Wood Lodge, Shooter's Hill, Kent.
Peyton, E. P., Chemical Works, Lister Street, Birmingham.
Pfeiffer, Karl, 1, Sutherland Road, West Ealing, Middlesex.
Phillips, H., 18, Exchange Street, Manchester.
Phillips, A. G., 18, Fopstone Road, South Kensington, S.W.
Phipps, Thos., 169, Bridge Street, Northampton.
Phipson, Dr. T. L., Laboratory, 8, Hotham Villas, Putney, London, S.W.
Pick, Dr. S., Direction der Soda Fabrik, Szczkowa, Galizien, Austria.
Pickard, Saml., Hope Paper Mills, Cefn-y-Bedd, Wrexham.
Pickles, H., Prussiate Works, Droylsden, Manchester.
Pilkington, G., Widnes.
Pilkington, Herb., Tipton Green Furnaces, South Staffordshire.
Pinkerton, D. J., Tradeston Gasworks, Glasgow.
Pinkney, Robert, 18, Bread Street Hill, London, E.C.
Pipe, Jas., Messrs. Wm. Henderson & Co., Irvine, N.B.
Pitt, T., 16, Coleman Street, London, E.C.
Pittuck, F. W., 25, Carr Street, Hebburn-on-Tyne.
Playfair, David J., 12, Woodside Terrace, Glasgow.
Polglase, F. J. W., Tyne Vale Chemical Works, Forth Bank, Newcastle-on-Tyne.
Pollock, A., Dillichip Turkey-red Dyeworks, Bonhill, Dumbartonshire.
Pond, J. A., 99, Queen Street, Auckland, New Zealand.
Poole, Thos., 25, Water Street, Liverpool.
Pooley, T. A., 121, The Grove, Denmark Hill, S.E.
Pope, S., Camden Works, Runcorn.
Porter, Herbert, Border Lodge, Honor Oak, S.E.
Porter, J. H., 165, Queen Victoria Street, London, E.C.
Pott, Gideon, c/o Watson, Laidlaw & Co., Kingston, Glasgow.
Pott, W. Hamilton, 22, Southwark Bridge Road, London, S.E.
Potter, E. P., Hollinhurst, Bolton-le-Moors.
Potter, Chas. E., Love Lane Sugar Refinery, Liverpool.
Powell, L. S., 5, Notting Hill Square, Campden Hill, London, W.
Powell, W. A., Maison Marie Louise, Hyères (Var), France.
Poynter, J. Edgar, Clydeneuk, Uddingston, near Glasgow.
Pratt, J. W., c/o Pratt & Co., Mobile, Alabama, U.S.A.
Prescott, Dr. Albert B., Ann Arbor, Mich., U.S.A.
Preston, R., Hill End, Holcombe, near Manchester.
Price, A. F., 715, Post Street, San Francisco, California, U.S.A.
Price, D. S., 26, Great George Street, Westminster, London, S.W.
Price, W. E., Gasworks, Hampton Wick, Middlesex.
Pringle, W., Laboratory, Mercara, Coorg, India.
Prinz, Dr. Otto, Schwarzenberg, Saxony.
Pritchard, W. S., Farnworth, Widnes.
Probert, Thos., Higher Grade School, Cardiff.
Procter, H. R., 30, Hotspur Street, Tynemouth.
Procter, J. W., Skeldergate Bridge, York.
Proctor, C., Government Laboratory, Somerset House, London, W.C.
Proctor, C. W. Cope, Heathercliffe, Clifton Down, Bristol.
Proctor, B. S., 11, Grey Street, Newcastle-on-Tyne.
Proctor, W. W., 33, The Side, Newcastle-on-Tyne.
Pugh, G., 12, Mark Lane, London, E.C.
Pullar, R., Pullar's Dyeworks, Perth, N.B.
Pullar, R. D., Pullar's Dyeworks, Perth, N.B.
Purser, E. T., 82, James Street, Dublin.

Q

Quaas, Gustav, Home Park Mills, King's Langley, Herts.
Quibell, Oliver, Highfield, Newark-on-Trent.

R

Rademacher, H. A., Cellulose Factory, Glossop, Derbyshire.
Rae, G., Tharsis Sulphur and Copper Co., Widnes.
Rait, G. L., 31, Moorgate Street, London, E.C.
Ramsay, Dr. W., University College, Gower Street, London, W.C.

Ramsden, Edw., Holly Bank, Great Horton, Bradford, Yorks.
Ramsden, J., Lion Brewery, Belvidere Road, Lambeth, London, S.E.
Rathbone, P. H., The Cottage, Greenbank, Liverpool.
Rawcliffe, Harold, Appleton Lodge, Widnes.
Rawes, F. B., 15, Gough Road, Stratford, London, E.
Rawlinson, A. J., Newton-le-Willows, Lancashire.
Rawson, C., 3, Union Street, Bradford.
Rawson, S. G., Chemical Laboratory, University College, Liverpool; and 118, Chatham Street, Liverpool.
Ray, Wm., School of Science, Kidderminster.
Raymond, C. W., 24, Lawrence Road, Addington Road, Bow, London, E.
Rayner, J. A. E., Sutton Alkali Works, St. Helens.
Readman, J. B., 9, Moray Place, Edinburgh.
Readman, J. F., Codnor Park Ironworks, by Alfreton, Derbyshire.
Reay, T. Burdon, 85, Herrington Street, Sunderland.
Reddrop, J., Laboratory, L. & N. W. Railway, Crewe.
Redfern, G. F., 4, South Street, Finsbury, London, E.C.
Redfern, Jos., 49, Harvie Street, Bridgeton, Glasgow.
Redmayne, J. M., 27, Grey Street, Newcastle-on-Tyne.
Redwood, B., 85, Gracechurch Street, London, E.C.
Redwood, I. J., Thorn House, Walthamstow, Essex.
Redwood, Robt., 85, Gracechurch Street, London, E.C.
Redwood, Dr. T., 17, Bloomsbury Square, London, W.C.
Rée, Dr. A., 121, Manchester Road, Middleton, near Manchester.
Reed, Albert E., 21, St, Andrew's Crescent, Cardiff.
Reeks, T. H., 71, Chelsea Gardens, Chelsea Bridge Road, London, S.W.
Reid, David E, Kaboonga Mines Co., Kilkivan, Maryborough, Queensland.
Reid, T. Anderson, 11, Mersey View, Runcorn.
Reid, W. C., 7, Graingerville, Newcastle-on-Tyne.
Reid, W. Hamilton, c/o Messrs. Mandall & Co., Stockton-on-Tees.
Reid, W. F., Fieldside, Addlestone, Surrey.
Reid, W. G., 2, Hailes Street, Edinburgh.
Remfry, H. H., 5, Fancy Lane, Calcutta, India.
Renard, Chas., 25, Allées de Meilhan, Marseilles, France.
Renaut, F. W., 65, Radipole Road, Fulham Road, S.W.; and 19, Great George Street, S.W.
Rennie, A. G., 27, Lansdowne Crescent West, Glasgow.
Rennie, Dr. E. H., University of Adelaide, South Australia.
Rennoldson, W. L., St. Bede Chemical Works, East Jarrow.
Reoch, R., River Point, Rhode Island, U.S.A.
Reynolds, Dr. J. Emerson, Trinity College, Dublin.
Reynolds, R., 13, Briggate, Leeds.
Rhodes, E., c/o Thos. Vickers & Sons, Widnes.
Rice, Dr. Chas., Bellevue Hospital, New York, U.S.A.
Richards, W. A., Sandbach, Cheshire.
Richardson, B. S., Scottdale, Westmoreland Co., Pa., U.S.A.
Richardson, C. T., Monkton Lodge, Jarrow-on-Tyne.
Richardson, J. G. F., Elmfield, Stoneygate, Leicester.
Richardson, J. G., Springwell Paper Mills, Jarrow-on-Tyne.
Richardson, J. H., 359, Blackburn Road, Accrington.
Richardson, F. W., 2, Farcliffe Place, Bradford, Yorkshire.
Richmond, H. D., 2, Trulock Villas, Park Lane, Tottenham, N.
Richmond, W. H., Liver Alkali Works Co., Limited, Lightbody Street, Liverpool; and 37, Merton Road, Bootle.
Rickman, J. Pellatt, Falcon Glass Works, St. Bride Street, London, E.C.
Riddell, Robert, Messrs. Allsopp & Co., New Brewery, Burton-on-Trent.
Rideal, Dr. Samuel, University College, London, W.C.
Ridsdale, C. H., 24, Outram Street, Stockton-on-Tees.
Rigg, R., Messrs. M'Bride & Co., Union Chemical Works, St. Helens.
Riley, E., 2, City Road, Finsbury Square, London, E.C.
Riley, Jas., 150, Hope Street, Glasgow.
Riley, J. E., Arden Hall, near Accrington.
Riley, J., Hapton Chemical Works, Accrington.
Riley, J., Mayfield, Castleton, near Manchester.
Riley, James, Laboratory, Brinscall Works, near Chorley, Lancashire.
Riley, W. G., Hapton Chemical Works, near Accrington.
Ripley, H., Bowling Dyeworks, Bradford, Yorkshire.
Ritchie, Robt., Shawfield Works, Rutherglen, near Glasgow.
Ritson, T. N., 96, St. Saviour's Road, Jersey.
Rix, W. P., Doulton & Co., Lambeth Art Pottery, London, S.E.
Robbins, J., Gibraltar Walk, Bethnal Green Road, London, E.
Robbins, J., 147, Oxford Street, London, W.
Roberts, Frank A., Messrs. Roberts, Dale & Co., Warrington.
Roberts, F. G. Adair, Clydach, Bethune Road, Stamford Hill, N.
Roberts, R. Wightwick, 22, Calle Arturo Prat, Valparaiso, Chili.
Roberts-Austen, Prof. W. C., Royal Mint, London, E.
Robertson, John, Mosswell, Milngavie, near Glasgow.
Robertson, R. A., 42, Aytoun Road, Pollokshields, Glasgow.
Robinson, A. E., Faraday Chemical Works, 5 and 6, Aston Road, Birmingham.
Robinson, G. C., Royal Institution, Hull; and Laboratory, Bond Street, Hull (for Journals).
Robinson, H. H., 12, Montpelier Row, Twickenham.
Robinson, J., Farnworth, Widnes; and 50, Irwell Street, Widnes.
Robinson, Jno., 5, Elizabeth Terrace, Ditton, Widnes.
Robinson, R., Apsley Buildings, Old Hall Street, Liverpool.
Robinson, Thomas, 401, West Street, Glasgow.
Rodger, Edw., 1, Clairmont Gardens, Glasgow, W.
Rogers, Daniel W., Hopkins Academy, Hadley, Mass., U.S.A.
Rohling, Ferd., c/o Rohling and Rave, Münster, Westphalia, Germany.
Rollin, J. C., St. Bede Chemical Co., Limited, Newcastle-on-Tyne.
Rooke, J. A., Horrocks Lane, Red Bank, Manchester.
Rooth, J. S., Walton Chemical Works, Chesterfield.
Roques, Adolphe, 36, Rue Sainte Croix de la Bretonnerie, Paris.
Roscoe, Sir Henry, M.P., 10, Bramham Gardens, South Kensington, S.W.
Roscow, Jas., Fairview, Littleborough, Lancashire.
Rosicki, Dr. F., 5, Quai Claude Bernard, Lyons, France.
Roskell, Jos., Port Tennant Copper Works, Swansea.
Ross, Alex. J. J., Battlefield Cottage, Falkirk, N.B.
Ross, J. G., 14, Argyle Place, Edinburgh.
Ross, Wm., 12, King Street, Manchester.
Rottenburg, Paul, c/o Messrs. Leisler, Bock & Co., 130, Hope Street, Glasgow, N.B.
Rowan, F. J., 121, West Regent Street, Glasgow.
Rowell, W. A., c/o Messrs. Sullivan & Co., Limited, British Alkali Works, Widnes.
Rowland, W. L., 4800, Chester Avenue, Philadelphia, Pa., U.S.A.
Rowley, Thos., Croston Cottage, Alderley Edge, Cheshire.
Rowley, W. J., Wellington Villas, Wellington Road, Handsworth, Birmingham.
Roxburgh, J. W., Levenbank Works, Jamestown, Dumbartonshire, N.B.
Royle, T., Dalton House, Upton Lane, Forest Gate, E.
Royse, S. W., St. Andrew's Chambers, Albert Square, Manchester.
Ruffle, Jno., Portway House, Plashet Road, Plaistow, E.
Rumble, C., Belmont Works, Battersea, London, S.W.
Rüntz, John, Linton Lodge, Lordship Road, Stoke Newington, N.
Rupp, Wm., 117, Pearl Street, New York, U.S.A.
Ruscoe, Jno., Albion Works, Henry Street, Hyde, near Manchester.
Rushton, H. F., 30, Juvenal Street, Liverpool.
Russell, D., Silverburn, Leven, Fife, N.B.
Russell, Jno., Anchor Brewery, Britten Street, Chelsea, London, S.W.
Russell, Dr. W. J., St. Bartholomew's Hospital, London, E.C.
Ryder, C. E., c/o Messrs. Elkington, Newhall Street, Birmingham.
Ryland, Howard P., The Cedars, Gravelly Hill, Birmingham.

S

Sadler, A. E., Sandhall, Ulverston, Lancashire.
Sadler, S. A., Middlesbrough-on-Tees.
Sadtler, Prof. Samuel P., University of Pennsylvania, Philadelphia, Pa., U.S.A.
Sainsbury, E., Briton Ferry Chemical Works, Glamorganshire.
Saint, W. Johnson, bei den Frau Pfarrer Kern, 13, Friedrichstrasse, Erlangen, Bavaria.
Salamon, A. G., 1, Fenchurch Avenue, London, E.C.
Salamon, Jno., The Willows, Wennington, near Romford, Essex.
Samuel, W. Cobden, 203, Norwood Road, Herne Hill, London, S.E.
Samuelson, Sir Bernard, Bart., M.P., 56, Prince's Gate, London, S.W.
Sandon, R., 118, Leighton Road, Kentish Town, London, N.W.
Sanderson, T. C., 231, Southampton Street, Camberwell, S.E.
Sansone, A., Vauxhall Chemical Works; and 8, Bignor Street, Cheetham Hill, Manchester.
Saul, C. H., 76, Mosley Street, Manchester.
Saunders, T. B., 8, Melbourne Place, Horton Lane, Bradford, Yorks.
Savage, W. W., 109, St. James's Street, Brighton.
Savary, W. J. H., 39, Lombard Street, London, E.C.
Scattergood, T., 22, North Front Street, Philadelphia, Pa., U.S.A.
Schad, Julius, 14, Charlotte Street, Manchester.
Schäppi, Dr. H., Badische Anilin und Soda Fabrik, Ludwigshafen-am-Rhein, Germany.
Schellhaas, H., 54, Navigation Road, Northwich.
Schenfelen, Dr. Adolf, Croseley Mills, Watford, Herts.
Scheurer-Kestner, Dr. A., 57, Rue de Babylone, Paris, France.
Schloesser, R., 14, Charlotte Street, Manchester.
Schofield, C., Whalley Range, Manchester.
Schofield, C. J., Clayton, Manchester.
Schofield, E., Scout Bottom, Newchurch, near Manchester.
Scholefield, H. E., 52, Edge Lane, Liverpool.
Schorlemmer, Dr. C., The Owens College, Manchester.
Schott, A., 26, Princess Street, Manchester.
Schreiber, F. T., Halliwell Bleachworks, near Bolton.
Schroeder, C., 55, Bloom Street, Manchester.
Schunck, Dr. E., Kersal, near Manchester.
Scorgie, J., College of Science, Poona, India.
Scott, A., High Calton, Edinburgh.
Scott, F., Rhodes Works, Middleton, near Manchester.
Scott, G. H., Hague Bar, New Mills, near Stockport.
Scott, Wm., 2, Robertson Street, Greenock, N.B.
Scott, W. Lascelles, Ambleside, Forest Gate, E.
Scott, W. T., 11, Cromartie Road, Hornsey Rise, N.
Scrutton, Willis, University College, Gower Street, W.C.
Scudder, F., 26, Devonshire Street, Ardwick, Manchester.
Seaward, G. A., St. George's Brewery, Commercial Road, London, E.
Segner, P., 26, Princess Street, Manchester.
Sellon, J. S., 78, Hatton Garden, London, E.C.
Sellon, S , 3, Salter's Hall Court, Cannon Street, London, E.C.
Semet, Louis, 217, Chaussée de Vleurgat; and 19, Rue du Prince Albert, Brussels.
Senier, Dr. A., Thornfield, Harold Road, Upper Norwood, S.E.
Senier, H., 88, Norwood Road, London, S.E.
Serre, C. A., 150, High Street, Stoke Newington, N.
Sevin, C., Strathmore, 72, Central Hill, Upper Norwood, S.E.; and c/o Dollman & Pritchard, 3, Laurence Pountney Hill, E.C. (for Journals).
Sexton, Prof. A. Humboldt, 7, Sefton Terrace, Rutherglen, Glasgow.
Seymour, J. R. W., Northcroft Farm, Inkpen, near Hungerford, Berks.
Shackel, W., Three Mills Distillery, Bromley-by-Bow, E.
Shackleton, C. J., Sydney Villa, Mill Hill, Derby; and Phœnix Chemical Works, Ironbridge, Salop.
Shadwell, J. E. L., Meadowbank, Melksham, Wilts.
Shapleigh, W., c/o Graham Blandy, 16, Broad Street, New York, U.S.A.
Sharp, Henry, Loseley Hurst, Bournemouth; and Poole.
Sharp, James, The Towers, Low Moor, near Bradford, Yorks.
Sharples, Stephen P., 13, Broad Street, Boston, Mass., U.S.A.
Shaw, D., Clayton, near Manchester.
Shaw, F. W., Heapey Bleachworks, near Chorley, Lancashire.
Shaw, Geo., 37, Temple Street, Birmingham.
Shaw, R., West Bank Chemical Works, Widnes.
Shaw, Walter, Sherdley Glass Works, St. Helens.
Shearer, A., Messrs. Boake & Co., Stratford, London, E.
Shenstone, W. A., Clifton College, Bristol.
Sherlock, T., New Market Place, St. Helens.
Shimidzu, Tetsukichi, c/o T. Hirano, 11, Ginza Shichome, Tokyo, Japan.
Shimosè, Masachika, Heiki-Seizo-Sho, Akabanè, Tokyo, Japan.
Shipstone, Jas., jun., Woodthorpe Lodge, Sherwood, Nottingham.
Siddall, F. P., Park Side, Barnet Common, Herts.
Sieber, C. H., Whitworth, near Rochdale.
Siebold, L., Carr Bank, Walmersley, near Bury.
Sill, T. T., Wallsend Chemical Co., Newcastle-on-Tyne.
Sillar, W. Cameron, The Native Guano Co., Limited, 29, New Bridge Street, Blackfriars, E.C.
Silva, Prof. R. D., 26, Rue de la Harpe, Paris.
Simon, H., 20, Mount Street, Manchester.
Simpson, J., 8A, Rumford Place, Liverpool.
Simpson, R., Grecian Terrace, Harrington, Cumberland.
Simpson, W. S., 95, Darenth Road, Stamford Hill, N.
Sims, T. H., Mayfield Printworks, Manchester.
Singleton, Jos., 41, Corporation Street, Manchester.
Sisson, G., jun., Washington Chemical Co., Washington, County Durham.
Skaife, Wilfred T., 630, Sherbrooke Street, Montreal, Canada.
Skinner, Sidney, Christ's College, Cambridge.
Slade, H. E., Streatham Common, London, S.W.
Slater, H. H., 36, Wray Crescent, Tollington Park, N.
Slatter, Geo. W., Saltaire Works, Shipley, Yorkshire.
Smail, J. I., Messrs. Gibbs & Co., Iquique, Chili.
Small, Evan W., Cavendish Crescent North, The Park, Nottingham.
Smeaton, F. W., 53, Renfield Street, Glasgow.
Smetham, A., 18, Brunswick Street, Liverpool.
Smiles, Jas., 3, Brandon Terrace, Edinburgh.
Smith, Alfred, Excelsior Chemical Works, Clayton, Manchester.
Smith, Anthony, Dublin Vitriol Works, Ballybough Bridge, Dublin.
Smith, A. E., Widnes.
Smith, A. J., Elswick Ordnance Works, Newcastle-on-Tyne.
Smith, Chas., c/o Roxburgh Street Refining Co., Greenock, N.B.
Smith, C. A., The Laboratory, 8, Loftus Street, Sydney, New South Wales.
Smith, Prof. Edgar F., Wittenberg College, Springfield, Ohio, U.S.A.
Smith, Edgar F., 35, Ampthill Square, Hampstead Road, London, N.W.
Smith, Ernest, 114, West Street, Glasgow.
Smith, Fred., c/o New Explosives Co., Ld., Stowmarket Suffolk.
Smith, G., Polmont Station, Scotland.
Smith, Geo. F., Cromwell Lodge, Putney Hill, S.W.
Smith, Henry, 11, Malvern Road, Dalston, London, E.
Smith, H. R., 1, Aubert Park, Highbury, London, N.
Smith, J. Johnstone, Castle Brewery, Newark-on-Trent.
Smith, J., Ash Grove House, Radcliffe, Manchester.
Smith, Dr. J. H., 1, Bute Terrace, Low Fell, Gateshead-on-Tyne.
Smith, J. W., West Street, Paddock, Huddersfield.

Smith, M. H., Messrs. Hopkin & Williams, Waterside, Wandsworth, S.W.
Smith, Richard, Metallurgical Laboratory, Royal School of Mines, South Kensington, S.W.
Smith, R. W., The Grange, Kirkburton, near Huddersfield.
Smith, S., 35, Ampthill Square, Hampstead Road, London, N.W.
Smith, Thos , Heriot Hill House, Edinburgh.
Smith, Watson, The Owens College, Manchester; and 147, High Street, Chorlton-on-Medlock, Manchester.
Smith, Wilfred, 114, West Street, Glasgow.
Smith, W.. 10, Corn Street, Bristol.
Smithells, Prof. A., Yorkshire College, Leeds.
Smithers, F. O., Dashwood House, 9, New Broad Street, London, E.C.
Smithson, J., Park Printworks, Halifax.
Snape, Thos., Phœnix Park Works, Widnes.
Snelling, E., 5, Spital Square, Bishopsgate Street, London, E.
Soames, J. K., Thames Soap and Candle Works, Greenwich, S.E.
Solvay, Ernest, 19, Rue du Prince Albert, Brussels.
Solvay, Alfred, Boitsfort, Belgium.
Sommer, Dr. G. Shack, 323, Vauxhall Road, Liverpool.
Sommer, Adolf, West Berkeley, Alameda Co., California, U.S.A.
Southall, A., Richmond Hill Road, Edgbaston.
Sowerby, W. M., 8, Clervaux Terrace, Jarrow-on-Tyne.
Soward, A. W., 18, Sevlla Road, The Rye, Peckham, S.E.
Spackman, Chas., c/o John Ellis & Sons, Barrow-on-Soar, Loughborough.
Spalding, E. S., South Darenth, Kent.
Spence, D., Alum Works, Manchester.
Spence, F., Alum Works, Manchester.
Spence, J. W., 63, West Regent Street, Glasgow.
Spencer, Hugh T., 104, Thomas Lane, Broad Green, near Liverpool.
Spencer, Jno., Globe Tube Works, Wednesbury.
Spencer, J. W., Newburn, Newcastle-on-Tyne.
Spiegel, Dr. Adolf, Messel, bei Darmstadt, Germany.
Spiller, J., 2, St. Mary's Road, Canonbury, London, N.
Spiller, A., 2, St. Mary's Road, Canonbury, London, N.
Sprengel, Dr. H., Saville Club, 107, Piccadilly, London, W.
Squire, E. L , Coalbrookdale, Shropshire.
Squire, P. W., 413, Oxford Street, London, W.
Squire, Dr. W. S., Clarendon House, St. John's Wood Park, N.W.
Stacey, H. G., 300, High Holborn, London, W.C.
Stacey, S. L., 300, High Holborn, London, W.C.
Stahl, Dr. K. F., Johnstown Chemical Works, Johnstown, Cambria Co., Pa., U.S.A.
Stanford, E. C. C., Glenwood, Dalmuir, N.B.
Stanley, C. L., Sandygate House, Wath-upon-Dearne, Yorkshire.
Stanning, Jno., Broadfield, Leyland, near Preston.
Stantial, Frank G., East Cambridge, Mass., U.S.A.
Stapleton, Jos., 3, Lower Sackville Street, Dublin.
Staples, H. J., Spondon, Derby.
Staples, Sir Nath. A., Bart., Lissan, Cookstown, Ireland.
Stark, J. F., Price's Patent Candle Co., Ld., Bromborough Pool, near Birkenhead.
Starling, J. H., The Avenue, Erith, Kent.
Staub, Dr. A., care of Brunner, Mond & Co., Northwich, Cheshire.
Staveley, W. W., Baghill, Pontefract.
Stead, J. E., 5, Zetland Road, Middlesbrough-on-Tees.
Stead, W. H., 23, Boundary Street, Liverpool.
Stebbins, J. H., 117, Pearl Street, New York, U.S.A.
Steedman, R. H., North British Chemical Co., Clyde Bank, near Glasgow.
Steel, J. M., 85, Gracechurch Street, London, E.C.
Steele, Dr. M., Newton Hall, Frodsham, Cheshire.
Steel, R. Elliott, Spring Cliffe House, Heaton Road, Bradford, Yorkshire.
Steel, Thos., Yarraville Sugar Refinery, Melbourne, Victoria,
Steiger, Alph., 16, Mincing Lane, London, E.C.
Steinhart, Dr. Oscar J., c/o Thomas and Dower, Ld., Garratt Lane, Tooting, S.W.
Stenhouse, T., 1, Milton Street, Rochdale.
Stephens, H. Chas., M.P., Avenue House, Finchley, N.
Steuart, D. V., Albert Chemical Works, Clayton, near Manchester.
Steuart, D. R., Broxburn, near Edinburgh, N.B.
Stevens, Wm., The Native Guano Co., Ld , 29, New Bridge Street, Blackfriars, E.C.
Stevens, W. J., Marsh Soapworks, Bristol.
Stevenson, J., Broxburn, N.B.
Stevenson, Jas., 23, West Nile Street, Glasgow; and The Bromfields, Largs, N.B.
Stevenson, H. E., 2, Bromfield Gardens, Onslow Road, Richmond, Surrey.
Stevenson, J. C., M.P., South Shields.
Stevenson, Dr. T., Guy's Hospital, London, S.E.
Stevenson, W., Standard Works, 95A, Southwark Street, London, S.E.
Stewart, A. Y., 212, Camden Road, London, N.W.
Stewart, S., Caledonian Railway Stores Department, St. Rollox, Glasgow.
Stewart, David, 152, Birkbeck Road, Tottenham, N.
Stiker, Flavius P., 453, Fourteenth Street, Buffalo, N.Y., U.S.A.
Stillwell, C. M., 55, Fulton Street, New York, U.S.A.
Stirk, Jos., 126, Station Street, Burton-on-Trent.
Stockdale, Wm., Irwell Printworks, Stacksteads, near Manchester.
Stocks, H. B., 13, Peet Street, Gladstone Road, Liverpool.
Stoddart, F. Wallis, Western Counties Laboratory, Bristol.
Stoddart, J. E., 60, Robertson Street, Glasgow.
Stoer, J., 6, Hanover Quay, Dublin.
Stoker, G. N., The Laboratory, Somerset House, London, W.C.
Stone, E. D., 19, Lever Street, Piccadilly, Manchester.
Stone, F. B., 1, Norfolk Villa, Picardy Hill, Belvedere, Kent.
Stopes, H., Kenwyn, Cintra Park, Upper Norwood, S.E.
Storey, H. L., Underfell, Lancaster.
Storey, I. H., Haverbreaks, Lancaster.
Strangman, J. Pim, Sarno, Salerno, Italy.
Strong, Colin R., 18, Exchange Street, Manchester.
Strype, W. G., The Murrough, Wicklow, Ireland.
Stuart, C. E., 29, Mosley Street, Newcastle-on-Tyne.
Stuart, Jas., Prince's Avenue, Hull, and 22, High Street, Hull.
Stuart, T. W., Newton Villas, Hebburn-on-Tyne.
Studer, Dr. A., 10, Marsden Street, Manchester.
Suilliot, H., 21, Rue Sté Croix de la Bretonnerie, Paris.
Sumner, R. M., 50A, Lord Street, Liverpool.
Sutherland, D. A., Burntisland Oil Co., Burntisland, N.B.
Sutherland, Jas., Ballyclare, co. Antrim, Ireland.
Sutherland, Jno., 16, Flinders Lane North, Melbourne, Victoria, Australia.
Sutherland, R. M., Lime Wharf Chemical Works, Falkirk, N.B.
Sutton, F., London Street, Norwich.
Sutton, F. Napier, 22, Hartham Road, Holloway, N.
Swan, J. C., 1, Dean Street, Newcastle-on-Tyne.
Swan, J. W., Lauriston, Bromley, Kent.
Swinburne, Geo., c/o J. Coates & Co., Planet Chambers, 8, Collins Street East, Melbourne, Australia.
Syddall, R. J., Roseleigh House, Chadkirk, near Stockport.
Sykes, E., 14, Edmond Street, Seedley, Pendleton, near Manchester.
Sykes, Dr. B. Clifford, St. John's House, Cleckheaton, Yorkshire.
Syme, W. B., c/o Young's Paraffin Oil Co., Addiewell, West Calder, N.B.
Symes, Dr. C., 14, Hardman Street, Liverpool.

T

Takamatsu, T., Tokyo University, Japan.
Takamine, J., Noshomusho, Tokyo, Japan.
Tanner, A. E., High Cross, Tottenham, N.
Tanner, B., Ferndale Villa, Disraeli Road, Forest Gate, Essex.

Tarn, Albert, 44, Alston Street, Monument Road, Birmingham.
Tate, A. Norman, Hackins Hey, Liverpool.
Tate, E., Sugar Refinery, Silvertown, London, E.
Tate, F. H., Holland Bank Chemical Works, Church, near Accrington.
Tate, H., jun., Allerton Beeches, Allerton, near Liverpool.
Tate, W., 43, Norwood Grove, Liverpool.
Tatlock, J., 100, Sauchiehall Street, Glasgow.
Tatlock, R. R., 138, Bath Street, Glasgow.
Tatters, J. G., Dean House, South Shields.
Taubman, R., 33, Southampton Row. London, W.C.
Taylor, Andrew, 11, Sutton Place, Edinburgh.
Taylor, C., Friars Field Villas, Uttoxeter New Road, Derby.
Taylor, G. Crosland, Riverside, Boughton, Chester.
Taylor, Jno. The Belgrave Pharmacy, Torquay, Devon.
Taylor, J.
Taylor, Jas., Osgathorpe Crescent, Sheffield.
Taylor. H. E., 4A, Brand Street, Greenwich, S.E.
Taylor, R. L., 37, Mayfield Road, Alexandra Park, Manchester.
Taylor, W. J., c/o Prentice Bros., Chemical Works, Stowmarket, Suffolk.
Teanby, G. W. A., 22, Grosvenor Place, Blackman Lane, Leeds.
Teed, Dr. F. L., 8, Victoria Chambers, Westminster, London, S.W.
Tennant, Sir Chas., Bart., 35, Grosvenor Square, S.W.; and Glen, Peebleshire, N.B.
Tennant, Jas., Dartmouth Lodge, Saltwell, Gateshead-on-Tyne.
Terry, Hubert L., 13, Duke Street, Greenheys, Manchester.
Tervet, R., Forth House, Fisher Row, Musselburgh, N.B.
Thatcher, C. F., Gwydyr House, 559, Old Kent Road, London, S.E.
Thew, Walter H., 47, Castle Street, Liverpool.
Thom, John, Birkacre, Chorley, Lancashire.
Thomas, C., Broad Plain Soapworks, Bristol.
Thomas, H. E., Hyde Lodge, Redland, Bristol.
Thomas, Henry, 44, Amberley Street, Sunderland.
Thomas, J., Brook House, Wooburn, near Beaconsfield.
Thomas, J. W., The Laboratory, Wharf, Cardiff; and Pen-y-lan, near Cardiff.
Thomas, R. Schofield, 70, Charlotte Street, Birmingham.
Thomas, S. M., 143, Cannon Street, London, E.C.
Thompson, Chas., 15, Patshull Road, Kentish Town, N.W.
Thompson, C. J., 11, Bentley Road, Prince's Park, Liverpool.
Thompson, Prof. Claude M., University College, Cardiff.
Thompson, G. E., Birkdale, South Road, Smethwick, Birmingham.
Thompson, W., jun., Larkfield, Earlstown, Lancashire.
Thompson, W. G., Tonge Springs Works, Middleton, near Manchester.
Thompson, W. P., Patent Office, 6, Lord Street, Liverpool.
Thomson, G. Carruthers, 39, Kersland Terrace, Hillhead, Glasgow.
Thomson, John, 70A, Grosvenor Street, London, W.
Thomson, Prof. J. M., King's College, London, W.C.
Thomson, J. S., Uphall Oil Works, Uphall, N.B.
Thomson, R., City Analyst's Laboratory, 138, Bath Street, Glasgow.
Thomson, Robt. T., 138, Bath Street, Glasgow.
Thomson, W., Royal Institution, Manchester.
Thomson, Wm. Garth, 41, Mitchell Street, Glasgow.
Thorne, E. E. H., c/o H. E. Thorne, Bridgetown, Barbadoes.
Thorne, Dr. L. T., 52, Fortess Road, London, N.W.
Thorneycroft, Wallace, Tettenhall Towers, near Wolverhampton.
Thornton, H., 5, George Street, Euston Road, London, N.W.
Thorp, T. W., Messrs. Crossman & Co., Mile End Road, London, E.
Thorp, W., 39, Sandringham Road, Kingsland, London, E.
Thorpe, Dr. T. E., Royal Normal School of Science, South Kensington, S.W.
Tichborne, C. R. C., 15, North Great George Street, Dublin.
Tickner, G., Castle Brewery, Guildford.
Tidy, Dr. C. Meymott, 3, Mandeville Place, Manchester Square, London.
Tighe, Patrick, Lake House, East Jarrow.
Tilden, Dr. W. A., Mason Science College, Birmingham.
Timmins, A., Stanley Villas, Runcorn.
Timmis, T. Sutton, Widnes.
Todd, A. M., Nottawa, St. Joseph Co., Mich., U.S.A.
Tomlinson, G. G., 10, Maude Grove, West Brompton, S.W.
Toms, F. Woodland, States Analyst's Office, St. Heliers, Jersey.
Tonks, E., Packwood, Knowle, near Birmingham.
Tothill, W. W., Messrs. Reckitt & Son, Limited, Hull.
Towers, J. W., Grosvenor Buildings, Victoria Road, Widnes.
Townsend, H. H., 14, Elgin Park, Redland, Bristol.
Townsend. Jos., 19, Crawford Street, Port Dundas, Glasgow.
Trachsel, E. F., c/o W. C. Moore, 9, Old Jewry Chambers, London, E.C.
Trechmann, C. O., 10, Cliff Terrace, Hartlepool.
Trench, G., Standard House, Faversham, Kent; and the Cotton Powder Co., Limited. Faversham.
Trewby, Herbert, Langford Lodge, New Park Road, Clapham Park, S.W.
Tribe, P. C. M., Oswego, New York, U.S.A.
Trimble, Prof. H., 632, Marshall Street, Philadelphia, U.S.A.
Trimnell, C. H., Elmhurst, New Malden, Surrey.
Trobridge, A., c/o Chance Bros., Alkali Works, Oldbury, Birmingham.
Truby, Charles, 53, High Street, Manchester.
Truman, Dr. E. B., 31, Derby Road, Nottingham.
Tsukiyama, S., Imperial Paper Mills, Oji, Tokyo, Japan.
Tuer, Arthur H., 28, Church Street, Standish, near Wigan.
Türgensen, Dr. R., Oberröblingen a/See, bei Halle, Germany.
Turnbull, Wm., 14, Wilberforce Terrace, Gateshead-on-Tyne.
Turnbull, W. S., Place of Bonhill, Renton, Dumbartonshire.
Turner, F. T., 17, Copeland Street, Stoke-on-Trent.
Turner, Thos., Mason College, Birmingham.
Turner, W. Spencer, 225, Oxford Street, Manchester.
Turney, J., Trent Bridge Leather Works, Nottingham.
Tweedie, G. R., 2, Torriano Villas, Broadstairs, Kent.
Twivey, A., Five Ways, Edgbaston, Birmingham.
Twynam, T., 54, Minford Gardens, West Kensington Park, London, W.
Typke, P. G. W., Fairlawn, New Malden, Surrey.
Tyrer, T., Garden Wharf, Battersea, London, S.W.
Tyzack, Stuart, Brockett House, Montgomery Road, Sheffield.

U

Umney, C., 50, Southwark Street, London, S.E.
Underwood, Prof. G. R., Mass. Inst. of Technology, Boston, Mass., U.S.A.
Upward, W., Albert Road, Widnes.
Usmar, J. H., 34, Palmerston Buildings, London, E.C.

V

Vary, G. M. P., General Post Office, San Francisco, Cal., U.S.A.
Vasey, T. E., 6, South Parade, Leeds; and 27, Corn Exchange Chambers, Mark Lane, London, E.C.
Vaughan, J. L., Woodleigh, East Dulwich Grove, S.E.
Vaux, Cuthbert, The Brewery, Sunderland.
Veitch-Wilson, J., Queen Street, Bradford, Manchester.
Venables, T., Parkburn Chemical Works, Kirkintilloch, N.B.
Verdin, Jos., The Brockhurst, Northwich, Cheshire.
Verel, W. A., 136, West George Street, Glasgow.
Vickers, W., Rose Hill, Smedley Lane, Manchester.

Vieth, Dr. P., 31, St. Petersburg Place, Bayswater, London, W.
Voelcker, E. W., 11, Salisbury Square, Fleet Street, London, E.C.
Voelcker, Dr. J. A., Royal Agricultural Society of England, 12, Hanover Square, London, W.
Voss, Hermann, Holstein House, Whitworth Road, South Norwood, S.E.

W

Waché, Alf., 6, Rue Lambrecht, Douai, France.
Wainwright, Dr. J. H., 402, Washington Street, New York, U.S.A.
Waite, C. N., Medford, Mass., U.S.A.
Walker, A., Irvine Chemical Co., Limited, Irvine, N.B.
Walker, Archibald, 8, Crown Terrace, Glasgow.
Walker, Arthur J., 38, Portsdown Road, Maida Vale, London, N.W.
Walker E. Robinson, 18, St. Ann's Street, Manchester.
Walker, Geo., City Analyst's Laboratory, 138, Bath Street, Glasgow.
Walker, R., The Pallett, Quarlton, near Bolton.
Walker, R. W., Quarlton Vale Printworks, Turton, near Bolton.
Walker, S. R., 21, School Street, Radcliffe, Manchester.
Walker, T., Merton Bank Chemical Works, St. Helens.
Wall, R. F., Thames Sugar Refinery, Silvertown, London, E.
Wallace, Andrew, 15, Abbey Street, Paisley, N.B.
Wallace, Robert, 126, St. Leonard's Street, Bromley, London, E.
Wallace, Dr. W., 138, Bath Street, Glasgow.
Waller, Dr. E., School of Mines, Columbia College, 50th Street, 4th Avenue, New York, U.S.A.
Walsh, F. T., Hamilton Printworks, Lowell, Mass., U.S.A.
Walsh, P. H., c/o Procter & Gamble, Soap Factory, Ivorydale, Ohio, U.S.A.
Waltham, T., Brewery, Stockwell, London, S.W.
Walton, Cornelius, 63, Queen Victoria Street, London, E.C.
Warburton, J., Kearsley House, Farnworth, near Bolton.
Ward, G., Messrs. Hirst, Brooke and Hirst, Leeds.
Ward, Geo., c/o Richardson & Co., 10, Friar Lane, Leicester.
Ward, Howard Chas., Yeatton, Hordle, Lymington, Hants.
Wardale, J. D., Redheugh Engine Works, Gateshead-on-Tyne.
Wardale, H., 52, Bewick Road, Gateshead-on-Tyne.
Warden, Dr. C. J. H., Medical College, Calcutta, India.
Wardle, Thos., Leek, Staffordshire.
Waring, E. S., Lillie Terrace, Castle Street, Sneinton, Nottingham.
Warington, Robt., Harpenden, Herts.
Warne, Thos., c/o Rainham Ferry Vitriol Co., Rainham, Essex.
Warner, H. G., c/o Wallis & Milestone, Garratt Lane, Wandsworth, S.W.
Warren, T. T. P. Bruce, Tamworth Villa, Earlham Grove, Forest Gate, Essex.
Warrington, A. W., Dinglefield, Dingle Lane, Liverpool.
Warwick, Jno., 11, Ashfield Terrace West, Newcastle-on-Tyne.
Warwick, J. F., The Brewery, Newark-on-Trent.
Waterfall, W. B., c/o Avon Manure Co., Bristol.
Wates, Edw. A., 4, Prince's Road, Lewisham, S.E.
Watson, Chas., 5, Paradise Row, Stockton-on-Tees.
Watson, D., Broughton Copper Works, Manchester.
Watson, F. Percy, 31, Carholme Road, Lincoln.
Watson, G., jun., 16, East Nelson Street, Whitevale, Glasgow.
Watson, J. C., The Rhyddings, Oswaldtwistle, near Accrington.
Watson, J. D., Irtside, Holmrook, near Carnforth.
Watson, T. Donald, 23, Cross Street, Finsbury, London, E.C.
Watson, Jno., Cement Works, Gateshead-on-Tyne.
Watson, Jno., Laboratory, Newcastle Chemical Co., Gateshead-on-Tyne.
Watson, W. H., Laboratory, The Folds, Bolton.
Watt, A., 89, Hartington Road, Sefton Park, Liverpool.
Watts, A. J., 130, Caixa, Pernambuco, Brazil.
Watts, Chas. W., Corporation Gasworks, Belfast.
Webb, Saml. G., c/o W. Pilkington & Son, Widnes.
Webster, C. S. Stanford, Malvern House, Redland, Bristol.
Wehler, Theodore, 32, Liberty Street, New York, U.S.A.
Weightman, John F., c/o Powers & Weightman, Philadelphia, Pa., U.S.A.
Weldon, Ernest, 42, Sandon Street, New Basford, Nottingham.
Weldon, Osmond, 66, North Gate, New Basford, Nottingham.
Weldon, W. F. Raphael, 14, Brookside, Cambridge.
Wells, G. I. J., 41, Francis Terrace, Victoria Park, London, E.
Welsh, Jas., Clayton Mount, Newton Heath, near Manchester.
Welsh, W., Orleton House, Whalley Range, Manchester.
Wessel, Carl, Bernburg, Anhalt, Germany.
West, John, Barfield House, Didsbury, near Manchester.
Westmoreland, J. W., 25, Park Square, Leeds.
Weston, Wm., H.M. Dockyard, Portsmouth.
Wetzel, H. A., Box 470, Detroit, Michigan, U.S.A.
Whalley, L. J., Ash Villa, Fillebrook Road, Leytonstone, E.
Wharton, A., Gasworks, Basford, Nottingham.
Wheatcroft, Ernest, 62, Page Hall Road, Sheffield.
Whewell, G., 15, Exchange Street, Blackburn.
Whiffen, T., Lombard Road, Battersea, London, S.W.
Whiffen, T., jun., Lombard Road, Battersea, London, S.W.
Whiffen, W. G., Lombard Road, Battersea, London, S.W.
Whitaker, Thorp, Messrs. E. Ripley & Sons, Bradford, Yorks.
Whitaker, Thos., 22, Delaunays Road, Higher Crumpsall, Manchester.
Whittaker, C. J., Willow House, Accrington.
White, A., Horton Field, West Drayton, Middlesex.
White, A. D., Avenue House, West Drayton, Middlesex.
White, J. Campbell, 7, West George Street, Glasgow.
White, P. T., Castle Street, Saffron Hill, London, E.C.
White, S. J., 3329, Powelton Avenue, Philadelphia, Pa., U.S.A.
White, W. H., Killingworth House, Killingworth, Newcastle-on-Tyne.
Whitehouse, Enoch, 128, Coventry Road, Birmingham.
Whitelaw, A., 87, Sydney Street, Glasgow.
Whiteley, Geo., Victoria Lead Works, Burdett Road, Limehouse, E.
Whiteley, R. Lloyd, University College, Nottingham.
Whowell, F., Carr Bank, Tottington, Bury, Lancashire.
Wigg, C., Hoole Bank, Chester.
Wigg, G. L., Runcorn.
Wigg, Walter J., Old Quay Copper and Alkali Works, Runcorn, Cheshire.
Wiggin, W. W., Metchley Grange, Harborne, near Birmingham.
Wightman, C., 1, Fenchurch Avenue, London, E.C.
Wild, Eugene,
Wilde, T., Spring Place, Rhiwderin, Newport, Mon.
Wilding, S. P., 1, Queen Victoria Street, Mansion House, London, E.C.
Wiley, M. W., Billsdale House, York Road, West Hartlepool.
Wilkie, T. M., Nobel Co.'s Works, Stevenston, Ayrshire, N.B.
Wilkin, Walter H., Appold Street, Finsbury, E.C.
Wilkinson, J. B., Tong Street, Dudley Hill, Bradford, Yorks.
Will, W. Watson, Ossory Villa, Ossory Road, London, S.E.
Williams, Chas., 1, Leadenhall Street, London, E.C.
Williams, C. Greville, 4, Queen Anne's Terrace, Schubert Road, Putney, S.W.
Williams, J., 63, Warwick Gardens, Kensington, W.
Williams, J. W., 6, Giltspur Street, London, E.C.
Williams, M. W., Queenwood College, near Stockbridge, Hants.
Williams, Rowland, 9, Albert Square, Manchester.
Williams, T., 3, York Buildings, 14, Dale Street, Liverpool.
Williams, T. Howell, 10, Ascham Street, Kentish Town, N.W.

Williams, T. H., Bank House, Garston; and 2, Chapel Walks, South Castle Street, Liverpool.
Williams, Prof. W. Carleton, Firth College, and 33, Bromsgrove Road, Sheffield.
Williams, W. Collingwood, 68, Grove Street, Liverpool.
Williams, W. J., 208, State Street, Camden, N.J., U.S.A.
Williamson, J. H., Goldenhill Works, Stoke-on-Trent.
Williamson, Robt., Osborne Villas, Cheetham Hill Road, Manchester.
Wills, G. S. V., Arundel Lodge, Tulse Hill, S.W.
Wills, J. Lainson, 1, Rue Maubourguet, Bordeaux, France.
Wilmot, H. Eardley, 27, Upper Berkeley Street, London, W.
Wilputte, N. L., 13, Park Road, Ebbw Vale, Mon.
Wilson, A., Stafford.
Wilson, Alexander, Caroline Park, Granton, N.B.
Wilson, Anthony W., 20, Westcott Street, Hull.
Wilson, C. T., 16, Gordon Square, London, W.C.
Wilson, David W. R., Sinderby, Thirsk, Yorkshire.
Wilson, Frank, The Brewery, Castle Street, Long Acre, London, W.C.
Wilson, F. H., Lancashire Sulphur and Alkali Co., Limited, Widnes.
Wilson, G., jun., Cairnview, Kirkintilloch, Dumbartonshire.
Wilson, G. E., The Chemical Works, Oldbury, near Birmingham.
Wilson, Jno. Ed., Wyddrington, Edgbaston, Birmingham.
Wilson, Jno., Redheugh Chemical Works, Gateshead-on-Tyne.
Wilson, J. H., 6, Fenchurch Buildings, E.C.
Wilson, J. Millar, Box 42, Chester, Pa., U.S.A.
Wilson, R. H., Egglescliffe, Yarm-on-Tees.
Wilson, Dr. W. H., Presidency College, Madras.
Wilton, Geo., Gasworks, Silvertown, E.
Wilton, Jno., Clydesdale, Norwich Road, Forest Gate, Essex.
Wilton, Thos., Tar and Liquor Works, Gas Light and Coke Co., Beckton, E.
Windus, W., 15, Vyvyan Terrace, Clifton, Bristol.
Wingham, A., 30, Oxford Mansions, London, W.
Winser, P. J., c/o Lever Bros., Soapworks, Warrington.
Winsloe, H., Messrs. Tennant & Co., 49, Faulkner Street, Manchester.
Winstone, A. B., 7, Gray's Inn Square, London, W.C.
Winstone, E. H., 2, Victoria Mansions, Victoria Street, London, S.W.
Wire, A. P., 1, Seaton Villas, Birkbeck Road, Leytonstone, E.
Wishart, G. J., 8, Dryden Street, Edinburgh.
Witt, Dr. Otto N. E., 33, Lindenallée, Westend, Charlottenburg, Berlin.
Wolfenden, S., Wellington Terrace, Cowley Hill, St. Helens.
Womersley, P. B., Lynmead, Wanstead, Essex.
Wood, C. H., 46, Lorraine Road, Holloway, London, N.
Wood, E. T., Brinscall, Chorley, Lancashire.
Wood, Robt. B., Dalquhurn Works, Renton, N.B.
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Mar. 5th (1st Monday).—Mr. Alexander M. Chance. "The recovery of Sulphur from Alkali Waste by means of Lime Kiln Gases."

* „ 19th (3rd Monday).—Mr. John Heron. "The Polariscope and its applications to Brewing."

*April 9th (2nd Monday).—Mr. Lewis T. Wright. "The present position and prospects of the Coal Gas Industry."

May 7th (1st Monday).—Mr. W. J. Dibdin. "Standards of Light."

June 4th (1st Monday).—Messrs. B. E. R. and J. A. R. Newlands. "The mode of using Char in Sugar Refining."
Mr. Thos. T. P. Bruce Warren. "The Adulteration of Olive Oil and methods of detection."

Notice will be given in the Journal and other Scientific Papers of other Meetings and papers.

Communications to be addressed to the Local Secretary.

Meeting held Monday, February 6th, 1888.

MR. D. HOWARD IN THE CHAIR.

STUDIES IN COAL DISTILLATION.

BY LEWIS T. WRIGHT.

1. *The influence of the distillation temperature on the quality of the tar.*

The coal used in the following experiments is a caking coal of very excellent quality found on the borders of Yorkshire and Derbyshire, and is much esteemed for its gas-making properties. This coal is distinguished by the letter W.

An average sample drawn from bulk was found to contain 2·26 per cent. of moisture at 100° C, and gave, on analysis, the following numbers (dried at 100°).

C	81·92
H	5·39
N	1·28
S	1·97
O	6·88
Ash	2·56
	100·00

The practice employed in gasworks of judging of the temperature of distillation by the appearance of the retort at the end of the charge when all the gas has been expelled from the coal, has led to a very general overstatement of the temperature actually employed for the expulsion of the volatile constituents.

Pyrometrical observations were made throughout the following experiments with a Murrie pyrometer, the bulb of which was immersed in the coal during the distillation, but the results thus obtained without a complete knowledge of all the circumstances it is thought might be misleading. It would be necessary, in order to give the observations which were made at regular time intervals their full meaning, to be able to state the quantity of gas being evolved from the coal during these intervals. It was not, however. convenient to make these latter observations. Briefly, the highest average temperature observed in the time basis during a charge was 800° C, and the lowest was 600° C. Between these ranges the following experiments were made.*

The coal was distilled in a setting of seven (double) through clay retorts 18″ × 16″ × 18 ft. at various temperatures requiring from five hours to eight hours to completely gasify the volatile constituents of the charge of 2 cwt. of coal per retort of 9 feet length. Under these circumstances, the coal yielded various amounts of gas ranging from 6,600 to 12,000 cubic feet per ton, and the retorts were gasifying the volatile constituents of the coal at the rates of from 50 to 137 cubic feet per superficial foot of internal retort heating surface per 24 hours.

The following table will serve to give a far better idea of the conditions of distillation than would the pyrometrical observations.

The coal was distilled in charges of 2 cwt. at various temperatures requiring five, six, seven, and eight hours to gasify the volatile constituents of the charge. The following table gives the average results obtained :—

Duration of Charge of 2 cwts.	Gas made per foot super. of Retort Heating Surface.	Specific Gravity of Tar at 15·5° C.	Fixed Carbon in Tar.
Hours.	Cubic feet.		Per Cent.
8	50	1·084	8·69
7	62	1·103	11·92
6	91	1·149	15·53
5	133	1·204	24·67

Five samples of tar were drawn off for examination. The specific gravities and yields of gas per ton of coals on the days when the tar samples were collected were as follow :—

Specific Gravity of Tar at 15·5° C.	Coal yielding Cubic Feet per Ton.
1·086	6,600
1·102	7,200
1·140	8,900
1·154	10,162
1·206	11,700

The tars were distilled in a cast-iron experimental tar still, capable of dealing with 20 gallons at a charge. This still is fitted with all the conveniences of a large still, and is heated by a specially constructed arrangement of gas burners, which affords a perfectly controllable means of heating. The anthracene oils are driven off with steam, and the pitch is not softened, but is hard pitch not twisting at temperatures under 100° C. The various fractions made are generally crude naphtha, light oil, creosote, and anthracene oil.

There are certain inevitable losses on the distillation of tar, such as the loss of very volatile constituents of the first oils, not condensable by the ordinary cold water condenser, the coke which settles on the bottom of the still and is not run off with the pitch, and also the loss of tar by the constant use of the dipping rod.

The various results obtained will be found summarised in the following table in weight percentages :—

Specific gravity of tar	1·086	1·102	1·140	1·154	1·206
Ammonia water	1·20	1·03	1·04	1·05	0·383
Crude naphtha	9·17	9·05	3·73	3·45	0·995
Light oil	10·59	7·46	4·47	2·59	0·567
Creosote	26·45	25·83	27·29	27·33	19·449
Anthracene oil	20·32	15·57	18·13	13·77	12·289
Pitch	28·89	36·80	41·80	47·67	64·080

The crude naphthas obtained were distilled in small glass retorts with thermometer bulb placed in the liquid a quarter of an inch from the bottom of retort, according to the usual method employed for the valuation of these oils.

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* N.B.—Had the average temperatures been stated on the basis of volume of gas evolved, the difference would not have been so great. The bulk of the gas leaves the coal at about 600° C., and the gasification proceeds just so fast as the heat of that grade is poured into the coal.

There is, of course, some superheating of the gas after it leaves the coal, and this is the more as the rate of gasification is higher.

The proportions of the distillates (by volume) coming over at 120°, 140°, and 170° were noted, and the oils volatile up to 140° were redistilled and the quantity by volume related to the original crude naphtha coming over up to 100° noted. In the following table the percentages obtained at 100° are from the 140° fraction:—

Specific Gravity of Tar.	Weight percentage of Crude Naphtha.	Specific Gravity of Crude Naphtha C. 15·5°.	Volatile at			
			100°	120°	140°	170°
1·086	9·17	0·909	7¼	7½	30½	58¾
1·102	9·05	0·929	10¾	9	27¾	53¼
1·140	3·73	0·925	21¾	24	43½	65¾
1·154	3·45	0·932	17½	18½	39½	59¾
1·206	0·935	0·915	29	41	61½	79½

By calculating the fractions $\frac{}{100^{\circ}}$, $\frac{}{120^{\circ}}$, $\frac{120^{\circ}}{140^{\circ}}$, $\frac{140^{\circ}}{170^{\circ}}$, as volume percentages on the tar, the following numbers are obtained:—

Specific Gravity of Tar.	Volume percentage of Crude Naphtha.	Volume percentages of various Distillates.			
		$\frac{}{100^{\circ}}$	$\frac{}{120^{\circ}}$	$\frac{120^{\circ}}{140^{\circ}}$	$\frac{140^{\circ}}{170^{\circ}}$
1·086	10·96	0·85	0·82	2·52	3·10
1·102	10·73	1·15	0·97	2·01	2·74
1·140	4·59	1·00	1·10	0·89	1·02
1·154	4·27	0·75	0·79	0·90	0·86
1·206	1·31	0·38	0·54	0·27	0·24

The paraffins in the five samples of crude naphtha were determined by dissolving these in nitrosulphuric acid, and distilling out the paraffins from the nitro compounds. The results obtained were as follow:—

Specific Gravity of Tar.	Percentage by Volume of Crude Naphtha as Paraffins.
1·086	5·0
1·102	4·0
1·140	1·5
1·154	1·0
1·206	1·0

The five samples of light oil obtained were distilled, and fractions at 160° and 180° noted.

Specific Gravity of Tar.	Volume percentage of Light Oil.	Weight percentage of Light Oil.	Specific Gravity of Light Oil.	Volatile up to	
				160°	180°
1·086	11·70	10·50	0·975	3·5	18·5
1·102	8·11	7·16	0·978	2·5	16
1·140	5·23	4·47	0·974	6·5	32·5
1·154	3·01	2·59	0·992	3·5	21·75
1·206	0·69	0·567	0·992	20·5	42·5

The volume percentages of the $\frac{}{160^{\circ}}$ and $\frac{160^{\circ}}{180^{\circ}}$ distillates of the light oils are:—

Specific Gravity of Tar.	Volume percentages of various Distillates.	
	160°.	$\frac{160^{\circ}}{180^{\circ}}$
1·086	0·41	1·76
1·102	0·21	1·14
1·140	0·34	1·36
1·154	0·11	0·55
1·206	0·14	0·15

The specific gravities of the creosote and anthracene oils at 43° C. were:—

Specific Gravity of Tar.	Creosote.		Anthracene.	
	Percentage by Weight.	Specific Gravity.	Percentage by Weight.	Specific Gravity.
1·086	26·45	0·999	20·22	..
1·192	25·83	1·004	15·57	1·068
1·140	27·29	1·003	18·03	1·098
1·154	27·33	1·012	13·77	1·096
1·206	19·44	1·024	12·28	1·086

The tar acids in the crude naphthas, light oils, and creosotes were by volume:—

Specific Gravity of Tar.	Tar Acids.		
	Crude Naphtha.	Light Oil.	Creosote.
1·086	13	34	35
1·102	9	34	29
1·140	8	29	28
1·154	9	31	27
1·206	6	22	29

The anthracene oils were tested for anthracene by the Meister Lucius test.

PERCENTAGE of PURE ANTHRACENE by WEIGHT of TAR.

Specific Gravity of Tar.	Anthracene.
	Per Cent.
1·086	0·215
1·102	0·267
1·140	0·370
1·154	0·277
1·206	0·232

The creosotes from the 1·206 and 1·154 tar were almost solid with naphthalene. All the other tars yielded perfectly fluid creosotes.

The oils coming over at 100° from the naphthas are at their maximum in the 1·102 sp. gr. tar.

The naphthalene makes its appearance prominently in the 1·154 sp. gr. tar.

The anthracene is at its maximum in the 1·140 sp. gr. tar.

The diminution of the tar acids (phenolic bodies) and the middle oils with increase of temperature is very marked.

The following instance is a further proof that the tendency of increased temperature in the distillation of coal is to destroy preferably the light oils intermediate between the crude naphtha and creosote. A tar obtained from a mixture of Yorkshire and Derbyshire coals, distilled at high temperatures, yielded the following results:—

PERCENTAGE COMPOSITION of TAR, Specific Gravity 1·23 at 7° C. by weight.

Ammoniacal liquor ...	4·39	..	..
Crude naphtha	4·11	0·922	Sp. gr. at 15·5° C.
Light oil..............	..	..	..
Creosote	18·99	1·015	,, 43° C.
Anthracene oil........	12·14	1·094	,, 43° C.
Pitch	59·14	..	..
	98·77		

TEST of CRUDE NAPHTHA.

35·5 per cent. at	100°.
35·25 per cent. at	120°.
48·5 per cent. at	140°.
66 per cent. at	170°.

Here the ordinary light oils are practically absent, and as soon as the crude naphtha (rich as regards benzols) had come over solid naphthalene made its appearance.

The manner in which the gravity of the products in regard to boiling points increases with increased coal distillation temperature is a very prominent feature, both in these experiments and in practice.

There are in the lighter oils certain indifferent hydrocarbons other than paraffins present in notable quantity. These are not attacked by concentrated or fuming sulphuric acid in the cold, and very barely by cold concentrated nitric acid which are yet nitrifiable with warm nitrosulphuric acid. These, which may be hexahydrobenzenes, are now being investigated, together with the olefines and the tar alkaloids, &c., in the tars of various pyrogenic origin.

2. *Influence of the distillation temperature on the sulphur compounds, other than sulphuretted hydrogen, occurring in coal gas.*

It has been commonly understood amongst gas manufacturers during the last 35 years that the compounds of sulphur other than sulphuretted hydrogen, occurring in coal gas, are increased in amount as the distillation temperature of the coal rises.

The sulphur existing in crude coal gas in forms other than sulphuretted hydrogen is known to be principally in the condition of carbon bisulphide.

During the last five years I have had frequent opportunities of observing the manner in which this sulphur in forms other than sulphuretted hydrogen is increased with increased temperature of the retorts employed for distilling coal for the manufacture of illuminating gas.

In all the cases quoted the gas was made in clay retorts with the usual form of gas plant, and the extent of the heat employed may be gathered from the quantity of gas made per ton of coals, which is always stated in cubic feet corrected to the standards of 60° Fahr. and 30° Bar. (saturated with water vapour), and the sulphur, other than sulphuretted hydrogen, in the washed but otherwise unpurified gas, is stated in terms of grains per 100 cubic feet of purified gas.

First Case.

Coal W., same as that mentioned in previous article.

Loss of weight at 100° C. = 2·26 per cent. (moisture).

ANALYSIS of COAL dried at 100° C.

Carbon	81·92
Hydrogen	5·39
Sulphur	1·97
Nitrogen	1·28
Oxygen (by diff.)	6·88
Ash	2·56
	100·00

—	Coal yielding Cubic Feet per Ton.	Grains of Sulphur other than Sulphuretted Hydrogen per 100 Cubic Feet.	Sulphur other than H_2S per 100 parts by Weight of Coal.
Average of 8 experiments..	11,620	44·17	·033
,, 2 ,, ..	10,772	36·93	·025
,, 8 ,, ..	9,431	26·75	·016
,, 5 ,, ..	8,370	19·16	·010
,, 7 ,, ..	6,896	13·91	·006

Second Case.

COAL from SILKSTONE SEAM (Coal A.).

Loss of weight at 100° C. = 3·92 per cent. (moisture).

ANALYSIS of SAMPLE dried at 100° C.

Carbon	78·81
Hydrogen	6·07
Nitrogen	1·78
Sulphur	2·42
Oxygen	7·81
Ash	3·11
	100·00

—	Coal yielding Cubic Feet per Ton.	Grains of Sulphur other than H_2S per 100 Cubic Feet.	Sulphur other than H_2S per 100 parts by Weight of Coal.
Average of 5 experiments..	11,190	40·52	·029
,, 6 ,, ..	7,562	27·00	·013

Third Case.

CANNEL COAL (COAL T.).

Loss on drying at 100° C. = 6·54 per cent. (moisture).

ANALYSIS of COAL dried at 100° C.

Carbon	72·50
Hydrogen	6·02
Nitrogen	1·32
Sulphur	1·16
Oxygen	11·92
Ash	7·08
	100·00

—	Coal yielding Cubic Feet per Ton.	Grains of Sulphur other than Sulphuretted Hydrogen per 100 Cubic Feet.	Sulphur other than Sulphuretted Hydrogen per 100 parts by Weight of Coal.
Average of 6 experiments .	10,047	31·74	·020
„ 10 „ .	9,852	24·00	·015
„ 7 „ .	7.853	20·30	·010
„ 6 „ .	7.125	20·75	·009

3. *Influence of the distillation temperature on the yield of ammonia from coal.*

The results obtained from individual experiments lasting 24 hours have never been very determinate, and it appears that there is some cause other than temperature of retorts, at present unknown, operating as a disturbing element.

The averages of large numbers of experiments, however, always bring out the fact that at very low distillation temperatures the yield of ammonia is low, that a medium temperature brings out a maximum, and that beyond this, higher temperatures result in a slightly diminished production.

The following case is typical of a great many that have been obtained, and will serve to illustrate the tendency, as well as the recital of a large number of experiments.

The coal was W., analysis of which is given in (1).

Coal yielding Cubic Feet per Ton.	Ammonia per Ton of Coal.	Percentage by Weight of Coal as Ammonia.
11,620	7·411	0·331
10,162	7·894	0·352
9,431	7·504	0·335
7,512	6·391	0·285

In this case the maximum of ammonia is at a make of 10,162 cubic feet of gas per ton of coal.

DISCUSSION.

The CHAIRMAN said the meeting must feel that Mr. Wright had given a most valuable paper. The problem of the distillation of coal had quite passed out of the sweetly simple state when all that was required was a decent yield and a decent gas and no questions were asked. Now it was equally necessary to get a good yield of the most valuable of the bye-products into the bargain, and on this side of the problem there were a great number of variants, all of which had to be considered. From this point of view the paper was of the highest value. One could never be sure which of the various bye-products of coal distillation would be the particular one most valuable at any given time. First one and then another had been considered *the* one to be obtained; and it was only by having such experiments as Mr. Wright's on record that the gas engineer could be ready to produce the most favourable results as they were required.

Dr. ARMSTRONG could not lose this opportunity of expressing his appreciation of the value of Mr. Wright's labours. Mr. Wright was certainly doing a great deal towards removing the stigma which had attached for so long to those concerned in the manufacture of gas—that they did nothing to raise the standard of the manufacture by scientifically investigating their own industry. If he had correctly understood him, Mr. Wright had said, or at least implied, that the light naphtha which he got at low temperatures was rich in benzene in comparison with that obtained at higher temperatures.

Mr. WRIGHT said he had not intended to convey that impression.

Dr. ARMSTRONG, continuing, said he was not quite clear on the point, but he had understood Mr. Wright to imply that the benzene became destroyed as the temperature was raised. It was more probable that the higher members of the benzene series became simplified down to benzene; that benzene should disappear as the temperature rose was less probable. Of course much would depend on the method adopted for examining the light naphthas. It would be unsafe to trust to any but a thorough determination of the constituents, which might be effected by carefully treating them by sulphuric acid.

Dr. TIDY had listened with much satisfaction to the paper, his interest in it being increased by his knowledge of the great care which always characterised Mr. Wright's work. Referring to the question of the amount of sulphur other than sulphuretted hydrogen produced in gas in proportion to the quantity distilled, his own advice to gas companies had always been to this effect: "If you will keep your yield of gas down to 9,500 cubic feet, you will have only 25 grains of sulphur other than sulphuretted hydrogen in your gas; that being an average of the coals generally used in gas-works. But if you exceed that yield and go up to, say, 10,500, you will have something like 40 grains." It was very difficult indeed to convince gas directors (and he was in a position to speak positively on this subject) that it was to their interest never to allow the yield of gas to exceed 9,500 cubic feet, and that it was cheaper to keep the sulphur out of the gas than to take it out when once in. Their idea of a good gas-maker was simply a man who could get out the most gas. But that was nonsense! He felt very strongly on this subject; he had had a great deal to do with it, and was perfectly clear that from any point of view it was absolutely wrong that the yield of gas should ever exceed 9,500 cubic feet. He knew of course that there were objections to this course, that directors and shareholders did not like it. But if gas-makers would only keep the yield down to the limit he had given, shareholders and directors would find it to their interest in the end. He had given these figures as the results of a long series of observations and over 100 experiments on the subject. He wished that Mr. Wright had given some information as to the illuminating power of the gas obtained by these various yields. There was a singular absence of information on this point, and he would be glad if Mr. Wright could give the meeting some in his reply. Another thing he would like to know more about was the tar acids and the method by which they had been estimated. It was difficult to understand why these country oils yielded such enormous quantities of tar acids compared with town oils. Perhaps Mr. Wright would inform him—though he knew pretty well what the explanation would be.

Mr. N. H. HUMPHRYS (Salisbury) thought the temperature in the retort would depend on the weight of the coal as well as on its size, and the manner in which it was put in. This charge of 2 cwt. seemed to him to be a somewhat small charge; he would have expected the retort to take a charge of 2½ or 2¾ cwts. With regard to the sulphur compounds, he inferred that the gas was all purified in the same way, and the tests taken in the ordinary manner after it was purified. In a small works—where they made seventy or eighty million feet of gas per annum—he found no difficulty in keeping these sulphur compounds down to 14 or 15 grains.

Mr. T. S. Lacey (Beckton Gasworks) said, with regard to the sulphur compounds, Dr. Tidy seemed to imagine that it would be much easier to deal with 27 grains per 1,000 cubic feet than with 44 grains. He had had considerable experience in sulphur purification, and he thought that Mr. Wright, who had had an enormous experience in that direction, would bear him out when he said that if you could not purify 44 grains you could not purify 27—or in other words, if one could reduce the 27 grains down to 8 or 9 grains of sulphur, as one ought to be able to do with a vessel in perfect order, one ought to be able to deal quite as easily with 44 grains. If the vessel would not deal with the one quantity it would not with the other. It was no uncommon thing to hear gas-makers say that they found no difficulty at all in purifying from sulphur compounds. Those people who had the largest experience met with the most difficulties. One might have a set of vessels capable of purifying two or three million feet a day for years. But if one conducted those operations on a large scale, anomalous conditions would arise owing to circumstances over which present information gave no control. The question of the removal of these compounds was one which needed further investigation. The subject was a complex one: the nature of the sulpho-carbonates was not understood, and probably there were decompositions going on from causes not yet investigated. Certainly sulphur would behave at times in a most mysterious manner. If the reactions that went on in a lime vessel were thoroughly understood, gas-makers would be able to speak of their method of procedure with some amount of confidence. At present, they could only say that they proceeded in a certain way: if a vessel went wrong they had to throw it away and try again. There were certain cases in which a sulphur vessel would actually give off more sulphur than was going into it, though no one understood why. It was certainly not due to carbonic acid or air entering the vessel. It might be due to a rise in temperature, or some other causes not yet investigated.

Professor Dewar said he would like to ask Mr. Wright one question relating to a point of great interest. It seemed to him that the law which Mr. Wright had enunciated was approximately this: that if the quantity of gas from a given coal was doubled, the quantity of sulphur would be squared. That showed the enormous rate of the increase of sulphur in proportion to gas, the one being as 1 : 2, the other as $1 : 2_2$. As Mr. Wright had said that the increase in the yield of gas was due to increase of temperature, perhaps he could give an idea of the difference in temperature required in the case of a coal yielding 6,000 ft. to make it yield, say, 12,000 ft. That might enable them to understand the complete law governing the relations of temperature, gas, and sulphur.

Mr. Lewis T. Wright, in reply, said he would like to call Dr. Armstrong's attention to the table in his paper in which certain quantities, expressed as a percentage on the tar, were given on what he called a 100 degree distillate. If those quantities were doubled they would indicate practically the amount of 50 per cent. benzol, which could be got out of that tar; and any tar distiller, with the assistance of the paper, would have sufficient experience of oils of various kinds to gather some idea of the character of these oils. This was perhaps not quite true as regarded some of the light tars. It would be seen from the figures given how the crude naphthas from the lighter tars differed from those obtained from the tars of higher gravity; and the reason for this difference would also be seen. With regard to the estimation of the tar acids, he thought that when he told Dr. Tidy that they were estimated by his own method, no further explanation would be necessary. Nor did he feel inclined to enter into the question of high heats as against low heats. He had given the Society some information on that subject some time ago; all he could now say was that as soon as Dr. Tidy had succeeded in educating gas directors and gas committees into being low-heat men he would himself become a low-heat man; but under present conditions he must confess to being a high-heat man. This question was, however, less of a bugbear than was generally believed. With proper plant intelligently used it would be easy to deal with gas containing 60 grains of sulphur; but unfortunately such plant did not *always* exist at present. Mr. Humphrys had asked some questions about the charges. If Mr. Humphrys would look at the rate of gasification as given in the table, he would see that he had proceeded on perfectly usual grounds—that he had gone from a gasification of 133 cubic feet per foot super. of internal retort heating surface down to a very low rate, and that was sufficient for his experiments. He might some day perhaps go in for experiments on the effect of larger charges on the retorts; but probably by that time these retorts would be worn out, so that he could hardly give Mr. Humphrys any hope in that direction. He was sorry that he had not been able to conduct the temperature observations throughout on a proper basis. The temperature on a time basis—that was to say, taking a number of observations at quarter-hour intervals and calculating the arithmetical average—would be in the highest case 800° C., and in the lowest case 600° C. But he must point out that had the temperature been stated on the basis of the volume of gas evolved instead of on the time basis, the difference would not be so great. He hoped some day to put before the Society some pyrometrical observations made on a better basis than those already given.

* * *

Meeting held Monday, February 20th, 1888.

MR. THOS. TYRER IN THE CHAIR.

NOTE ON KJELDAHL'S METHOD FOR THE DETERMINATION OF NITROGEN.

BY RAPHAEL MELDOLA, F.R.S., AND E. R. MORITZ, PH.D.

In the analysis, by Kjeldahl's method, of substances containing minute quantities of nitrogen, it is of importance to employ* acid free from nitrogen, for as in such cases the nitrogenous impurity of the acid used is not infrequently in excess of the quantity contained in the substance under examination, the accuracy of the determination is naturally impaired; even with substances containing appreciable nitrogen percentages, it is on all grounds preferable to employ a nitrogen free acid than to be obliged, as is so frequently the case, to estimate the nitrogenous impurity by a series of blank experiments, and subsequently allow for this in the result. Kjeldahl's method is becoming increasingly popular, especially in laboratories where large numbers of technical analyses are performed; we have therefore thought that the following note, describing a method by which the acid may be freed from nitrogenous impurity, will not prove useless to analysts.

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* The acid usually employed by us in Kjeldahl determinations is a mixture of equal parts of ordinary and fuming sulphuric acid.

There is good reason for believing that the traces of nitrogen found in impure sulphuric acid represent small quantities of ammonium sulphate, and the plan which we now suggest is based upon the well-known decomposition of ammonia by nitrous acid:—

$$NH_3 + NO.OH = N_2 + 2\ H_2O.$$

In order to purify the sulphuric acid employed it occurred to us that a preliminary treatment with a small quantity of pure potassium or sodium nitrite would effectually destroy any ammonia that might be present, and at the same time would not interfere with the subsequent use of the acid, since, on heating, the excess of nitrous acid would be completely driven off. That this method of purifying the acid can be safely employed will be seen from the results of the experiments subjoined. We may add that about ·05 gram of potassium nitrite for 10 cc. of acid will be found sufficient, this quantity being added to the acid either hot or cold, and then heat being applied for 2¼ to 2½ hours prior to the introduction of the nitrogenous body, the analysis of which is then proceeded with as usual. By the end of the time mentioned all ammonia will have been decomposed, and oxides of nitrogen expelled. It is clearly advantageous that a minimum of nitrite should be employed in order that the excess of nitrous acid should be expelled in the least possible time. It is further obvious that the most practical method of working is to purify a considerable quantity of acid at one operation, and keep it in stock for use.

Experiments.

In the following experiments the sulphuric acid as purchased contained 0·05 per cent. of nitrogen, determined by blank experiments with the unpurified acid:—

1st Series.—Five or six blank experiments were made with the above acid after purification by nitrite. No ammonia was found in the distillate in any case.

2nd Series.—Three experiments were made by adding pure cane sugar to the purified acid and then going through the process as though a nitrogenous substance had been introduced. No ammonia was found in any case.

3rd Series.—The nitrogen in a sample of malt was determined, (*a*) with purified acid, (*b*) with unpurified acid. The first result (*a*) gave 9·27 per cent. albumen (nitrogen calculated as such); the second result (*b*) gave 9·13 per cent. albumen *after correction for the nitrogen known to be present in the acid.* The difference between the results is only 0·14 per cent. albumen = 0·02 per cent. N, thus proving that the purification of the acid by nitrite in no way interferes with the accuracy of the Kjeldahl method.

The next experiments were made in order to test the effect of introducing nitrogenous compounds of known composition into the acid:—

Exp. 1.—Digested 0·1 grm. ammonium sulphate in 10 cc. of the purified acid for 15 minutes, and then added 0·15 grm. KNO_2 (theoretical quantity required = 0·12). After heating for two hours and treating as usual, the distillate was found to contain no ammonia. This experiment gave direct proof that the ammonia could be completely eliminated by the nitrite, even when present to an extent that is never likely to be met with in any commercial sample of "pure" sulphuric acid.

Exp. 2.—Digested ·03 grm. urea with purified acid and determined nitrogen as usual:—

Calculated percentage of N	46·66
Found	46·71

Exp. 3.—Added 0·1 grm. ammonium sulphate to 10 cc. of purified acid, heated for 15 minutes, and then added 0·15 grm. KNO_2 and continued digestion for two hours. 0·03 grm. urea then added and the determination of N completed in the usual way:—

Calculated	46·66
Found	46·39 per cent. N

This experiment clearly shows that the elimination of the ammonia by means of nitrite does not impair the acid for subsequent use.

From the results submitted it follows that if the nitrogen present in sulphuric acid should be in the form of some organic impurity other than nitro-, nitroso-, azo-, or diazo- compounds, purification by the nitrite method can be equally effected, since the nitrogen would be obtained in the form of ammonia by a preliminary digestion of the acid.

We wish to thank Mr. J. C. Welch for assistance in the experiments.

THE BROMINE ABSORPTION OF MINERAL OILS.

BY JAS. B. MᶜARTHUR.

A FEW months ago I had occasion to make a comparative examination of a number of lubricating oils made from Scotch shale, with a view of finding some explanation of the great differences in viscosity or "body" which are met with in oils of equal sp. gr. made by different Scotch oil companies.

When engaged in this investigation of purely technical interest, and in endeavouring to approach the subject from its chemical and semi-scientific side, it occurred to me that the amount of bromine which the various samples of oil would combine with might throw some light on the matter. But in this, unfortunately, I was disappointed.

While failing in the immediate purpose for which the investigation was commenced, I have ventured to gather together the results, and more especially those of the critical experiments which were made on the conditions of applying the test, in the hope that they may prove of interest.

The method which, after a few preliminary trials, was adopted, is fundamentally that of Professor Mills and others, some results of which, when applied to vegetable oils, resins, &c., have already been communicated to the Glasgow Section of this Society. It was slightly modified, according to the recommendations given in Allen's Commercial Organic Analysis, 1886 edition, Vol. 2, page 331, and consists essentially in adding a known excess of bromine in bisulphide of carbon to a known weight of the oil which has also been dissolved in the same liquid. After allowing it to stand for a certain length of time, aqueous solution of iodide of potassium is added, and the free iodine liberated is titrated with standard solution of thiosulphate of soda. This last reagent was deci-normal, and the bromine in bisulphide of carbon approximately so. The latter solution was kept in a stoppered bottle, covered with black paper to exclude light, a few lumps of fused chloride of calcium being added to absorb moisture. The bisulphide of carbon used in the tests had been recently distilled after having been treated with bromine till just coloured, and it also was kept over chloride of calcium.

The titrations were done in dry stoppered bottles of about 120 ccs. capacity, a standard solution of the oil in bisulphide of carbon being generally made of 1 per cent. to 4 per cent. strength. For each titration 10 ccs. of this solution were accurately measured out from a pipette, and after diluting with bisulphide of carbon, the varying excess of bromine solution was added from a narrow graduated cylinder. After remaining in contact for a definite number of minutes, an approximately deci-normal solution of iodide of potassium was added, in quantity equal to that of the bromine solution used, and the standard thiosulphate of soda run in from a burette, with frequent shaking, the end point being finally caught with great exactitude by using starch solution as an indicator. The results were always calculated as grms. of bromine combining with 100 grms. of the oil examined.

A few preliminary titrations with mineral lubricating oil showed that some arbitrary rules, not mentioned by Allen, must be made and adhered to in order to obtain constant and comparative results, and a critical examination was at once made of the effect of varying the several conditions which might influence the result. These conditions were:—moisture, light, time, dilution, and excess of bromine used; and from the experience thus gained the following method was adopted and adhered to throughout.

Moisture and light to be rigorously excluded.

The time of bromination to be 15 minutes.

The amount of bromine added to be twice as much as is required by the oil, as indicated by a preliminary titration; that is, the excess found in the backward titration with thiosulphate solution to be equal to the amount absorbed by the oil.

Lastly, the oil solution to be diluted with bisulphide of carbon to three times the volume of the $\frac{1}{10}$ normal bromine solution about to be added, so that the total volume during bromination to be four times that of the bromine solution added.

The effect of differences in temperature during the bromination was not tried, though no doubt it would be considerable. All the experiments were carried out at the ordinary atmospheric temperature.

In "Allen" the absence of light and moisture is insisted on, but no statement is made as to the influence of varying degrees of concentration or proportions of bromine added; but these were found to affect the result to a very great extent, as will be seen from the following critical experiments:

I.—Effect of Moisture.

The average of a number of comparative titrations showed that—other conditions being the same—the addition of one to five drops of water along with the bromine increased the amount of bromine absorbed in all cases. With shale oil of about 890 sp. gr. the increase was ·3 per cent.; with intermediate oil of 868 sp. gr. the increase was ·6 per cent., and with burning oil of about ·804 sp. gr. the increase was about 2·5 per cent. With sperm oil the presence of water had no appreciable effect on the result.

II.—Effect of Light.

With 890 sp. gr. shale oil, 15 minutes' exposure in a somewhat shaded part of the room, increased the absorption from the normal 14·0 per cent. in complete darkness, to 17·3 per cent. A similar exposure to ordinary diffused daylight in a position near a window, showed 26·6 per cent. absorbed.

III.—Effect of Time.

(*a.*) Using a shale oil of 890 sp. gr., contact with proportions of bromine equal to double the absorption found (as was the general rule), for varying lengths of time, showed the following absorptions:—

	Per Cent.
½ minute contact ……	11·3 bromine absorbed.
15 minutes „ ……	14·0 „ „
1 hour „ ……	19·2 „ „
18 hours „ ……	29·6 „ „

(*b.*) Using olive oil:—

	Per Cent.
15 minutes contact……	47·0 bromine absorbed.
30 „ „ …..	47·8 „ „
2 hours „ …..	48·6 „ „
4 „ „ …..	49·4 „ „

IV.—Effect of Dilution.

(*a.*) With 890 sp. gr. shale oil, the bromination being effected in solutions having the following various degrees of dilution, expressed in volumes of the $\frac{1}{10}$ normal bromine solution absorbed:—

	Per Cent.
Diluted to 2·6 volumes, absorption…..	= 18·7
„ 4·0 „ „ …..	= 16·7
„ 6·8 „ „ …..	= 15·1
„ 8·0 „ „ …..	= 14·0
„ 10·0 „ „ …..	= 11·9

(*b.*) Using olive oil:—

	Per Cent.
Diluted to 1 volume, absorption …….	= 51·3
„ 2 volumes, „ …….	= 49·1
„ 4 „ „ …….	= 47·0
„ 8 „ „ …….	= 46·4

V.—Effect of varying excesses of Bromine.

(*a.*) Average results from 890 sp. gr. shale oil, the volume of $\frac{1}{10}$ normal bromine solution absorbed being taken as unity:—

	Per Cent.
Bromine added 1·2 volumes, absorption …	= 12·0
„ „ 1·8 „ „ …	= 13·6
„ „ 2·0 „ „ …	= 14·0
„ „ 3·4 „ „ …	= 16·1

(*b.*) Using olive oil:—

	Per Cent.
Bromine added 1·2 volumes, absorption …	= 44·9
„ „ 2·0 „ „ …	= 47·0
„ „ 3·0 „ „ …	= 49·4
„ „ 4·0 „ „ …	= 55·5

VI.—The Combined Effect of long time, little dilution, and large excess of bromine on olive oil, is shown by the following experiments, the volume of bromine solution absorbed in each case being (as in the above tables) taken as unity:—

(1.)	Total dilution ……….	6·9 volumes.
	Bromine added ………	6·3 „
	Time …………………	15 minutes.
	Absorption found…….	= 71·5 per cent.
(2.)	Total dilution ……. ..	5·0 volumes.
	Bromine added ………	4·5 „
	Time …………………	4 hours.
	Absorption found …….	= 102·1 per cent.

In some of these experiments, and more especially in the last two, the so-called "Bromine absorption" will include a considerable amount of bromine reduced to hydrobromic acid. This fact was fully kept in mind throughout the investigation, but no systematic estimation of this hydrobromic acid formed was made.

These strictly comparative experiments show the great influence which some of these conditions have on the result, and the folly of comparing results, unless the conditions under which the titrations were carried out have been identical. But by adhering strictly to the same method, the titration gives perfectly constant results. The end point of the final titration with thiosulphate solution is very distinct, and results not varying more than one or two per cent. of their value may be regularly looked for. The standard solution of bromine in bisulphide of carbon was found to keep fairly well; after standing for a fortnight in a covered bottle, with frequent use, the remainder was found to have practically the same strength.

As to the results themselves, I fear that they are, with mineral oils at least, only comparative. With mineral oils the amount of bromine absorbed should indicate the quantity, or rather the molecular proportions, of olefins present, as paraffins do not, under these conditions, combine with bromine. The very small absorption of refined paraffin wax and ozokerite, Nos. 74 and 76 of the table, show that this holds true with solid paraffins; and the sample of German white vaseline oil, No. 32, shows that liquid paraffin oils can also be made which do not combine with bromine. But the extremely slow nature of the reaction after a certain point, and the great influence of time, concentration, and mass action, show that it is difficult, if not impossible, to obtain an exact indication of the olefins present. Even with vegetable and animal oils there seems to be an uncertainty as to the true absorption, although the results, within moderate differences of conditions, show smaller variations than with mineral lubricating oil. Perhaps if the amount of bromine which had been reduced to hydrobromic acid had been estimated, the results would have been more in accordance with theory; but this was not attempted in this series of experiments. Nothing more than comparative results were required, and in all probability the absorptions given do not represent the saturation of the full quantity of olefins present. The reason for the sluggishness of the reaction, whether caused by the presence of olefins in some isomeric but less active form, or by the tendency of the reaction to stop when mono-bromo derivations have been formed, I am not in a position to state. Neither can I say whether treatment with bromine in large excess, in concentrated solutions and with long contact, would act on the olefins only, and would do so fully within reasonable time. The exhaustive treatments such as are necessary to prove this were not tried.

The results of the absorption of mineral oils, as recorded in the following table, may be calculated into percentages of olefins acted on, as follows:—The product formed is supposed to be $C_nH_{2n}Br_2$, and taking, for example, fraction V. of naphtha, No. 48 of the table, its boiling point, 180° to 186° F., shows that the average olefin molecule present will be C_6H_{11}, so the bromine absorption (41·3 per cent.) is equal to 23·5 per cent. of olefins of that average formula. With burning oil, the olefins present will probably have an average molecular formula of $C_{13}H_{26}$, and 25 per cent. absorption will correspond to 28·4 per cent. of olefins. With lubricating oil of about 890 sp. gr., an absorption of 14 per cent. will correspond to 29·5 per cent. of olefins of the average formula $C_{24}H_{48}$.

These percentages of olefins are much lower than those generally assumed to be present in these oils. The fatty oils which were tested also gave lower results than are demanded by theory, and than those found by Professor Mills, but it may be noted that the results of the mineral oils quoted by him agree very closely with those reported below.

TABLE of BROMINE ABSORPTIONS.

No.	Nature and Origin of Oil.	Sp. Gr. at 60° F.	Bromine Absorption.
	SCOTCH SHALE LUBRICATING OILS.		
1	"A." Co.'s Black Oil	960	19·6*
2	„ „ „ „	955	18·5
3	„ „ Pale Oil	924	11·2
4	„ „ „ „	908	14·5
5	„ „ „ „	890	12·9
6	„ „ „ „	886	14·7
7	"B." Co.'s Pale Oil	894	11·2
8	"C." Co.'s Pale Oil	892	12·7
9	„ „ „ „	888	12·1
10	"D." Co.'s Pale Oil............	887	17·3
11	„ „ „ „	886	16·7
12	"E." Co.'s Pale Oil............	883	14·3
13	"F." Co.'s Pale Oil............	903	12·6
14	„ „ „ „	898	12·2
15	"G." Co.'s, W. of Scotland, Pale Oil	898	11·4
16	„ „ „ „ „ „	888	12·0
17	"H." Co.'s „ „ „ „	893	15·3
	SCOTCH SHALE INTERMEDIATE OILS.		
18	"A." Co.'s Pale Oil............	863	18·3
19	„ „ „ „	868	17·4
20	"C." Co.'s Pale Oil............	873	16·3
21	„ „ „ „	865	16·5
	AMERICAN LUBRICATING OILS.		
22	From residuum, Scotch refining .	908	7·61
23	„ „ „ „ .	920	7·30
24	„ „ English „ .	912	5·90
25	„ „ „ „ .	911	5·10
26	American make, pale............	905	6·10
27	„ „ „	905	5·57
28	„ „ „	916	4·95
29	„ petroleum jelly.........	890	5·33
	RUSSIAN AND GERMAN LUBRICATING OILS.		
30	Crude Russian distillate	..	6·45
31	Vaselin oil, German..............	..	4·80
32	Water-white vaselin oil, German.	890	·008

* Each result is the mean of three or more experiments.

TABLE OF BROMINE ABSORPTIONS—*cont.*

No.	Nature and Origin of Oil.	Sp. Gr. at 60° F.	Bromine Absorption.
	SCOTCH SHALE BURNING OILS.		
33	"A." Co.'s first quality	804	24·9
34	,, ,, ,, ,, ...	802	27·2
35	,, ,, second ,, unwashed.	810	27·5
36	,, ,, ,, ,, washed ...	810	26·4
37	,, ,, ,, ,, ...	809	24·1
38	,, ,, special quality	797	26·3
39	"C." Co.'s first quality	802	24·2
40	,, ,, second ,, ...	809	23·8
41	"B." ,, first quality	800	23·8
42	"H." ,, ,, ,, ...	803	26·3
	SCOTCH SHALE NAPHTHAS.		
43	Ordinary refined naphtha	734	42·2
44	1st 10 per cent., from fractional distillation of above	699	47·4
45	2nd ,, ,, ,, ...	713	43·8
46	3rd ,, ,, ,, ...	720	42·2
47	4th ,, ,, ,, ...	726	41·7
48	5th ,, ,, ,, ...	731	41·3
49	6th ,, ,, ,, ...	735	40·6
50	7th ,, ,, ,, ...	740	40·5
51	8th ,, ,, ,, ...	745	39·8
52	9th ,, ,, ,, ...	753	38·8
53	10th ,, (residue)	789	34·2

No.	Nature of Oil.	Sp. Gr. at 60° F.	Bromine Absorption.
	ANIMAL AND VEGETABLE OILS.		
54	Refined rape oil..................	914	50·2
55	Air-blown rape oil	915	28·5
56	Cotton seed oil....................	922	40·2
57	Air-blown cotton seed oil	895	31·4
58	Olive oil	917	47·0
59	Castor oil	961	49·0
60	Raw linseed oil	932	65·0
61	,, ,, ,, ...	932	65·3
62	Boiled linseed oil	..	63·2
63	,, ,, ,, ...	..	66·3
64	Palm oil	..	27·8
65	Sperm oil	878	45·1
66	Whale oil	..	40·0
67	Butter fat........................	..	22·2
68	Tallow	..	25·5
69	Pressed stearic acid..............	..	5·9

No.	Nature of Wax.	M. P., F°.	Bromine Absorption.
	PARAFFIN WAX, &c.		
70	Soft semi-refined wax	92°	3·60
71	,, ,, ,, ...	103	3·20
72	Semi-refined wax	120	1·30
73	,, ,, ...	125	1·00
74	Refined wax	125	0·73
75	Crude ozokerite..................	142	1·41
76	Purified ozokerite................	140	0·54

THE OXIDATION OF ESSENTIAL OILS.—PART VI.

NOTE ON THE ATMOSPHERIC OXIDATION OF TURPENTINE, CAMPHOR OIL, AND OIL OF SUNFLOWER.

BY C. T. KINGZETT, F.I.C., F.C.S.

CONSIDERABLE attention has been paid during the last few years to the study of camphor oil, which has found its way into commerce, to some extent, as a substitute for turpentine in the manufacture of paints and varnishes.

H. Yoshida has made a chemical examination* of this oil, and by the fractional distillation of a sample which was five years old, and analyses of the various distillates, he arrived at the conclusion that the specimen under examination was composed as follows:—

Terebenthene	....b.p. 156°.........about	7	Per Cent.
Citrene	...........b.p. 172° to 173°..about	20	,,
Camphor	.... 205°.........about	23	,,
Camphorogenol	..b.p. 212° to 213°..about	50	,,

The terebenthene appeared to be identical with the terebenthene of French turpentine, and the citrene is probably identical with citrene from lemon oil. Yoshida thus gave quantitative expression to the fact which was previously known, namely, that camphor oil consists of camphor dissolved in a mixture of terpenes, and he identified the constituent hydrocarbons.

Much of the camphor contained in camphor oil may be abstracted by suitable means, such as freezing. The chief interest, however, of this investigation attaches to the substance which is termed "camphorogenol," inasmuch as Yoshida arrived at the conclusion that it constitutes the source from which camphor itself is produced. The evidence upon which he based this conclusion may be stated as follows: if camphor oil be freed from camphor, as far as possible, by freezing, and afterwards heated to about 212° to 220° C., it yields, upon further freezing, a further amount of camphor. The analysis of camphorogenol furnished figures agreeing very well with the theoretical requirements of the formula $C_{10}H_{18}O_2$, and as the conversion into camphor was always accompanied with the elimination of a small quantity of water, he concluded that the decomposition might be expressed by this equation:—

$$C_{10}H_{18}O_2 = C_{10}H_{16}O + H_2O.$$

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* J. Chem. Soc. Trans. 1885, p. 779.

By the action of energetic oxidants, like nitric and chromic acids, camphorogenol is resolved first into camphor and then finally into a number of acids, the chief of which is camphoric acid. The change of camphorogenol into camphor is always attended with the polymerization of a part of the substance into a dark yellow oil.

The production of camphor, which goes on in camphor oil by ageing, or by the passage of air or oxygen into it in a heated condition, is therefore assumed to be brought about in this way: the terpenes are oxidised and hydrated simultaneously, as represented by the following equation:—

$$C_{10}H_{16} + H_2O + O = C_{10}H_{18}O_2.$$

and the camphorogenol thus formed is, in its turn, resolved into camphor and water as follows:—

$$C_{10}H_{18}O_2 = C_{10}H_{16}O + H_2O.$$

Interesting as are these results, they can hardly be regarded as conclusive evidence respecting the mode of production of camphor, since, as all the operations were conducted in the free presence of air (which was observed by Yoshida to favour the change) it is possible that camphor was produced by the direct oxidation of the terpenes.

Some years ago, I subjected samples of camphor oil to oxidation by air in the presence of water, with the view of ascertaining if the products are identical with those which are furnished by terpenes generally, and found that peroxide of hydrogen was freely produced. This result was in itself a proof that the oil contained one or more terpenes, because I had previously proved that all terpenes yield peroxide of hydrogen when they are oxidised in this manner. Since then, I have on several occasions employed camphor oil on a large scale in manufacturing operations, as a substitute for ordinary turpentine or eucalyptus oil in my process of preparing disinfectants, with fairly satisfactory results. In one experiment there was obtained from 120 gallons of the oil during 52 hours' oxidation, a quantity of above 1,000 grms. of peroxide of hydrogen, its capability of producing that substance remaining, of course, anything but exhausted. In another trial, a quantity of 320 gallons, during a similar period, yielded 3,379 grms. of peroxide of hydrogen (calculated as pure H_2O_2), the density of the oil having increased to 925. This partially oxidised oil yielded a further quantity of H_2O_2 nearly equal in amount to that originally produced during a further period of oxidation, but after that time, although it still continued to yield the peroxide in diminished amount, the oxidation proceeded much more slowly than happens with turpentine oil at that stage.

In another and more recent trial, in which 110 gals. of camphor oil was submitted to oxidation during 100 hours, 74 gals. of partially oxidised oil of sp. gr. 925 resulted, and this, upon further oxidation during 246 hours, yielded 62 gallons of oxidised oil of sp. gr. 950. A sample of this oxidised oil is now produced.

The formation of peroxide of hydrogen in this process necessitates the previous production of the compound which I have termed camphoric peroxide, which, unless it be identical in composition with Yoshida's camphorogenol, complicates the chemistry of the oxidation of camphor oil much beyond that gentleman's expressed views. If the two substances were identical, the formation of H_2O_2 might be assumed to result from some such reaction as is expressed by the following equation:—

$$C_{10}H_{18}O_2 + H_2O = H_2O_2 + C_{10}H_{18}O,$$

and if that happened it might be supposed that from the resulting substance $C_{10}H_{18}O$ (the formula of Borneol camphor) successive quantities of camphorogenol could be produced by continued oxidation. This hypothesis would not be prohibitive of the assumed direct production of ordinary camphor from camphorogenol by heating.

It would be therefore of much interest, if Yoshida would examine his camphorogenol in order to ascertain if peroxide of hydrogen can be produced therefrom by mere contact with water. There are many weighty reasons, however, for concluding that the peroxide of hydrogen results from a chemical reaction of water upon a more highly oxidised substance—possibly $C_{10}H_{18}O_4$,—for I have shown that while in the atmospheric oxidation of turpentine, the H_2O_2 is accompanied in the aqueous solution with a very small quantity of camphoric acid* ($C_{10}H_{16}O_4$) there is found a very much larger quantity of a glucose-like bitter substance, giving upon analysis figures supporting the formula $C_{10}H_{18}O_3$.† The following reaction may possibly represent the chemical change which furnishes peroxide of hydrogen and the substance $C_{10}H_{18}O_3$, and which are found together in the aqueous solution accompanying the oxidation of turpentine oil when conducted in the presence of water:—

$$C_{10}H_{18}O_4 + H_2O = C_{10}H_{18}O_3 + H_2O_2.$$

The further possibility remains that Yoshida's camphorogenol furnishes my camphoric peroxide by further oxidation, thus:—

$$C_{10}H_{18}O_2 + O_2 = C_{10}H_{18}O_4.$$

It will be seen that Yoshida has assigned to his camphorogenol the formula which I originally suggested‡ might represent the constitution of the organic peroxide which is formed by the atmospheric oxidation of terpenes, namely $C_{10}H_{18}O_2$, or a mono-hydrated terpene oxide ($C_{10}H_{16}O$, H_2O)—the substance which was first obtained by Soret. This view, however, I subsequently abandoned, and adopted the formula $C_{10}H_{14}O_4$. In so doing I was influenced to a great extent by the researches of Brodie, who had claimed to have established the existence of a substance which he termed *camphoric peroxide*, and which he represented by that formula. Since then I have shown§ that Brodie was in error, and that such a substance is not formed in the reaction which he investigated. I therefore feel quite at liberty to change my own views as to the constitution of the product in which I am more particularly interested, and am now inclined to adopt either the formula $C_{10}H_{18}O_4$ or $C_{10}H_{16}O_3$, more particularly since by their use the production of the substance $C_{10}H_{18}O_3$ and peroxide of hydrogen is readily explained. I take the choice because further investigation may show the substance $C_{10}H_{18}O_3$ to be really $C_{10}H_{16}O_2$ H_2O, and in that case its production simultaneously with that of H_2O_2 from the active peroxide when placed in contact with water could be represented as follows:—

$$C_{10}H_{16}O_3 + H_2O = C_{10}H_{16}O_2 + H_2O_2,$$

and the formation of the peroxide itself could be represented by the equation

$$C_{10}H_{16} + O_3 = C_{10}H_{16}O_3.$$

It will be observed that the only difference between $C_{10}H_{16}O_3$ and $C_{10}H_{18}O_4$ is that of a molecule of water, and I am inclined to give the preference to $C_{10}H_{16}O_3$, because water is not essential to the production of the peroxide.

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* J. Chem. Soc. Trans., ser. 2, Vol. XIII., p. 210.

† Chem. News, Vol. 39, p. 279.

‡ J. Chem. Soc., ser. 2, Vol. XII., p. 511.

§ J. Chem. Soc. Trans. 1884, pp. 93-99.

I have here a sample of oxidised turpentine which contains a large amount of the peroxide, and which has been obtained by the dry oxidation of turpentine by my process, and with this sample we will demonstrate the production of peroxide of hydrogen by shaking some up with water and testing the water in the usual way. I will also make the same experiment with oxidised camphor oil.

I also submit samples of what I have termed *soluble camphor* ($C_{10}H_{18}O_3$) obtained respectively from turpentine and camphor oil, while another specimen is that of the same substance but obtained by agitating the oxidised dry turpentine at a subsequent stage with water.

The quantity of soluble camphor ($C_{10}H_{18}O_3$) which is obtained in this way is proportionate to the amount of peroxide of hydrogen which is also obtained, and both vary with the constitution of the terpenes which are subjected to the process of oxidation. While in some instances, therefore, an aqueous solution is obtained which contains not more than 2 to 4 per cent. of the soluble camphor, and from 1 to 2 volumes of peroxide of hydrogen, in other cases a solution results containing as much as 7½ per cent., by weight in volume, of soluble camphor, and 3 to 4 volumes of peroxide of hydrogen.

The aqueous solution of this composition which results from the oxidation of turpentine in the presence of water always gives the reactions of thymol, and when it is subjected to distillation it yields an oily distillate with an odour resembling somewhat that of thymol, but which has not yet been subjected to analysis. Similarly, it yields an oil, although of a darker colour, which slowly separates from the solution when it is admixed with a large proportion of dilute (1 to 5) sulphuric acid; but whether this substance is identical with that which is furnished by distillation I have not yet ascertained.

In concluding this part of my subject I would point out a possible relation which may exist between the soluble camphor ($C_{10}H_{18}O_3$) and thymol. If we assume that the soluble camphor contains a molecule of attached water, its real formula becomes $C_{10}H_{16}O_2$, which in its turn contains the elements of one molecule of water in addition to those which are representative of thymol ($C_{10}H_{14}O$).

Although I have made many attempts, I have not succeeded in obtaining from this soluble camphor ordinary camphor. Further investigation is required before the chemistry of the air oxidation of terpenes can be discussed with assurance.

This soluble camphor furnishes an orange-yellow product when treated with strong nitric acid, and once or twice during its distillation I have observed evidences of the production of a crystalline substance.

In conclusion, I wish to direct attention, very briefly, to the importance of these matters in connexion with the subject of natural sanitation. In my work on "Nature's Hygiene"* I have given a careful account of the immense influences on climate which are exercised by pine and eucalyptus forests wherever they exist. In the case of Australia, Mr. Bosisto has calculated that in New South Wales and South Australia there may be held no less than 968,887,440,000 gallons of eucalyptus oil at one and the same moment in the leaves of trees more or less massed together and occupying a belt of country over which the hot winds blow. Accepting this estimate, I have calculated that this quantity of oil can, and must, give rise by its oxidation in the atmosphere to the production of 92,785,023 tons of peroxide of hydrogen, and 507,587,945 tons of soluble camphor ($C_{10}H_{18}O_3$), not to mention the other products of oxidation; and when one reflects upon the powerful oxidising property of the one substance and the intense antiseptic characters of the other product, it is easy to understand how large an influence for good they must exercise upon the sanitary condition of the country in which they are generated. Now that the chemistry of camphor oil has been studied, and that I have shown it to be equally effective with eucalyptus and pine oils in the production of the substances just referred to, it necessarily follows that within the limits of the existence of camphor forests they may be regarded as constituting a natural sanitary agent of the same high order as forests of pine and eucalyptus trees. This subject will be dealt with in further detail in the new edition of my book which is now in the press.

The note I have to communicate respecting sunflower oil is simply to the effect that a specimen with which I experimented some time ago did not yield any peroxide of hydrogen when oxidised by my process, so I conclude that it did not contain any terpene. I am not sure, however, whether this sample was produced from the seeds of the sunflower or from the leaves.

Newcastle Section.

Chairman: P. P. Bedson.
Vice-Chairman: J. C. Stevenson, M.P.
Committee:

Alfred Allhusen.
G. T. France.
John Glover.
John Morrison.
John Pattinson.
J. B. Payne.
H. R. Procter.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
C. T. Richardson.
T. W. Stuart.

Local Secretary and Treasurer:
J. T. Dunn, The School, Gateshead.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting in the College of Science, February 8th, 1888.

DR. BEDSON IN THE CHAIR.

MISCELLANEOUS COMMUNICATIONS.

Mr. T. W. Lovibond exhibited an apparatus, the invention of Mr. J. W. Lovibond, for matching and registering the tints of coloured fluids. The instrument consists of a long narrow box, with a partition down the middle of its length. A hole at one end serves as an eye-piece for viewing the divided field produced by the partition. One half of the field is occupied by the fluid under observation, in a column of any required length, and on the other side coloured glasses are dropped into grooves through slits in the top of the box, till the light passing through them matches the tint of the fluid.

The Chairman said he proposed to use it in estimating the organic matter in air by a modification of Carnelley's permanganate method, but had as yet found difficulty in matching the permanganate tints, except by combinations of glasses of quite different colours.

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* Bailliere and Company, 2nd edition, chap. 13.

Mr. B. S. Proctor described a method he had once used for estimating the purity of saffron by matching it against bichromate solution, and suggested the application of the tintometer in this and similar cases.

DISCUSSION ON MR. PEILE'S PAPER ON THE SHOTLEY SPA WATER.

Mr. J. H. Payne furnished the following quotation from Squire's "Companion to the British Pharmacopœia," 8th edition, 1871 :—

"Spas of Europe.—In Britain.—Shotley (Northumberland), saline, chalybeate ; contains 20 grs. in 20 oz., chiefly chloride of sodium, with 1 gr. oxide of iron and 4½ grs. chloride of calcium. Not much frequented."

He commented on the difference of Mr. Peile's analysis from this and from another old analysis which Mr. Peile had quoted, especially on the fact that Mr. Peile had found barium in the water.

Mr. John Pattinson also considered the presence of barium a feature of interest in a water used for medicinal purposes.

Mr. B. S. Proctor stated that barium chloride was occasionally given in doses larger than could well have been taken by drinking the water. He suggested that the differences among the analyses probably arose from changes in the composition of the water.

The Chairman could confirm Mr. Peile's analysis in its essential points, having had the water analysed in the College laboratory. He agreed with Mr. Proctor as to the probability of the water changing through time.

A SIMPLIFIED CHROMOMETER FOR COMPARISON OF MODERATELY DEEP TINTS.

BY C. H. RIDSDALE, F.I.C., F.C.S.

In November 1886 I had the honour of reading a paper on "A new form of apparatus for colour tests, and notes on Stead's alkali method for estimating low percentages of carbon," before this Society. In it I described my rotary "chromometer," by which solutions of very faint tint could be compared, and the depth of that tint measured, the indications so obtained being utilised, amongst other things, for the determination of carbon in very soft steel.

During the informal discussion which followed, a gentleman asked whether the apparatus could be used for the determination of carbon in ordinary soft steel, containing from ·1 to ·12 per cent. of that element, and I pointed out that this would give too strong a tint unless diluted considerably. I have, however, since then devised the present apparatus, which is very much simpler, and may be used for comparison of deeper tints than can with advantage be compared in the rotary chromometer.

Description of apparatus.—Three glass comparison tubes of equal bore throughout, graduated to 15 main divisions, each of which is sub-divided into fifths, hang as near each other as possible through a perforated strip of wood. This, in turn, is supported at each end by a thick glass rod, terminating at its lower extremity in the base board. The centre tube, which can be used for the standard, is sealed at the bottom, whilst the two side tubes have a $\frac{3}{16}$th hole in them. In all three is a small enamel glass cylinder, the top of which is the zero line, and the graduation continues upwards.

Clamped on the two glass rods which support the top piece is a grip arrangement, holding three ordinary test tubes, which slide easily over the graduated comparison tubes, and the tops of which, when in their lowest position, are about up to the zero mark of the graduated tubes. The grip arrangement consists of three fixed jaws, against which are held, by indiarubber bands, three moveable jaws pivoted on a horizontal axis, the jaws being hollowed so as to grip the test tube sliding in them. They serve to keep the sliding tube at any height to which it may be raised.

The process of comparison is as follows :—Fill the centre tube up to 10 divisions (or any other number preferred) with solution of standard depth of tint, pour the solution to be compared into one of the side tubes, when it will at once run through the hole in the bottom into the test tube beneath, and when this is nearly full, look right down the two comparison tubes and raise the test tube beneath, containing the solution to be compared (keeping the hand below the grip all the while so that it does not cast a shadow on the liquid in the tubes), until the depth of tint is equal to that of the standard.

Then read off the number of divisions required, and calculate :—

$$\frac{\text{Number div. stan.} \times \text{per cent. stan.}}{\text{Number div. sol. to be tested}} = \text{per cent. sought.}$$

Then pull out the comparison tube and the test tube, rinse and return to their places, put in the next solution to be tested, and so on.

The centre sliding tube should be raised to the same height as the side one, so as to equalise any effect which the double thickness of glass may have upon the tint.

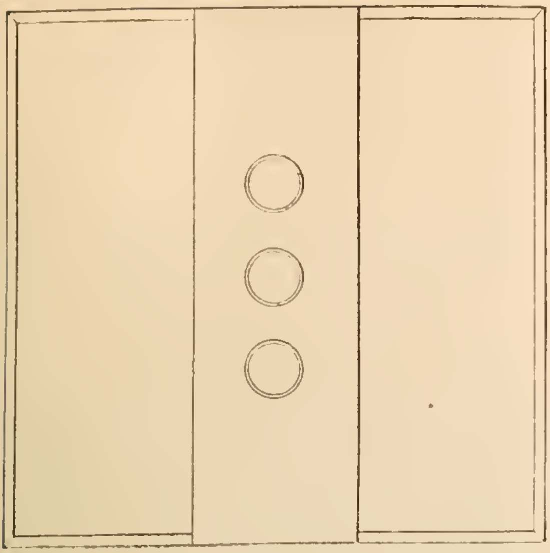
It is of course a matter of indifference whether a measured quantity of *standard* solution be put into the centre tube, and the height of the column of solution of unknown strength adjusted till it is the same tint, or a measured quantity of the *unknown* solution put in the centre tube, and the standard solution adjusted ; indeed where the solutions to be tested vary a good deal in tint I have used a perforated tube for the centre also, and adjusted *both* columns, using fewer divisions of standard for the weaker and more for the deeper tints, this being, of course, on account of the comparatively small number of divisions on the tubes.

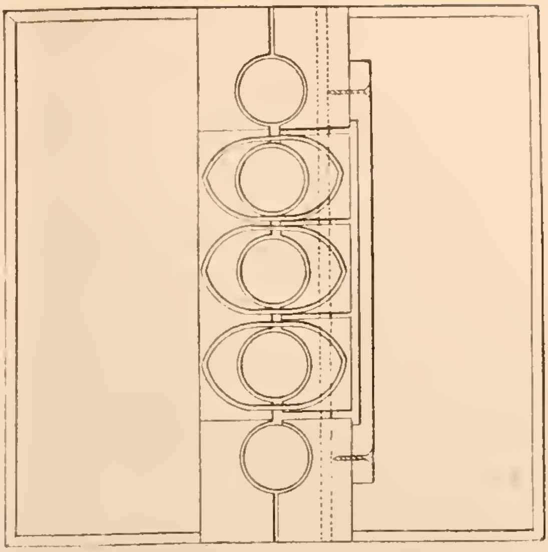
If a measured quantity of the *solution to be tested*, say 10 divisions, be taken, and the height of the column of *solution of known strength* (the standard) adjusted, then if the standard contains ·10 per cent. of the body being estimated, the percentage of it contained in the sample being tested can be read off *direct* from the scale.

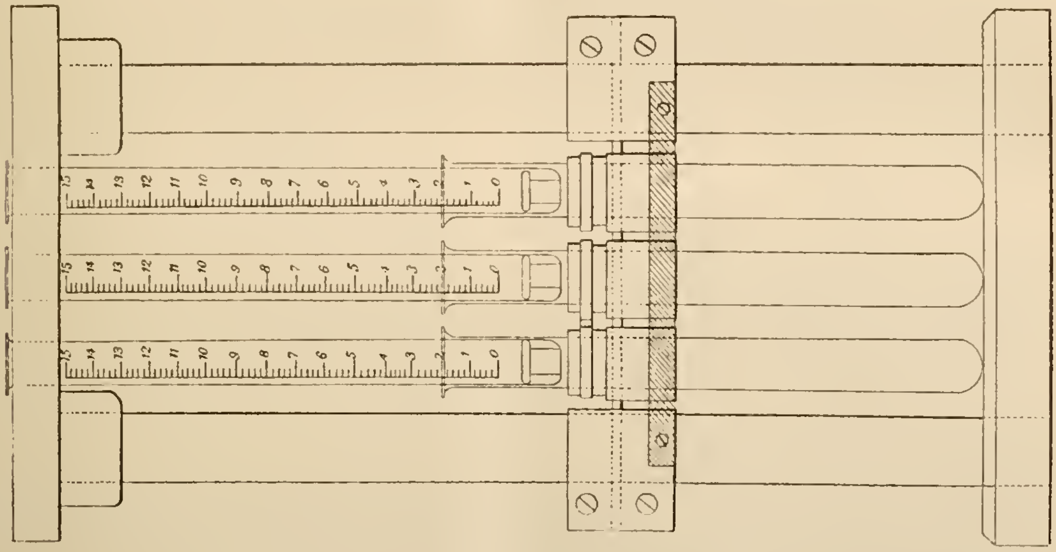
For instance, if we are estimating carbon in soft steel, with a standard containing ·10 per cent. of this body, and we find that 10 divisions solution of unknown strength require 8 divisions solution of standard, then the sample being tested contains ·08 per cent. C.

If 12 divisions solution of standard were required, the sample would contain ·12 per cent. C., each division being equal to ·01 per cent.

The same of course applies to the estimation of copper in steel, pig-iron, ferromanganese, &c., to ammonia in water by Nessler's test, or to any other



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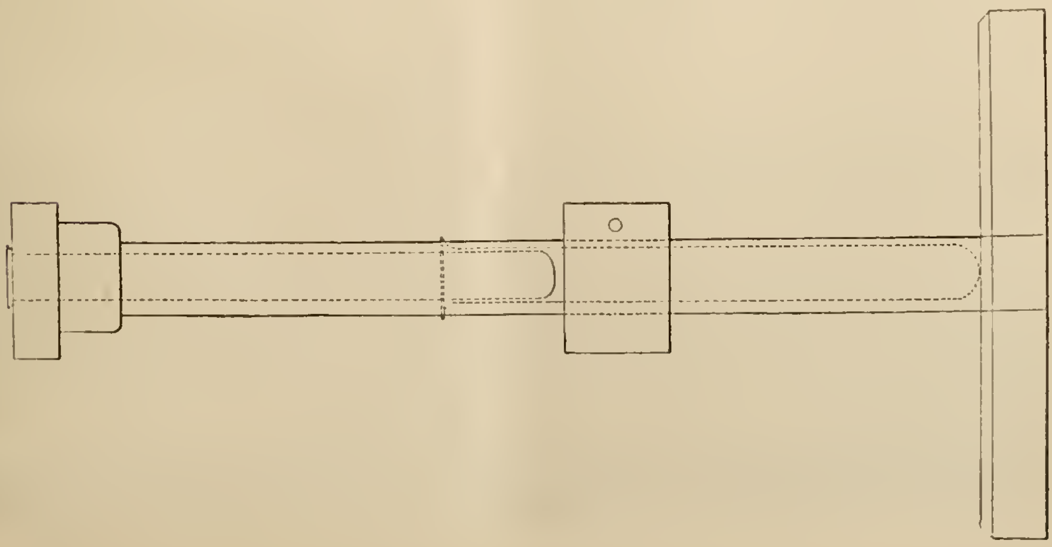

colorimetric estimations, to all of which it is equally applicable.

In short, to read the percentage straight off, all that is necessary is to use as many divisions of the solution of unknown strength as there are hundredths per cent. of the body to be estimated in the standard. Thus, if our standard steel contained ·12 per cent. C. we should use 12 divisions of the solution of unknown strength.

If the hundredths per cent. of constituent in the standard be some number higher than the graduations of the apparatus show, as many divisions solution of unknown strength can be used as will when multiplied by 2, 3, 4, &c. give the hundredths per cent. contained, *e.g.*, in testing rail steel we use a standard with ·3 or ·4 per cent. C., and still take 10 divisions solution of unknown strength and multiply the divisions standard required by 3 or 4. In cases where the particular class of work done renders it desirable, the graduations could of course be altered to suit requirements.

It will be seen that there is *no* pumping of solutions as in the other chromometer, and indeed nothing that can get out of order.

I have used this apparatus chiefly for testing carbon in steel by the "Eggertz" colour method, and proceed as follows:—Weigh off ·1 to ·2 grams drillings into a test tube 6 inches by $\frac{5}{16}$th, add dilute nitric acid 1·20° sp. gr. quantity as shown below, put into boiling water, shaking the tube every minute or so till the steel is dissolved, then make up with cold water to the bulk indicated below.

Weigh off.	For Steel containing probably Carbon.	Dissolve in cc. HNO_3 1·20° Sp. Gr.	Make up with cold water to a bulk of
	Per Cent.		Cc.
·1 or ·2 grms.	Up to ·08	1¼	10
		2½	20
·1 grm.	·08 to ·19	1½	20
·1 „	·20 to ·30	1¾	40
·1 „	·31 to ·40	2	80

Compare these solutions with those of standards of about the same content treated similarly. To facilitate the operation of "making up" for ordinary soft steel up to ·19 per cent. C., test tubes can be used which have a file mark to show how high to fill them for 10 and 20 cc. They then only need to be shaken, and the solution poured into the apparatus. If all of the same gauge they could, if preferred, be simply inserted in the grip, but it is questionable whether this saves any time, and it only restricts the use of ordinary test tubes. One advantage of using this apparatus for comparison instead of the ordinary method of adding water drop by drop to the solution of unknown strength till it is sufficiently diluted is, that in the latter case too much water may be added, thus giving too high a result, and if this is done the extent to which it has been over diluted can only be guessed, and as every drop may make a difference of ·01 to ·02 per cent., the result is often seriously invalidated, whereas in the apparatus the tints can be adjusted until they are absolutely the same, the readings taken, and then anyone else can check the comparison. Further, all the solutions can be easily kept till it is seen whether any of the results appear doubtful.

Again, steels dissolved in dilute nitric acid usually show a greenish yellow tint, due to the nitrate of iron, but which, when diluted considerably, disappears. This tint interferes very much with the ordinary "Eggertz" method when the sample being tested contains under ·1 per cent. C., and it becomes practically impossible to distinguish the amount of carbon with any degree of certainty by that method when the percentage is below ·07.

Our younger assistants almost always fail to discriminate between it and a real carbon tint, and in consequence add too much water, so that if they come unexpectedly upon a sample containing ·08 per cent. they probably show the result too high.

With the apparatus, however, the nitrate of iron tint is destroyed because the solutions are diluted to an extent which would be inadmissible by the ordinary modification of Eggertz' method.

A large number of samples containing from ·07 to ·09 per cent. carbon showed this amount *when done very carefully* by the ordinary method, *making due allowance for the nitrate of iron tint*, and these results also agree with those given by the apparatus, but when tested by junior assistants showed from ·02 to ·03 per cent. higher, being over diluted to that extent. Indeed so completely is the difficulty hitherto caused by the nitrate of iron tint overcome, that the carbon in even *extra* soft steel can be very fairly estimated by this apparatus.

The following samples, all of which by the ordinary Eggertz method showed ·05 to ·10 per cent. C. when tested as above, gave the appended results:—

No.	C. content by Alkali Method and Rotary Chromometer.	C. by Method described and new Deep Tint Chromometer.
	Per Cent.	Per Cent.
1	·042	·043
2	·040	·040
3	·037	·041
4	·035	·041
5	·045	·046
6	·049	·042
7	·040	·040
8	·020	·021

Thus it will be seen that though perhaps not quite as accurate for minute traces of carbon as the ordinary rotary chromometer in conjunction with Stead's alkali method, yet it yields results which are near enough for most purposes, thus showing approximately right results when samples containing a very low percentage of carbon are come upon unexpectedly, and where the ordinary Eggertz method would fail entirely.

As regards *rapidity*, when the apparatus is clean it takes no longer to make the comparison this way than by the ordinary Eggertz method, and when doing a quantity there is the advantage that one assistant can make up to the required quantity and another test them, so that they can be got out in remarkably little time. The making up and testing by the *same* person of the eight samples for which results are just given only took 12 minutes, of which time the greater part was spent in making up and shaking, the comparison only taking two or three minutes. The total time from putting on to dissolve to the finishing of the last result was 17 minutes, whereas the time by the alkali method and rotary chromometer would have been for the eight samples 40 to 45 minutes.

In the matter of *accuracy*, besides the examples already cited I have checked the results repeatedly against standards which have been analysed by several chemists by the ordinary Eggertz colour method, Stead's alkali method, and by combustion in oxygen, and have found it thoroughly reliable, and a great assistance in obtaining accurate results rapidly.

NOTES ON DETERMINATION OF VANADIUM IN THE PRESENCE OF CHROMIUM, ALUMINIUM, AND PHOSPHORUS.

BY C. H. RIDSDALE, F.I.C., F.C.S.

It is a pretty well-known fact that the converter slag in the Basic-Bessemer process not infrequently contains small quantities of vanadium. This is of course derived from the cinder and clay ironstones of which one or other variety is generally used for the manufacture of the pig. Ever since the North-Eastern Steel Company's works commenced in 1883, I have known that there was vanadium present in the slag produced by them, but as I had no good method, and as my time was fully occupied with more pressing duties, I did not give much attention to the subject.

Early in the spring of 1886, however, in the course of some investigations on its constitution, and analyses of crystals found in it, I felt it would be absolutely necessary to be able to accurately determine the amount of vanadium present, and I accordingly commenced to use several of the published methods. As I had only a small quantity to work upon, I felt it to be essential to get a thoroughly dependable method before attempting the analysis of the crystals themselves, and I therefore determined to thoroughly investigate all the best ones.

The first one I took up was one I had given to me as being used at Creusot, and which appears to be a modification of Berzelius' method,[*] and is as follows:—Dissolve the slag in HCl, oxidise with HNO_3, precipitate the Fe, Cr, Al, part of the Ca, and the V, with NH_3 and $NH_4C_2H_3O_2$. Dry, roast at a low red heat, grind, dissolve out the V_2O_5 with NH_3, saturate the NH_3 solution with NH_4Cl, and add about four times its bulk of C_2H_6O, filter, wash with C_2H_6O, dry and burn off, fuse, weigh the resulting V_2O_5.

I very soon found, however, that this method was not reliable, as there was in the first place a difficulty in extracting all the V_2O_5 from the precipitate with NH_3; and, secondly, that the NH_4Cl did *not* precipitate all the V_2O_5, but a considerable portion remained in the filtrate, or re-dissolved on washing, besides which, some is carried off on ignition.[†] On the other hand, if the filtrate was evaporated to get the contained V_2O_5, or if the extract with NH_3 was evaporated at once, instead of first precipitating with NH_4Cl, the residue after calcination contained a certain amount of CaO, and also some Al_2O_3, which is slightly soluble in NH_3.[‡]

Then the V_2O_5 after fusion was so insoluble in NH_3 that it was impossible to re-dissolve it, and filter or remove by decantation completely from the earthy residue, and indeed, before the V_2O_5 was nearly all dissolved part of the Al_2O_3 would again pass into solution.

Neither was it possible with weak HNO_3 or other acid to dissolve the earthy matter, and leave the fused V_2O_5 insoluble, as *some* would always redissolve, though it was very difficult to dissolve it *completely* in any acid.

After repeated trial of many modifications of this process, I was compelled to abandon it, as the results were sometimes high, sometimes low, and never agreed twice running.

I then turned my attention to the methods in which V_2O_5 is precipitated from an alkaline vanadate as a Pb or Ba salt, which is subsequently decomposed by HNO_3, and H_2SO_4 added, thus precipitating the Pb or Ba as sulphates and liberating the V_2O_5.

Unfortunately in this method, however, CrO_3 and P_2O_5 are also precipitated, and liberated by the HNO_3 and H_2SO_4, so that the resulting solution also contains them. I tried a large number of experiments to see if there was not some way in which the V salt acted differently from the P and Cr salts, but I could find nothing in which the V salt was *completely* soluble or insoluble, in which the other salts were not also partly so.

Rose (p. 316) says if the three lead salts of As_2O_3, P_2O_5, and V_2O_5 are powdered, and boiled several times with Na_2CO_3, and evaporated several times to dryness, that water afterwards dissolves out the P_2O_5 and As_2O_3 salts, and leaves the V_2O_5 salt together with $PbCO_3$ insoluble. This I have never found to take place *completely*, besides it does not cover the separation of CrO_3, which also interferes greatly with the accurate estimation of P_2O_5 and V_2O_5, its salt being partly soluble and partly insoluble.

If, therefore, before precipitating with Pb or Ba we try first to separate the P_2O_5 and CrO_3 from the V_2O_5, we find that:—

1.—P_2O_5 separated as *phospho-molybdate of ammonia.*
    a. Brings down some of the V_2O_5, enough to spoil the V_2O_5 estimation but not that of the P_2O_5.
    b. The excess of molybdate of ammonia present is also precipitated by Pb or Ba salts and decomposed by HNO_3 and H_2SO_4, and thus appears as V_2O_5.
2.—P_2O_5 separated as *ammonia-phosphate of magnesia* carries down a decided quantity of V_2O_5.
3.—CrO_3 when precipitated as hydrated sesquioxide carries down V_2O_5.

EFFECT OF V_2O_5 ON PRECIPITATION OF P_2O_5 AS PHOSPHO-MOLYBDATE OF AMMONIA.

Quantity of liquid used; that suitable for precipitation of P_2O_5 present.

V_2O_5 up to 12·5 per cent. of the weight of P_2O_5 present.

P_2O_5 precipitate rather an orange shade, contained trace of V_2O_5. Results practically identical with those obtained from portions similarly treated in solutions containing *no* V_2O_5.

Average of four results, above amount V_2O_5 added, 20·27 per cent. P_2O_5.

Average of four results, no V_2O_5 present, 20·20 per cent. P_2O_5.

The results did not vary more than ·05 per cent. amid themselves.

V_2O_5 up to 37·5 per cent. of the weight of P_2O_5 present.

P_2O_5 precipitate decided orange, contained strong trace of V_2O_5.

Results rather irregular, and tendency to come *lower* than in absence of V_2O_5.

Average of four results, above amount V_2O_5 added, 19·71 per cent. P_2O_5.

V_2O_5 up to 75 per cent. of the weight of P_2O_5 present.

P_2O_5 precipitate orange red, contained decided quantity of V_2O_5.

Results irregular, on the whole lower than in absence of V_2O_5, still if done with great care fairly accurate for small quantities.

Average of three results, above amount V_2O_5 added, 17·9 per cent., considerable variation in extremes.

P_2O_5 only 10 per cent. of weight of V_2O_5 present.

P_2O_5 precipitate bright reddish orange, containing very decided quantity of V_2O_5. Results very irregular, if allowed to settle till all P_2O_5 precipitated, a quantity of MO_3 precipitated also, and if precipitate re-dissolved in NH_3 and re-precipitated, results are decidedly low, not half what they should be.

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[*] Chem. Soc. Journ., July 1887, page 691. Roscoe and Schorlemmer, Vol. II., page 299, call it Von Hauer's method.

[†] Roscoe and Schorlemmer, Vol. II., page 299.

[‡] Fresenius, Vol. I., page 126.

Vanado-molybdate of ammonia, if this compound *is* formed, appears to be a much more soluble salt than phospho-molybdate of ammonia.

V_2O_5 carried down on precipitation of P_2O_5 as ammonia-phosphate of magnesia.

Quantity of liquid used, that suitable for precipitation of P_2O_5.

V_2O_5 up to 12·5 per cent. of the P_2O_5 present.

No.	P_2O_5 taken.	V_2O_5 taken.	V_2O_5 precipitated.	Per cent. of total V.	Remarks.
	Gram.	Gram.	Gram.		V in
1	·04	·005	·0004	8·48	Oxidised state.
2	·04	·005	·0004	8·48	
3	·04	·005	·0004	8·48	Reduced state.
4	·04	·005	·0004	8·48	
V_2O_5 equal to P_2O_5 present.					
	Gram.	Gram.	Gram.		V in
5	·04	·04	·0047	11·66	Oxidised state.
6	·04	·04	·0076	19·08	
7	·04	·04	·0067	15·09	Reduced state.
8	·04	·04	·0059	14·84	
P_2O_5 only 13·33 per cent. of the V_2O_5 present.					
	Gram.	Gram.	Gram.		V in
9	·04	·30	·0115	3·81	Oxidised state.
10	·04	·30	·0861	28·70	
11	·04	·30	·0487	16·24	Reduced state.
12	·04	·30	·0399	13·29	

It appears from these experiments that with V_2O_5 up to 12·5 per cent. of the weight of P_2O_5 present, the quantity carried down is pretty uniform, being about 1 per cent. of the weight of the P_2O_5. When, however, there is about equal quantity of each, V_2O_5, equal to about from 10 to 20 per cent. of the weight of the P_2O_5, appears to be carried down; and where the V_2O_5 present is seven or eight times as much as the P_2O_5, it amounts to from a quarter to twice the weight of the P_2O_5. In the last two cases the quantity carried down is very irregular.

I tried to modify the process by treating as in the Creusot method, then neutralising the NH_3 extract with $C_2H_4O_2$, or first adding NaHO to it and neutralising this as above, then precipitating as Pb or Ba salts. This modification effectually got rid of the P_2O_5, and CrO_3, but on neutralising with $C_2H_4O_2$ the Al_2O_3 extracted by the NH_3 was precipitated, together with some of the V as hydrated oxides and vanadate of ammonia, and the precipitate obtained on adding the Pb or Ba salt contained these also, and as they were somewhat soluble in the dilute $C_2H_4O_2$ used to rinse on and wash the precipitate, part was of course lost in the filtrate, whilst on the other hand the Al_2O_3 which was retained on the filter was dissolved in the HNO_3 and H_2SO_4 used for decomposing the Pb or Ba salts, and thus was weighed as V_2O_5.

If, however, by any such imperfect means the CrO_3 and P_2O_5 are first separated, there are still two difficulties, the first that Pb and Ba salts do not in all cases *completely* precipitate the V_2O_5, or when precipitated it is not completely insoluble; secondly, that no amount of boiling with HNO_3 and H_2SO_4 will *completely* decompose the salts referred to. I may say too that the number of evaporations with Na_2CO_3 necessary for separating P_2O_5 and V_2O_5 renders the method very tedious, as I have found it to require 12 evaporations, which takes about six days, and about 50 per cent. of the portions are spoiled through the beaker breaking, even though evaporated in a water bath. This alone makes it a very undesirable method. Altogether there were so many sources of error, and the results obtained were so unsatisfactory, that I was compelled to abandon all methods depending on the precipitation of the V_2O_5 and P_2O_5 as Pb or Ba salts.

I then tried whether anything dependable could be done by colorimetric comparison, either of solutions of alkaline vanadates acidified, and with H_2O_2 added, which causes them to yield a rich *red* colour, or of solutions coloured *yellow* by sodium tetra vanadate, $Na_2V_4O_{11} + 9H_2O$, one part of which gives a distinct colour in 200,000 parts of water,* or of the *blue* solutions of hypovanadates, as obtained by reducing acid vanadium solutions with $SnCl_2$ or $C_2H_2O_4$. In the first, though unaffected by CrO_3 or P_2O_5, the colour seemed scarcely stable enough, whilst in the next two CrO_3 of course affected the results.

There seems some promise in these methods, but as yet I have not been able to get as regular results from them as is desirable before *trusting* to a method. I next tried the volumetric method described in Roscoe and Schorlemmer, Vol. II., page 300, also in Crooke's new edition of "Select Methods."

The substance is fused with Na_2CO_3 and KNO_3, or as recommended by several authorities, first dissolve in nitrohydrochloric acid, then evaporate to dryness, scrape out of the beaker, and fuse as above, and the alkaline vanadate so obtained is reduced with SO_2 to V_2O_4, *cooled*, and then oxidised with standard $K_2Mn_2O_8$.

This method gives accurate results, both in the presence of CrO_3 and P_2O_5, but the fusion, and subsequent reduction with SO_2, and boiling-off of the excess of the same, take considerable time. If the body were dissolved at once, say in H_2SO_4, instead of fusion, the presence of Fe would obviously interfere.

I tried also to estimate V_2O_5 on the same principle as the well-known method for estimation of MnO_2, depending on the quantity of $FeSO_4$ oxidised by V_2O_5, the excess of $FeSO_4$ being estimated in the usual way with standard $K_2Cr_2O_7$. This method answered very well for V_2O_5 and P_2O_5 only, but was obviously no use where CrO_3 was present.

Finally, I tried Lindemann's method, as described in the *Chemical News*, Jan. 5, 1883, and this I found to be at once *rapid* and *reliable*.

It is as follows :—

"Dissolve 4 grms. finely-powdered slag in 60 cc. dil. H_2SO_4 (1 vol. H_2SO_4, 1·84° sp. gr. to 4 vol. H_2O.), boil a few moments, *cool*, make up to, say, 80 cc., filter, and take 40 cc.

Add $K_2Mn_2O_8$ (about deci-normal strength) till there is a slight pink colour, to ensure oxidation of lower oxides of V to V_2O_5. Add, drop by drop, weak $FeSO_4$ till colour just disappears. The V is then present as H_2SO_4 solution of V_2O_5. Run in freshly-prepared $FeSO_4$ of known strength (2·183 grms. pure iron dissolved in H_2SO_4 and diluted to 1 litre) till a drop of liquid taken out of the beaker just begins to show greenish blue (presence of protosalt of Fe) when it touches a drop of ferricyanide of potassium. Note the quantity of $FeSO_4$ used.

	grm.		
1 cc. =	·002	weight	V
	·002888	„	V_2O_2
	·003648	„	V_2O_5."

---

* Roscoe and Schorlemmer, Vol. II., page 287.

One good feature of this method is, that if too much $FeSO_4$ be added, the whole can be re-oxidised with $K_2Mn_2O_8$ and re-tested.

A single drop of $FeSO_4$ solution of the strength named in 80 cc. water gives a distinct and unmistakeable colour with the ferricyanide spot, and is only equal to $\frac{1}{20}$th cc. $FeSO_4$ or ·0001 grm. weight of V, or ·005 per cent. V on a 2 grm. portion, so there is not much fear of inaccuracy due to the slight excess necessary before complete reduction of V_2O_5 is indicated.

Cr if present does not interfere with this method, as I have found by repeated experiments, as the solution of sesquioxide is not oxidised by the weak $K_2Mn_2O_8$ in the *cold*.

In practice I modify the details slightly as follows:—In dissolving, first add a little H_2O, boil, and then add the dilute H_2SO_4, as there is less fear of the slag clotting, and portions escaping solution.

In titrating also, I do not trouble to make fresh $FeSO_4$ solution every time, but test its strength with half strength, $K_2Cr_2O_7$. Also I prefer to add an excess of $FeSO_4$ at once, then titrate with half strength $K_2Cr_2O_7$ to estimate the $FeSO_4$ which remains unoxidised. By this means the gradual diminution of the excess is easily watched.

Having at length found a method which repeated experiment on slag showed to be accurate, it now remained to apply it in conjunction with methods for the estimation of the other bodies, to the analysis of the small quantity of the various kinds of crystals, for though in all cases I made direct analysis of them for V as a check, yet it was necessary, as it was more or less precipitated with several of the other bodies, to determine the amount present in each one, in order to arrive at the exact quantity of each of them present.

Accordingly I again had recourse to numerous analyses of slag until I could determine the best order for separation of the various constituents, and which processes would best work in conjunction. It may, perhaps, be of interest if I give the method which I finally devised to effect this object.

METHOD "B."

Dissolve one or two grms. finely ground substance (crystals, slag, &c.) in HCl, oxidise with HNO_3, evaporate to dryness to separate SiO_2, re-dissolve in HCl, and if not known to contain enough Fe to prevent $Ca_3P_2O_8$ from being precipitated on addition of NH_3, add a known quantity of the purest obtainable Fe (previously dissolved in HCl and oxidised with HNO_3), the composition of which has been also accurately determined. Precipitate the $Fe_2O_3.Al_2O_3.V_2O_5.Cr_2O_3$ and P_2O_5 with $NH_4.C_2H_3O_2$ in a solution rendered faintly ammoniacal. If a little filter-paper pulp, previously acid-washed, be added, this will filter better. Re-dissolve and re-precipitate once or twice more, filter. Render ammoniacal and note if any blue colour due to Cu, and, if so, either determine the amount colorimetrically or add HCl and pass H_2S filter off Cu, then neutralise with NH_3 and add $C_2H_4O_2$.

Into the filtrate rendered just acid with $C_2H_4O_2$ pass H_2S for half an hour, and keep boiling all the time. This will precipitate Co and Ni. To the filtrate add NH_3 and Br to precipitate Mn, treat in the usual way, deducting, of course, from the weight of precipitate the weight of Mn added (if any) with the iron or steel.

In the filtrate precipitate CaO with $NH_4C_2O_4$, filter, evaporate if necessary, and precipitate MgO as ammonia-phosphate.

TREATMENT OF MgO FILTRATE.

Evaporate the filtrate to dryness, calcine in a platinum dish, dissolve in dil. H_2SO_4 and test for V by Lindemann's method as described.

Treatment of Fe_2O_3, &c. precipitate.

Grind, fuse in silver crucible with known weight of KHO which is either absolutely pure or in which the quantity of Al_2O_3 present is known, and when it has been fused, at a low red heat for a few minutes, add a few grains $NaNO_3$. A blank of all the salts used should be done for Fe and Al_2O_3. Filter off the Fe_2O_3 and test volumetrically for Fe, the amount added, of course, to be deducted.

Gravimetric results would certainly show too high a percentage, from the presence of a little KHO which cannot be completely washed out. Acidify the filtrate with HCl and precipitate the Al_2O_3 with NH_3 and with $NH_4C_2H_3O_2$. This carries down a good deal of P_2O_5 and V_2O_5.

To the filtrate of the Al_2O_3 precipitate add SO_2, boil, and precipitate the Cr_2O_3 with NH_3. This also carries down some V, and may contain P_2O_5.

The filtrate of the Cr_2O_3 is evaporated, acidified with H_2SO_4, and tested by Lindemann's method for V, after which the P_2O_5 is precipitated in the same portion by the molybdate method.

Treatment of Al_2O_3 precipitate.

This is ground fine in an agate mortar, transferred to a little beaker, and a few drops strong H_2SO_4 and an equal quantity H_2O added. After keeping heated all night to nearly boiling point, although some of the Al_2O_3 will yet be undissolved, all the V_2O_5 will be, and can be estimated by Lindemann's method.

HNO_3 and HCl are then added, and the solution boiled, when all the Al_2O_3 will dissolve and the P_2O_5 can be precipitated as phosphomolybdate. The weight of V_2O_5, plus the weight of P_2O_5, subtracted from the weight of the Al_2O_3 precipitate, gives the quantity of that body present.

Treatment of the Cr_2O_3 precipitate.

This must be ground fine and again fused with KHO and $NaNO_3$, after which it is acidified with dil. H_2SO_4, reduced with $FeSO_4$ to reduce the CrO_3, which is not again oxidised by $K_2Mn_2O_8$, cooled, and tested for V by Lindemann's method, and afterwards for P_2O_5 by molybdate. The sum of the P_2O_5 and V_2O_5 deducted from the impure Cr_2O_3 precipitate gives the pure Cr_2O_3.

It will be noticed that the same portion which has been used for estimation of V_2O_5 is used for determination of P_2O_5. As a few drops of the liquid are used on the plate to test with ferricyanide when the action is complete, all spots containing any of the original liquid should be carefully rinsed back into the beaker, or, if preferred, the quantity of liquid can be measured before and after testing, thus showing how much has been used for indication, so that due allowance can be made in calculating the results. I have never found the amount so used to be more than 1 per cent. of the liquid, so that the error from this source was only trivial, as samples containing 1 per cent. V would show ·99 per cent. even if this be not allowed for.

MnO, CaO, AND MgO PRECIPITATES.

These can be boiled up with dilute H_2SO_4 and tested for V_2O_5.

We have now the V from—

The main portion MnO, CaO, and MgO precipitates.
The „ „ MgO filterate.
The V precipitated with Al_2O_3 in the Fe, &c. precipitate.
„ „ „ Cr_2O_3 „ „ „
„ from the Cr_2O_3 filtrate „ „ „

which added together should give the correct percentage. Samples tested direct and also as above have, on working out and adding together the results, in some cases come exactly the same, and in others very near.

	Per Cent.	Per Cent.
By direct titration, V	·20	1·34

V present in various precipitates tested as described above. Results not worked out and added together till long after direct titration had been done.

Main portion.		Per Cent.	Per Cent.
Fe, &c. precipitate	Al_2O_3 precipitate	—	·081
	Cr_2O_3 „	·08	·058
	Cr_2O_3 filtrate	·08	1·011
CaO precipitate		—	·050
MgO „		·04	·030
MgO filtrate		—	·087
		·20	1·317

In like manner the P_2O_5 from the Al_2O_3 and Cr_2O_3 precipitates, and the Cr_2O_3 filtrate should be added together.

As to whether the P_2O_5 precipitated in the portion that has been used for determination of V_2O_5 carries down any V, the experiments quoted earlier show that with the proportions present in basic slags this will not occur to such an extent as to invalidate the results of the P_2O_5, and the V_2O_5 being estimated first of all, it of course does not suffer from this action.

In description of this method I have not gone into the minuter detail of precaution, such as using pure chemicals, acid-washed filters, covering of all vessels used to keep them from dust, care in incinerating and transferring of precipitants, &c.

The first method I had used for making analysis of small quantities of similar samples before I had got a satisfactory method for estimating the V, gave fairly good totals independently of V, and was as follows:—

METHOD "A."

Dissolve in HNO_3 and HCl, evaporate and separate SiO_2.

Precipitate S with $BaCl_2$, filter and remove all excess Ba with H_2SO_4.

Neutralise with NH_3 till just muddy, and add $H_2C_2O_4$.

Boil and filter off CaO. Neutralise filtrate with NH_3 and render just acid with $C_2H_4O_2$; boil and pass H_2S to precipitate Fe_2O_3 and Al_2O_3.

Just neutralise filtrate with NH_3, the Mn, Ni, and Co are precipitated. Render filtrate strongly ammoniacal and MgO is precipitated with part of the P_2O_5.

To filtrate, add "magnesia mixture," and precipitate the rest of the P_2O_5.

The question naturally presents itself, that since when complete analyses have been made of slags containing as much as one per cent. V without its having been specially tested for, and they have nevertheless added up so nearly to 100 as not to excite suspicion, in what proportions does it come down with the various precipitates? I therefore did parallel analyses by the two methods, testing all the precipitates and filtrates for V and comparing the check results, and the following will give some idea of the proportions in which the different precipitates carry down the V:—

TABLE showing TENDENCY of VARIOUS PRECIPITATES to bring down V.

METHOD "A."

Designation of Precipitate.	Per Cent. of Body present.	Per Cent. V carried down.	Per Cent. of Total Amount of V present.		Per Cent. of V in Precipitate.
CaO (in oxalic acid solution)	56·596	·26	15·65	57·93	·46
Fe, &c.	1·510	·072	4·33		4·77
MnO	·240	·086	5·19		35·83
MgO	·820	·028	1·68		3·41
P_2O_5 (as ammonia phosphate of magnesia)	29·703	·433	26·08		1·46
Filtrate of P_2O_5	..	·782		42·07	
Total V present	..	1·661		100·00	

Remarks.—Analyses by this method generally gave low totals when V was ignored. (Due to loss of V in filtrate of P_2O_5.)

SAME ANALYSIS by METHOD "B."

Fe, &c.	99·6 p.c. with added iron.				
„ $-Al_2O_3$ precipitate	Trace	None			
„ „ filtrate	..	1·441	85·48	88·05	
MnO	·21	Trace	..		Trace
CaO	56·56	·043	2·57		·07
MgO	·74	None	..		
MgO filtrate	..	·201		11·95	
Total V present		1·685		100·00	

The following are also some analyses by Method "B" which will serve further to illustrate the way in which V is carried down by other bodies, including Al_2O_3 and Cr_2O_3.

METHOD "B."

Designation of Precipitate.	Per Cent. of Body present.	Per Cent. V carried down.	Per Cent. of Total Amount of V present.		Per Cent. of V in Precipitate.
Fe, &c.:					
„ $-Al_2O_3$	13·60	·07	5·48	93·18	·51
„ Cr_2O_3	2·80	·058	4·54		2·07
„ Filtrate of Cr_2O_3.	..	1·011	79·24		..
MnO	·79	Trace	Trace		Trace
CaO	53·53	·050	3·92		·09
MgO	·48	Trace	Trace		Trace
Filtrate of MgO	..	·087		6·82	
Total V present		1·276		100·00	

METHOD "B."—*cont.*

Designation of Precipitate.	Per Cent. of Body present.	Per Cent. V carried down.	Per Cent. of Total Amount of V present.		Per Cent. of V in Precipitate.
Fe, &c.:					
„ Al_2O_3 …………	12·200	·289	14·97	91·05	2·37
„ Cr_2O_3 …………	5·600	·866	44·85		15·46
„ Filtrate of Cr_2O_3.	..	·636	32·93		..
MnO ………………	1·023	Trace	Trace		Trace
CaO ………………	44·730	·025	1·30		·055
MgO ………………	·960	Traee	Trace		Trace
Filtrate of MgO ………	..	·115		5·95	
Total V present ….		1·931		100·00	
Fe, &c.:					
„ Al_2O_3 …………	8·20	·317	13·57	92·58	3·87
„ Cr_2O_3 …………	5·70	1·155	49·49		20·26
„ Filtrate of Cr_2O_3.	..	·664	28·45		..
MnO ………………	1·318	Trace	Trace		Trace
CaO ………………	39·010	·025	1·07		·061
MgO ………………	1·290	Trace	Trace		Trace
Filtrate of MgO ………	..	·173		7·42	
Total V present ….		2·334		100·00	

In conclusion, though the investigations here described are far from complete, I trust they will throw some light on the estimation of Vanadium, and on the relative value of existing methods.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Fourth Meeting for this Session was held in the Rooms, 14, St. Andrew Street, Edinburgh, on Tuesday, 7th February 1888.

PROFESSOR CRUM BROWN IN THE CHAIR.

NOTE ON THE ESTIMATION OF STARCH.

BY J. NAPIER SPENCE, CHEMICAL LABORATORY, EDINBURGH SCHOOL OF MEDICINE.

I HAVE to make some apology for bringing this subject before the Society, as the note relates merely to the method of analysis and not to chemical manufacture. I have ventured to bring this note before the Society feeling the want of a simple and reliable method for the direct estimation of starch.

Professor Dr. Alexander Von Asboth has, however, claimed to have supplied this want, and his process appeared in the Analyst, July 1887, and also in Dr. John Muter's Short Manual of Analytical Chemistry published in September last.

The process is based upon the fact that starch forms an insoluble compound with baryta. The formula of the starch-baryta compound is $C_{24}H_{40}O_{20}BaO$, and therefore contains 19·1 per cent. BaO.

Having occasion to estimate the amount of starch in pepper, I tried the process as described in Dr. John Muter's book, but could not obtain constant results. With the view of overcoming this difficulty I made a series of experiments so that I might remove the cause of inconsistency of results, and I think have succeeded in getting the process to work in a satisfactory manner. The following is the process which I have adopted after many check analyses of my own and others, and the results have always been practically exact. Three grams are placed in a mortar (when there is any oil or resinous bodies present they must be extracted by ether in the "Soxhlet" first), and 30 cc. of cold distilled H_2O added in quantities of 10 cc., rubbing well between each 10 cc. Then 30 cc. of boiling water are added in the same manner, and 40 cc. of boiling H_2O used to transfer the substance out of the mortar into the 250 cc. flask. The flask is then placed in a water bath and allowed to remain for half an hour, with frequent shaking (to prevent lumping). At the end of the half-hour the contents will be entirely gelatinised. Immediately on taking the flask out of the bath 50 cc. of baryta water are added, the stopper replaced, and the whole well shaken for a few minutes (taking care not to let the stopper stick). I find it advisable to standardise the baryta while the starch is gelatinising, as this process will not work unless the 50 cc. of baryta water require 90 cc. or over it of decinormal HCl. Therefore if the baryta does not require so much it must be made up. After shaking, proof spirit is added up to the 250 cc. mark, and the whole well shaken (care being taken not to let the stopper fly out). After settling, 50 cc. of the clear liquid are run off and titrated in the usual way.

Professor Asboth recommends two drops of phenolphthalein to be used, but this depends on the strength of the phenol-phthalein solution. I find it best to add it until a faint marked pink colouration has been produced.

The difference between the two processes seems to lie in the fact that Professor Asboth recommends the addition of the baryta water *in the cold*, whereas by adding it *to the hot* solution a better marked compound is obtained. I find that the compound formed by the addition of baryta water to gelatinised starch is soluble in water, but is precipitated again by the alcohol; it is therefore not insoluble as stated.

I also use the baryta never below the strength capable of saturating 90 cc. of $\frac{N}{10}$HCl; my reason for this is, that I find it possible to form more than one compound, depending on the strength of the baryta water.

For example, I find that starting with the baryta capable of saturating 20 cc. $\frac{N}{10}$HCl, the compound formed contains only about 2 per cent. BaO, whereas by using baryta capable of saturating 90 cc. $\frac{N}{10}$HCl, the compound contains about 20 per cent. BaO. Therefore by using baryta which consumes 90 cc. $\frac{N}{10}$HCl, you supply sufficient baryta to form the proper compound, and also have a small quantity in excess. I think it is possible to form a great many compounds with baryta and gelatinised starch, all depending on the strength of the baryta. No matter how weak your baryta, you always get some left over, until you reach the strength capable of saturating 90 cc. $\frac{N}{10}$HCl, above which there seems to be no change in the proportions of the compound.

I think these are the reasons why the process as described gave constant results.

DISCUSSION ON MESSRS. CARNELLEY AND FREW'S PAPER ON THE CORROSION OF LEADEN WATER PIPES (Journal VII., 15).

Mr. E. C. C. Stanford wished to ask if any idea had been formed of the exact action which occurred on these leaden pipes. It was a well-known fact that lead pipes corroded rapidly wherever a drop of mortar had been allowed to fall on them. He some years ago tested a number of leaden water-closet sewage pipes corroded with this same oxide, and he was struck with two remarkable things: first, that the holes were all outward, showing the pressure of gas underneath, and in the next place, the extraordinary action on the lead, and at the time he was extremely puzzled as to what could be the action of the mortar on the lead to produce this result.

Professor Mills said that some reference had been made to Loch Katrine water. He might mention, with regard to the present state of the water supply, that Loch Katrine resembled many other waters in acting upon lead pipes very severely. If anyone took a 10 year old pipe from a Glasgow dwelling-house, he would find inside of it a thick layer of peat slime, and if this were removed there would be found underneath it a thick layer of white lead. The action began very rapidly, and, as far as he knew, never ceased, at any rate for a period of 10 years. Anyone could convince himself of this by turning off a tap overnight and taking the first 500 cc. the next morning. The water would be found to be quite different in colour from that which it ordinarily possessed, in fact quite yellow, and with a little sulphuretted hydrogen it would turn black, thus showing the presence of lead. He believed that there was not sufficient silicate in Loch Katrine water, and that its action was owing to the fact that it was really a strongly acid water, and generally charged with as much oxygen as it could naturally take up.

Mr. Frew, in reply to Mr. Stanford, said, it was thought that this might be analogous to the action of sodium hydrate on lead; that first calcium plumbate might be formed, and the carbonic acid in the air acting on that, would combine with the calcium oxide, forming calcium carbonate, and the lead oxide would be left intact.

FURTHER DISCUSSION ON MR. DOTT'S PAPER ON THE SUPPLY OF PURE ALCOHOL FOR MANUFACTURING PURPOSES (Journal VI., 805).

Mr. Fawsitt said that he was very much interested in Mr. Dott's valuable paper, and was sure that all chemists would agree with him in wishing to have a supply of pure alcohol for manufacturing purposes; but to him the chances of persuading the Government seemed very meagre, as past experiences go to prove, as if it were permitted the Inland Revenue staff would require to be considerably enlarged, and great difficulty would be experienced in carrying out the matter successfully.

No doubt the authorities were slow to change their ideas regarding methylated spirit, but the reason they had not as yet been persuaded to change its process of manufacture was for want of something better, and, as events have proved, that now in use had stood the test for 30 years fairly well. There could be no question that unlawful use was often made of methylated spirit, and he was informed that at present the Somerset House officials were experimenting with the view of making the quality still worse, so there seemed very little chance of their allowing anything purer to be used. The naphtha used by methylators a few years ago was no doubt very impure, and imparted very nauseous properties to the alcohol, so much so as to render it unfit for many purposes; but in recent years it had been much improved in quality by most makers, and was now usually guaranteed "water white," and would keep its colour on standing. At 60 O.P., or sp. gr. ·829, it on an average contained 80 per cent. methyl alcohol, 6 per cent. acetone, 12 per cent. water, and 2 per cent. of other constituents. It all distils between 65—80° C., the rise in temperature being chiefly due to presence of water; it has a strong characteristic smell.

If methylated spirit is found to be of bad quality the naphtha is blamed, whereas it is very often the spirit, as this is the channel through which all distillers pass their bad charges. I had a case brought under my notice lately which proved this conclusively. As regards an assertion by Dr. Squibb that naphtha can be easily separated, it would have been interesting to have had the details, as it must be by some method other than distillation, and if so would, he was afraid, be too complicated to repay anyone for their trouble. The "pyridine bases" which have been introduced by the German Government, and which he was told are being given up again, would be very much more easily separated from alcohol, as they boil 130°—145° C., and combine with an acid to form salts. They would also be unsuitable, as, on account of their being so non-volatile, they would be left almost entirely behind in the evaporation of the spirit in the varnish, hat, and other manufactures, and impart a very unpleasant smell. He quite agreed with Mr. Dott that ordinary methylated spirit is unsuitable for the manufacture of chloral, chloroform, &c., but it should, he thought, be unlawful to manufacture such important medicines from anything but pure alcohol, even although the duty is paid upon it. Of course an import duty would be placed upon these articles, and a "drawback" given on all exported.

It seems strange that nine people out of ten can afford to buy alcohol, duty paid, to drink, and they cannot afford it for articles which are so rarely used.

As regards Mr. Dott's idea about having two qualities of methylated spirit, he thought the

Government would never consent to 5 per cent. of pure commercial methyl alcohol, it would be practically pure alcohol.

We have really at present two qualities, as some manufacturers are most particular as to the quality of their naphtha and spirit, whilst others are the reverse, and the difference in quality is very great.

He was of opinion that if a good quality of naphtha were insisted upon it would be an improvement to increase the proportion to 15 or 20 per cent., as it could be added without interfering in any way with the uses to which the methylated spirit is applied, and it at the same time would not be so liable to be tampered with.

It would also be a step in the right direction if the law relating to the misuse of methylated spirit were altered so that anyone could be subjected, not only to a fine but also to imprisonment.

Mr. Dott, in reply, referring to Mr. Fawsitt's remarks, agreed with much that he said. Dr. Squibb was, no doubt, wrong in saying that the "methyl" could be easily removed from methylated spirits. What he, no doubt, meant was, that methylated spirit could easily be purified so as to render it drinkable, which is perfectly correct. As regards opposition to change by the Revenue Department, it must be borne in mind that Somerset House is only one factor in the case; the matter ultimately rests with the Legislature. The impure pyridine bases of the German spirit are not as easily separated as one might imagine. Even after distillation with sulphuric acid the odour and taste are very different from those of pure alcohol. He entirely dissented from the view that chloroform, &c. should only be made from pure alcohol. A manufacturer ought to be free to make his goods with anything he pleases so long as he turns out a pure product. If it were declared illegal to prepare chloroform from methyl spirit it would not follow that alcohol would be used for the purpose. Acetone would be used. He quite agreed that the mixture he had suggested would be practically pure alcohol. That is exactly what is wanted. The object of the addition of 5 per cent. methyl alcohol would not be to prevent the stuff being drunk, but to enable the Excise to prove their case in the extremely unlikely event of a manufacturer fraudulently disposing of his fine quality of methylated spirit.

* * *

MANURES.—NATURAL AND ARTIFICIAL.

BY W. IVISON MACADAM, F.I.C., F.C.S., &C., PROFESSOR OF CHEMISTRY, NEW VETERINARY COLLEGE, EDINBURGH, &C.

The manures used for agricultural purposes may be divided into, *first*, those formed on the farm, and *second*, manures which are purchased from outside sources. The first class I designate "Natural," the second "Artificial."

The removal from the soil year by year of large quantities of its saline ingredients, and the sale of the produce for consumption off the farm, leads to the necessity for the introduction of "artificial" manures. The material made on the farm is so small and the proportion of saline substances returned to the soil so infinitesimal, that the employment of "artificials" becomes a necessity. A further demand for this class of manures lies in the demand by the plant for food which shall be immediately available, and which can only be procured through the use of manufactured substances.

The "*natural*" manures consist of the bedding and excreta of the animals fed on the farm, which yields a manure which varies much in the proportions of its ingredients, differing according to the class of stock fed, the age of the stock, the conditions under which it is collected, the treatment it receives after collection, and the nature of the absorbent or "bedding."

The substance most usually employed for the "bedding" of farm stock is straw, but occasionally other bodies are used, such as dried ferns, disintegrated peat, sawdust, &c. Great variation is noted between straw manure collected from *open courts* and that obtained by *box feeding*. The first is subjected to rain and other climatic conditions, and consequently is liable to have much of its soluble matters washed out and lost. The box feeding manure, on the other hand, is protected from rain, and contains practically all the valuable constituents of the excreta. Provided that the farmyard manure is carefully made and properly protected, it improves by keeping—the manurial substances becoming more readily available for plant food. The following analyses give the average composition of this material in its fresh state—as removed from the boxes—and the same manure after rotting:—

Table A.

Composition of Farmyard Manure.

——	Fresh.	Rotted.
Water	71·0	79·9
Organic matter *	24·6	14·5
Ash†	4·1	6·5
	100·0	100·0
* Containing nitrogen	0·45	0·58
Equal to ammonia	0·54	0·70
† Containing:— Potash	0·52	0·50
Soda	0·15	0·13
Lime	0·57	0·88
Magnesia	0·14	0·18
Phosphoric acid	0·21	0·30
Sulphuric acid	0·12	0·13
Chlorine	0·15	0·16

Seaweed, which is also largely used as a manure, has the following average composition:—

Table B.

Composition of Seaweed.

Water	80·44
Organic matter*	9·25
Ash†	10·31
	100·00
* Containing nitrogen	0·45
Equal to ammonia	0·54
† Containing potash	1·95
" phosphoric acid	0·47

From these results it will be seen that seaweed is by no means a bad substitute for the common farmyard manure. When properly collected and sun-dried it becomes much more concentrated, and thus more valuable.

Peat Litter.—This substance is now largely employed in place of straw, for which it is an excellent substitute. The first cost is probably rather greater than straw, but the length of time that the bed lasts much more than counterbalances this extra sum. The substance is very absorbent, and being somewhat antiseptic, prevents for a time the liberation of ammonia. The following analyses will show the composition of the litter before and after use :—

TABLE C.

COMPOSITION OF PEAT LITTER.

—	Before Use.	After Use.
Moisture	9·12	19·37
Organic matter*	89·39	71·86
Alkaline salts	0·03	0·07
Phosphates	0·16	1·97
Carbonate of calcium	0·93	1·66
Silica	0·32	5·07
	100·00	100·00
* Nitrogen = Ammonia	0·62	2·32

After deducting the water, we can more readily compare the analyses :—

Deducting Water.	Before Use.	After Use.
Phosphates	0·17	2·44
Ammonia	0·68	2·87

It will thus be seen that the manure formed by the use of peat litter is of considerable value, and is more concentrated than straw-litter manure.

The farmyard manure varies much according to the class of animal yielding it. Of four-footed animals, that of the horse is more valuable than the cow. This fact is illustrated in the following results :—

TABLE D.

—	Horse.	Cow.
SOLID EXCRETA.	Per Cent.	Per Cent.
Calcic phosphate	5·0	10·9
Magnesic oxide	36·25	10·0
Nitrogen	4·02	1·13
Equal to ammonia	4·31	1·37
URINE.		
Nitrogen	1·55	0·44
Equal to ammonia	1·89	0·53

Bird Manure.—The droppings of farmyard poultry are also of considerable value. That of the pigeon is the most concentrated, and always finds a ready market. Hen manure contains the largest proportion of phosphates, and is followed by duck droppings. That of the goose is the least valuable. The following figures may be taken as giving the average composition of this class of substances :—

TABLE E.

COMPOSITION OF BIRD EXCRETA.

—	Pigeon.		Hen.	Duck.	Goose.
Moisture	58·32	56·08	60·88	46·65	77·08
Organic matter*	28·25	19·56	19·22	36·12	13·44
Phosphates	2·69	2·54	4·47	3·15	0·89
Carbonate and sulphate of calcium	1·75	3·08	7·85	3·01	2·94
Alkaline salts	1·99	0·82	1·09	0·32	
Silica and sand	7·00	17·92	6·69	10·75	5·65
	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen equal to ammonia	1·75	1·21	0·74	0·85	0·67

For the bedding of poultry an excellent substance is found in ordinary wood sawdust, which is very absorbent, and is afterwards readily placed upon the land. The reason why sawdust is not more extensively employed as an absorbent of urine, &c. seems to lie in an old belief that it was poisonous to plant life. I am told by a farmer, who has had much experience in the use of the material, that it is perfectly safe, and that he has in no way found evil effects from its use.

Human Excreta is only used to a very limited extent for farm manure. The present water-carriage system adopted in our populous places for the removal of waste animal matters dilutes the substance too much to allow of its after employment on the farm. In Germany and France large quantities of the material are placed on the land, especially for tobacco, beet, and mangol, with the best results. In Japan the refuse materials are accepted in part payment of the house rent. The urine contains fully half a per cent. of soluble phosphates and about a like amount of potash salts, whilst the saline matter of the solids contains nearly 75 per cent. of phosphates.

The irrigation system is only applicable to certain crops, and must be carried out within reasonable distance to large centres of population.

Police manure, or the ashes and refuse collected in dust carts, is also employed, especially on stiff clay lands, but its action is possibly more that of rendering the soil open and porous, mechanically, than from any great manurial value it possesses. An attempt has been somewhat successfully made to render the body more readily applied to land by grinding the rough material and screening out the metal and other obnoxious bodies. The analysis of the ground material is given below :—

TABLE F.

POLICE MANURE.

Moisture	11·26
Organic matter (including coal, cinder, &c.)*	36·84
Alkaline salts	0·34
Phosphates	0·67
Oxide of iron, &c.	7·05
Carbonate of lime	3·08
Silica and sand	40·76
	100·00

* Nitrogen = Ammonia....0·52 per cent.

The amount of plant food being very limited on the farm, supplies require to be obtained from other and outside sources. These supplies must be sufficient to make up the losses sustained by the soil from the removal of the various crops. The materials which are contained in the plants are partly organic in nature and partly mineral. Possibly the only substance belonging to the organic class which it will be necessary for us to consider is nitrogen, the continued supply of which is most essential to healthy plant growth.

The inorganic series contains a much larger number of substances, but the most necessary to be considered are potash, lime, magnesia, silica, phosphoric acid, sulphuric acid, and chlorine.

The following table gives the percentage composition of the ash or mineral part of some of the more common farm crops:—

TABLE G.

PERCENTAGE COMPOSITION OF THE ASH OF PLANTS.

—	Potash.	Soda.	Lime.	Magnesia.	Oxide of Iron.
Wheat grain ..	25·7	9·1	2·8	12·0	0·7
Wheat straw..	12·5	0·2	6·7	3·9	1·3
Barley grain ..	13·6	8·1	2·6	7·5	1·5
Barley straw .	9·2	0·3	8·5	5·0	1·0
Oats grain	26·2	..	6·0	10·0	0·4
Oats straw	19·1	9·7	8·1	3·8	1·8
Beans.........	33·6	10·6	5·8	8·0	0·6
Potatoes	55·7	1·9	2·0	5·3	0·5
Turnips.......	41·9	5·1	13·6	5·3	1·3
Hay	18·1	1·3	23·0	6·8	1·7
Clover	35·5	0·7	32·9	8·4	0·4

—	Phosphoric Acid.	Sulphuric Acid.	Silica.	Chlorine.
Wheat grain ..	50·0	0·3	1·2	..
Wheat straw..	3·1	5·8	65·4	1·1
Barley grain ..	39·0	0·1	27·3	Trace.
Barley straw..	3·1	1·0	67·6	0·6
Oats grain	43·8	10·5	2·7	0·3
Oats straw	2·6	3·3	48·4	3·2
Beans.........	38·0	1·0	1·2	0·7
Potatoes	12·6	13·6	4·2	4·2
Turnips.......	7·6	13·6	7·9	3·6
Hay	6·0	2·7	37·8	2·6
Clover	8·4	3·3	3·4	7·0

These ingredients are all contained in the soil, and are wholly derived by the plant therefrom. The following analyses will show the proportions of the ingredients contained in various soils:—

COMPOSITION OF SOILS.

	Vegetable Mould.	Sandy.	Fertile Clay.	Loam.	Calcareous (Lime).	Marl.
Organic matter	10·08	0·49	3·38	11·21	6·33	10·50
Iron oxide.....	6·30	3·19	8·82	4·87	9·31	11·92
Alumina.......	9·30	2·65	6·67	11·04		
Lime..........	1·01	0·24	1·44	0·83	51·56	19·92
Magnesia	0·20	0·70	0·92	1·02	Trace	0·25
Potash	0·01	0·12	1·48	2·80	1·03	0·71
Soda		0·02	1·08	1·43		
Phosphoric acid	0·13	0·07	1·51	0·24	Trace	0·38
Sulphuric acid.	0·17	Trace	Trace	0·09	Trace	0·04
Chlorine.......	..	Trace	..	0·25	..	0·76
Clay and sand .	72·80	92·52	72·83	63·19	28·77	55·52
Carbonic acid, &c.	..	..	1·87	..	..	..
	100·00	100·00	100·00	100·00	100·00	100·00

Whilst a large number of saline ingredients are required by the plant, yet those which are most essential for its growth are stated above. On most soils the ingredients requiring to be yearly added are phosphates, nitrogen, and potash.

Bones.—The first two of these bodies are stored up in the bones of animals fed upon the farm crop, and consequently they become the staple of the more common manures.

In order that the bones may be more readily soluble in the soil, and so become useful as plant food, they are first broken up more or less finely, and go to produce what are known as—

- ½-inch bones.
- ¼-inch bones.
- Crushed bones.
- Bone dust.
- Bone meal.
- Bone flour.

The breaking up of the bone is a somewhat difficult matter on account of the extreme toughness of the substance. The apparatus most commonly employed consists of two grooved or toothed rollers running into one another, which crush the bones to a more or less fine state of division, but where still finer meal is required, then other machines known as disintegrators are necessary. Carter's machine consists of a series of revolving "beaters" which cut the material and at the same time throw it against a series of chilled ratchets until the fragments reach the screens at the lower part and escape, if sufficiently fine to pass through.

Messrs. Marsden make a combination of the two machines by causing the crushed substance to pass from the "cracker" to a revolving screen, where the finer portion escapes, and the coarser part is thrown into a box, from whence it is returned by means of an "elevator" to the "cracker," to be reground.

A machine for "cracking" and grinding manurial bodies is that of Messrs. Morris Brothers, of Doncaster. The apparatus consists of a revolving pan, in which are mounted edge runners of great weight, and which are so mounted that they revolve upon their axes. The pan is perforated by a series of holes which taper downwards and outwards so as to prevent clogging. As the crushed material passes through the perforations, it is transmitted by means of an elevator to the second part of the apparatus, which consists of a box, in which a partial vacuum and induced current is created by means of a fan. The material falls upon a series of inclined partitions and against the air current, the finer portions being carried forward by the air current to the body of the box, where they are deposited, whilst the coarser part falls to a shoot which conducts it back to the stones to be again ground. The apparatus is most successful, and may be used with mineral phosphates as well as with bones. The "cracker" will break 40 to 50 tons of phosphate rock in 10 hours to the size of peas, and will give about 4 cwt. per hour of actual dust. The finer "grinding mill" will pass about 16 cwts. of material per hour.

The bone meal varies considerably in composition, the phosphates running from 45 to 57 per cent., and the ammonia from 3¼ to 5¼ per cent. Generally speaking, where the phosphates are high the ammonia is low, and *vice versâ.*

TABLE H.

COMPOSITION OF BONE MEAL.

Moisture	7·68	8·56	8·84	9·52	8·48
*Nitrogenous organic matter	30·64	32·96	28·42	31·84	29·82
Alkaline salts	0·61	0·32	0·63	0·62	0·68
Phosphates	53·07	49·12	51·72	45·16	50·84
Carbonate of lime	6·88	8·36	9·43	8·44	9·26
Silica, &c.	1·12	0·88	0·96	1·42	0·92
	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen equal to ammonia	4·82	4·76	4·54	4·82	4·53
Moisture	8·32	8·56	8·62	9·51	8·32
*Nitrogenous organic matter	39·56	31·12	30·04	28·42	24·13
Alkaline salts	0·55	0·48	0·43	0·58	0·49
Phosphates	44·72	52·88	53·52	54·92	57·08
Carbonate of lime	5·39	5·04	6·73	5·66	7·42
Silica, &c.	0·96	1·92	0·66	0·88	2·56
	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen equal to ammonia	5·23	5·02	4·86	5·02	3·34

If the bones are fresh, or, as technically known, "green," then a considerable amount of oil may be present. In all cases there is in the bone much gelatin, and part of this may be removed by placing the bones in a cylinder and subjecting them to steam, under pressure. By this process the bones become what are known as "steamed" or "degelatinised," and lose a part of their nitrogen at the same time that the phosphates increase. The bone becomes very brittle, and can, by means of the disintegrator, be thrown into a very fine powder. The composition of the material is given on Table I., and shows that the phosphates run from 57 to 68 per cent., whilst the ammonia is from 1½ to 3½ per cent.

TABLE I.

STEAMED BONE FLOUR.

Moisture	17·92	5·16	5·82	6·96	5·28
Organic matter*	11·16	21·78	21·04	21·78	20·24
Alkaline salts	0·54	0·62	0·68	0·58	0·56
Phosphates	57·68	60·64	60·84	58·21	61·08
Carbonate of lime	11·76	9·24	9·14	10·12	9·16
Silica	0·94	2·56	2·48	2·32	0·68
	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen equal to ammonia	1·62	3·62	3·25	3·42	3·46
Moisture	9·76	6·58	5·68	5·84	7·04
Organic matter*	14·12	17·02	19·36	18·72	18·22
Alkaline salts	6·42	0·61	0·66	0·86	0·78
Phosphates	60·88	65·48	67·92	65·75	63·86
Carbonate of lime	11·54	6·36	5·86	8·11	8·58
Silica	3·28	3·92	0·52	0·72	1·52
	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen equal to ammonia	2·12	2·53	3·25	2·62	2·04

During the acid process for the manufacture of glue a liquid is obtained containing much phosphate. This, if precipitated with lime, forms "precipitated phosphate," or precipitated bone flour. The following analysis will show the composition. If the lime is added in too large quantity the ammonia entirely disappears.

TABLE J.

COMPOSITION OF PRECIPITATED BONE FLOUR.

Moisture	12·82
Organic matter*	10·64
Alkaline salts	0·52
Phosphates	60·92
Carbonate of lime	14·46
Siliceous matter	0·64
	100·00
* Nitrogen equal to ammonia	0·71

Fish Guano.—A substance yielding phosphates and nitrogen, obtained from fish, is known as *fish guano* or *fish manure.*

In the manufacture of this body the waste fish or fish scrap is dried and ground. There are many varieties of the material, the best class being known as "Polar Fish Guano." This substance is principally manufactured in Norway, and is a most excellent fertiliser.

TABLE K.

POLAR FISH GUANO.

Moisture	10·28	7·28	6·48	9·92	6·08
Nitrogenous organic matter*	52·88	75·62	62·52	59·36	61·08
Alkaline salts	10·92	0·78	1·24	0·84	0·92
Phosphates	15·41	12·42	23·32	25·56	27·52
Carbonate of lime	8·39	3·44	5·76	3·68	3·76
Silica	2·12	0·46	0·68	0·64	0·64
	100·00	100·00	100·00	100·00	100·00
* Nitrogen equal to ammonia	8·42	11·62	7·42	9·15	10·42

Moisture	7·44	7·58	10·72	8·96
Nitrogenous organic matter*	56·08	75·91	42·68	45·16
Alkaline salts	2·02	0·62	4·12	38·84†
Phosphates	29·36	12·52	12·92	4·12
Carbonate of lime	4·54	3·05	24·28	2·44
Silica	0·56	0·32	5·28	0·48
	100·00	100·00	100·00	100·00
* Nitrogen equal to ammonia	9·62	11·83	7·06	5·22

† Common salt.

The composition as shown on Table K. is—phosphates from 12½ to 30 per cent., ammonia from 7 to 12 per cent. The last sample is evidently made from the refuse of cured fish, and although sold as "Polar," has no claim to that title.

The composition of fish guano varies somewhat with the species of fish used. The following table will show the extent of this variation :—

TABLE L.

FISH GUANOS FROM VARIOUS FISH.

——	Anjovis Refuse.	Herring Guano.	Cod Guano.
Moisture	8·06	6·14	6·24
*Nitrogenous organic matter	66·18	70·18	57·68
Alkaline salts	4·54	1·56	2·12
Phosphates	14·92	7·92	26·17
Carbonate of lime	3·28	3·68	6·35
Silica	3·02	10·52	1·44
	100·00	100·00	100·00
* Nitrogen equal to ammonia	8·62	10·42	10·13

In this country fish manures are manufactured from the raw fish offal obtained in the curing yards. This substance contains much water and oil. The following is an analysis of one sample :—

TABLE M.

RAW FISH OFFAL.

Moisture	50·58
Oil	15·51
*Nitrogenous organic matter	18·54
Alkaline salts	10·93
Phosphates	3·84
Carbonate of lime	0·48
Silica	0·12
	100·00
* Nitrogen equal to ammonia	3·31

The product obtained is not so regular in its condition as the "Polar" guano, and as it contains more oil, is not so quickly decomposed and rendered soluble in the soil. The phosphates run from 7 to 14 per cent., and the nitrogen is capable of yielding from 3 to 5½ per cent. of ammonia. The oil present often reaches 10 per cent. Instead of a fine powder as in "Polar" guano, the material may consist of the dried refuse without grinding, and has often a pasty consistence. It is much darker in colour and more disagreeable to smell than the "Polar" material. Table N. gives analyses of the substance.

TABLE N.

FISH MANURE (*Home Manufacture*).

Moisture	25·46	22·96	28·36	31·44
*Nitrogenous organic matter	27·84	36·32	37·96	47·00
Alkaline salts	6·62	9·36	6·73	8·04
Phosphates	14·54	8·34	12·52	7·84
Carbonate of lime	23·72	18·44	9·82	5·72
Silica	1·82	4·58	4·61	0·86
	100·00	100·00	100·00	100·00
* Containing nitrogen equal to ammonia	4·26	4·92	4·93	3·14
Oil	..	..	..	10·48

Moisture	29·24	35·52	42·92	33·32
*Nitrogenous organic matter	40·06	24·34	35·64	36·56
Alkaline salts	9·16	15·32	11·12	13·81
Phosphates	10·08	19·04	7·16	9·08
Carbonate of lime	7·01	3·86	1·88	4·51
Silica	4·45	1·92	1·28	2·72
	100·00	100·00	100·00	100·00
* Containing nitrogen equal to ammonia	5·21	3·06	4·42	4·45
Oil	..	..	8·21	..

Fish Bone Flour closely resembles the animal bone flour. It is, however, in a finer state of division, and free from oil or grease.

TABLE O.

COMPOSITION OF FISH BONE FLOUR.

Moisture	6·72	5·16
*Nitrogenous organic matter	29·52	30·32
Alkaline salts	1·34	1·04
Phosphates	53·12	54·24
Carbonate of lime	7·82	4·76
Silica	1·48	4·48
	100·00	100·00
* Nitrogen equal to ammonia	4·82	4·83

Fray Bentos Guano is made from the refuse flesh and bone left as a residue in the manufacture of Liebig's extract of meat. It is a fine powder, free from oil and readily soluble in the soil. The phosphates run from 20 to 30 per cent., and the nitrogen is sufficient to yield from 7 to 10 per cent. of ammonia. Three analyses are given below:—

TABLE P.

COMPOSITION OF FRAY BENTOS GUANO.

Moisture	9·85	10·92	8·64
*Nitrogenous organic matter	53·52	62·24	53·26
Alkaline salts	1·45	1·32	0·78
Phosphates	29·86	21·12	31·58
Carbonate of calcium	4·37	3·38	4·66
Silica	0·95	1·02	1·08
	100·00	100·00	100·00
* Nitrogen equal to ammonia	7·12	9·62	7·64

A substance made only from the meat is called *Liebig's guano*, and yields from 10 to 12 per cent. of ammonia, and 3 to 5½ per cent. of phosphates. This body is also known as "*Meat Meal*," although the three terms "Fray Bentos Guano," "Liebig's Guano," and "Meat Meal" are often used as synonymous.

Animal Refuse derived from abattoirs, &c. is occasionally dried and sold in the undissolved state. The composition closely resembles bone meal, but the alkaline salts are higher and the body contains some potash. The following is an analysis:—

TABLE R.

ANALYSIS OF ANIMAL REFUSE.

Moisture	6·48
*Nitrogenous organic matter	26·77
Alkaline salts	3·42
Phosphates	45·68
Carbonate of lime	12·61
Silica	5·04
	100·00
* Nitrogen equal to ammonia	4·41

It will have been observed that in all the materials yet treated of, the phosphates have been in the insoluble condition or the tricalcic phosphate. These manures are therefore comparatively slow in their action upon plant life, and their manurial value extends over a long period. To meet the demand for a more rapid plant food, or, in other words, one more readily available for the plant, it is necessary to obtain the phosphates in a more soluble state. This condition may either be a combination of phosphoric acid with ammonia, sodium, or potassium, or it may be an acid phosphate of calcium, &c. The first or alkaline phosphates are probably preferable, as they are not so liable to be "reverted" or returned to the insoluble state, as is the case with the acid phosphates; indeed so liable are the latter to "revert" that it is very generally believed that they are invariably rendered insoluble immediately on being thrown on the soil. Still we know by experience that such dissolved manures are more available for plant food than those which are not so treated. Possibly the fine state of division into which the phosphate is reverted may have all to do with its after availability to the plant. We know that the finer the state of division to which ordinary bone is ground, the more rapidly does its action proceed, and a similar result is found with mineral phosphate. If any further evidence was required it might be found in the more rapid action of precipitated bone flour over the ordinary bone meals.

To meet this want for a soluble phosphate we may go to guanos, which are composed of the excrement and feathers, and in many cases the bodies of birds, principally of those frequenting the sea. Such deposits are found on many of the West Indian, African, South American, and Australian Islands and Capes. If the material has been deposited on a spot not liable to be moistened by sea spray, and if the climate be hot and dry, then the substance rapidly loses its moisture and retains its nitrogenous matter and alkaline phosphates. Such guanos are termed "*Nitrogenous*" and are most largely represented in the market by the *Peruvian* and *Ichaboe* deposits.

If the droppings, after being deposited, are subjected to rain or spray, then the alkaline or soluble phosphates are washed out, and the moisture aiding decomposition results in a loss of nitrogenous matter, and the consequent disappearance of the ammonia. These guanos are called "phosphatic." They are sometimes used in the raw or natural state, but more commonly are first treated with acid. Between these two extremes we have many guanos which have been more or less degraded by loss of nitrogen, but which are used in the raw state.

Peruvian Guano.—This guano was the earliest to be introduced into this country. When first obtained it was of ancient deposit and very nitrogenous, and contained from 16 to 20 per cent. of ammonia. These early deposits became in time exhausted, and the material now imported is much less rich. The ammonia may occasionally be found as high as 12 or 13 per cent., but is more usually between 4 and 8 per cent., although it not unfrequently comes down even below these figures. Sometimes Sulphate of Ammonia is added to the guano, and the material then becomes "fortified" or "equalised" guano. The phosphates present as soluble or alkaline phosphates, may vary between half a per cent. and 9 per cent., but the general proportion lies between 4 and 8 per cent. The insoluble or tricalcic phosphate also varies much, being often as low as 10 per cent. and not unfrequently as high as 30 or 35 per cent.

TABLE S.

COMPOSITION OF PERUVIAN GUANO.

Moisture	14·28	13·46	17·02	12·52	15·28
Organic matter* and ammonia	18·46	22·32	19·56	25·76	15·44
Alkaline salts†	10·84	12·36	10·74	8·92	12·96
Ordinary guano phosphates‡	28·92	28·12	36·12	25·04	35·12
Carbonate of calcium	8·54	7·11	10·68	11·64	5·52
Silica	18·96	16·63	5·88	15·12	15·68
	100·00	100·00	100·00	100·00	100·00
* Containing ammonia, equal	4·06	6·32	4·24	8·73	4·42
† Phosphoric acid in alkaline salts equal to bone phosphate rendered soluble	8·87	11·16	3·76	0·46	6·52
‡ Ordinary guano phosphate	28·92	28·12	36·12	25·04	35·12
Total phosphates	37·79	39·28	39·88	25·50	41·64
Moisture	12·72	14·48	15·72	13·82	14·52
Organic matter and ammonia*	16·64	17·82	16·92	43·72	41·76
Alkaline salts†	14·72	11·54	16·32	7·32	7·04
Ordinary guano phosphates‡	30·64	35·28	31·48	10·36	10·12
Carbonate of calcium	5·44	5·76	5·64	6·36	6·74
Silica	19·84	15·12	13·92	18·12	19·82
	100·00	100·00	100·00	100·00	100·00
* Containing ammonia, equal	3·74	4·42	4·82	13·38	12·42
† Phosphoric acid in alkaline salts equal to bone phosphate rendered soluble	7·12	6·34	6·64	4·32	2·72
‡ Ordinary guano phosphate	30·64	35·28	31·48	10·36	10·12
Total phosphates	37·76	41·62	38·12	14·68	12·84

Ichaboe Guano.—Next in importance to Peruvian guano stands the substance derived from the African island of Ichaboe. This guano is formed from year to year, the deposit of last season forming the guano of this year. It differs from Peruvian guano in appearance on account of the large number of feathers it always contains. It is of a highly nitrogenous nature, being capable of yielding as high a proportion as 13 per cent. of ammonia, and rarely falling below 8 per cent. The soluble alkaline phosphates run usually from 6 to 9 per cent., although occasionally they fall lower. The ordinary guano or insoluble phosphates range between 9 and 20 per cent., but falling in special cases as low as 5 per cent., and in rare instances coming up to 30 or 33 per cent. As a nitrogenous guano the Ichaboe Island guano now stands highest in the list of bird manures.

Table T gives the analyses of samples on the market during last season.

TABLE T.

COMPOSITION OF ICHABOE GUANO.

Moisture	20·48	22·08	19·76	14·24	20·31
Organic matter and ammonia*	35·16	38·36	34·04	32·08	35·72
Alkaline salts†	8·77	9·88	8·36	7·81	8·25
Ordinary guano phosphates‡	11·44	14·06	21·68	8·92	3·44
Carbonate of lime	4·19	6·75	6·68	7·63	4·15
Silica	18·96	9·07	9·68	29·32	27·83
	100·00	100·00	100·00	100·00	100·00
* Containing ammonia, equal to	11·95	12·85	11·92	11·33	10·94
† Phosphoric acid in alkaline salts equal to bone phosphate rendered soluble	7·92	8·83	7·16	6·04	7·48
‡ Ordinary guano phosphates	11·44	14·06	21·68	8·92	3·44
Total phosphates	19·36	22·89	28·84	14·96	10·92
Moisture	20·54	15·32	6·08	10·36	16·62
Organic matter and ammonia*	31·87	34·84	33·76	28·92	32·48
Alkaline salts†	8·14	6·96	2·84	10·96	14·64
Ordinary guano phosphates‡	5·02	5·42	33·68	20·56	13·12
Carbonate of lime	5·51	3·84	19·12	4·42	10·98
Silica	28·92	33·62	4·52	24·78	12·16
	100·00	100·00	100·00	100·00	100·00
* Containing ammonia, equal to	11·21	10·96	9·86	8·06	9·86
† Phosphoric acid in alkaline salts equal to bone phosphate rendered soluble	6·47	4·32	0·74	7·12	3·36
‡ Ordinary guano phosphates	5·02	5·42	33·68	20·56	13·12
Total phosphates	11·49	9·74	34·42	27·68	16·48

Afuera Guano is another illustration of the highly nitrogenous class. In this deposit the ammonia runs from 7 to 10 per cent., the soluble alkaline phosphate from 10 to 13 per cent., and the insoluble phosphate from 30 to 33 per cent. It is more of the Peruvian class than of the Ichaboe, and belongs to the west coast of South America. The following two analyses will show the composition of last season's samples :—

TABLE U.

COMPOSITION OF AFUERA GUANO.

Moisture	12·24	16·92
Organic matter and ammonia*	33·11	26·82
Alkaline salts†	17·42	19·56
Phosphates‡	32·72	31·74
Carbonate of lime	..	..
Silica	4·48	4·96
	100·00	100·00
* Ammonia	9·16	7·42
† Phosphoric acid in alkaline salts Equal to bone phosphate rendered soluble	10·52	12·38
‡ Ordinary guano phosphate	32·72	31·74
Total phosphates	43·24	44·12

Halifax Island Guano is also highly nitrogenous, and contains a considerable proportion of soluble alkaline phosphates.

Table V. gives the composition of two samples. It is of the Ichaboe class.

TABLE V.

COMPOSITION OF HALIFAX ISLAND GUANO.

Moisture	16·48	15·56
Organic matter and ammonia*	38·56	40·12
Alkaline salts†	10·24	8·38
Phosphates‡	12·02	9·37
Carbonate of lime	5·18	4·21
Silica	17·52	22·36
	100·00	100·00
* Ammonia	11·92	12·84
† Containing phosphoric acid = bone phosphate rendered soluble	7·12	6·04
‡ Ordinary guano phosphates	12·02	9·37
Total phosphates	19·14	15·41

Ascension Island Guano is also highly nitrogenous, but the alkaline phosphates frequently come down to one per cent., or even less.

Table W. gives the analyses of three samples.

TABLE W.

COMPOSITION OF ASCENSION ISLAND GUANO.

Moisture	6·65	9·12	11·04
Organic matter and ammonia*	32·84	36·76	27·48
Alkaline salts†	2·83	6·74	9·36
Phosphates‡	34·16	24·92	31·16
Carbonate of lime	18·98	5·42	6·64
Silica	4·54	17·04	14·32
	100·00	100·00	100·00
* Containing ammonia, equal to	9·83	12·34	8·82
† Phosphoric acid in alkaline salts equal to bone phosphate rendered soluble	0·56	4·86	6·32
‡ Ordinary guano phosphates	34·16	24·92	31·16
	34·72	29·78	37·48

From these deposits, which are at present the most highly nitrogenous, we find a gradual diminution in nitrogen and alkaline salts containing soluble phosphate, until we arrive at deposits practically free from these substances. Of these intermediate guanos we have very many, but the analyses given on Table X. will sufficiently illustrate the class:—

TABLE X.

COMPOSITION OF GUANOS.

	Penguin Island.		
Moisture	21·84	19·52	20·68
Organic matter and ammonia*	20·96	20·61	18·72
Alkaline salts†	6·21	6·36	7·24
Phosphates‡	16·26	16·08	19·24
Carbonate of lime	6·65	7·61	9·78
Silica	28·08	29·82	24·34
	100·00	100·00	100·00
Ammonia	4·84	4·65	4·82
† Phosphoric acid in alkaline salts = bone phosphate rendered soluble	4·16	4·56	4·08
‡ Ordinary guano phosphates	16·26	16 08	19·24
Total phosphates	20·42	20·64	23·32
	Patagonian Guano.		
Moisture	19·32	10·64	21·22
Organic matter and ammonia*	24·24	34·04	21·62
Alkalino salts†	5·08	8·62	6·34
Phosphates‡	28·16	19·44	29·12
Carbonate of calcium	8·72	7·54	10·56
Silica	14·48	19·72	11·14
	100·00	100·00	100·00
* Ammonia	6·21	5·21	4·75
† Phosphoric acid in alkaline salts = bone phosphate rendered soluble	1·92	0·72	1·14
‡ Ordinary guano phosphates	8·16	19·44	29·12
Total phosphates	30·08	20·16	30·26

Phosphatic Guanos.—In this class of guano the alkaline phosphates disappear or do not exceed one-half per cent. The ammonia derivable from the organic matter may run from ½ to 1½ per cent., in some cases reaching 2 per cent. On the other hand the insoluble phosphates are very high, sometimes reaching 70 to 75 per cent., and being rarely below 50 per cent. The substances are used as manure in the raw state, but are more frequently dissolved with acid to form high class superphosphates, or are mixed with other dissolved manures to increase the phosphates. Of this class possibly Mexillones and Lacepede are the best-known deposits. There are, however, many other members of the class.

Mexillones Guano.—In this deposit the phosphates vary between 45 and 70 per cent., but more usually run about 66 per cent. The soluble phosphates are about ¾ per cent., and the ammonia from ½ to 1½ per cent.

Lacepede Guano.—This American guano frequently reaches 70 per cent. phosphates, but like the preceding is more usually about 66 per cent. In general composition, &c., it is like Mexillones guano.

Avola Guano.—Very similar to the two previous deposits, but its phosphates rarely go higher than 60 per cent.

Huon Island Guano.—Phosphates from 50 to 56 per cent. Ammonia may reach 2 per cent. and over.

Ashmore Shoals Guano.—Practically the same as Huon Island guano in composition.

Bahamas Island Guano.—A lower class of guano, with phosphates ranging between 35 and 42 per cent.

Guanahani Guano.—This is also a lower class phosphatic substance, containing from 20 to 40 per cent. of phosphate.

Table Y gives the analyses of these guanos.

TABLE Y.

COMPOSITION OF PHOSPHATIC GUANOS.

——	Mexillones.		
Moisture	8·64	11·82	13·08
Organic matter and ammonia*	6·68	4·96	7·64
Alkaline salts†	3·84	2·36	4·54
Ordinary guano phosphate‡	62·96	70·52	66·67
Carbonate of lime	7·76	5·56	5·16
Silica	10·12	4·78	2·91
	100·00	100·00	100·00
* Containing ammonia, equal	0·83	0·71	0·62
† Phosphoric acid in alkaline salts equal to bone phosphate rendered soluble	0·76	0·84	1·12
‡ Ordinary guano phosphates	62·96	70·52	66·67
Total phosphates	63·72	71·36	67·79

TABLE Y. 2.

PHOSPHATIC GUANOS.

——	Mexillones.		Lacepede.	Avola.	Huon Island.
Moisture	5·24	4·96	15·36	14·68	20·16
Organic matter and ammonia*	12·92	14·08	6·93	7·24	13·58
Alkaline salts†	0·86	0·52	2·63	0·86	1·12
Phosphates‡	72·76	46·48	67·84	58·48	54·96
Carbonate of lime	7·38	33·42	5·76	16·86	6·34
Silica	0·84	0·54	1·48	1·88	3·84
	100·00	100·00	100·00	100·00	100·00
* Ammonia	1·16	1·24	1·23	1·12	1·98
† Alkaline phosphates	0·42	0·36	0·12	0·12	0·58
‡ Ordinary guano phosphates	72·76	46·48	67·84	58·48	54·96
Total phosphates	73·18	46·84	67·96	58·60	55·54

——	Ashmore Shoals.	Bahamas.	Guanahani.		
Moisture	22·12	15·16	24·48	11·16	24·96
Organic matter and ammonia*	10·08	14·27	12·23	11·12	11·84
Alkaline salts†	1·24	15·64	6·04	7·28	7·92
Phosphates‡	52·68	38·92	23·72	37·54	30·91
Carbonate of lime	13·36	13·49	31·45	29·86	22·13
Silica	0·52	2·52	2·08	3·04	2·24
	100·00	100·00	100·00	100·00	100·00
* Ammonia	1·98	0·84	1·07	1·77	1·74
† Alkaline phosphates	..	0·14	..	..	..
‡ Ordinary guano phosphates	52·68	38·92	23·72	37·54	30·91
Total phosphates	52·08	39·06	23·72	37·54	30·91

DISSOLVED MANURES.

In the previous part of this communication I have dealt solely with such manures as could be obtained on the farm, or which could be used in the natural state. We have noted the desirability of obtaining phosphate in the soluble condition, and we have discussed the sources of soluble alkaline phosphate in guano. By much the larger proportion of soluble phosphate employed as manure is, however, the acid phosphate of calcium derived from the action of sulphuric acid on the ordinary bone or guano tricalcic phosphate ($Ca_3\ 2\ PO_4$). In the manufacture of this substance all that is required is the addition of the acid in sufficient quantity to remove and combine with two of the calcium atoms contained in the insoluble phosphate, so as to convert it into the tetrahydric monocalcic phosphate ($CaH_4\ 2\ PO_4$). The reaction is shown in the equation—

$$Ca_3\ 2\ PO_4 + 2\ H_2SO_4 = CaH_4\ 2\ PO_4 + 2\ CaSO_4.$$

Sometimes, however, this equation is written—

$$Ca_3\ 2\ PO_4 + 2\ H_2SO_4 = Ca\ 2\ PO_3 + 2\ CaSO_4 + 2\ H_2O.$$

It matters little, however, which of these equations is accepted, as the result is the same, namely, that the insoluble phosphate is converted into the soluble state.

In calculating the amount of acid required for this result, we must, however, take into account the proportions in which other ingredients are present in the raw material we are to work upon. Of these extra substances we must especially note calcic carbonate and calcic fluoride, although the latter is usually present in quantities so minute as to be ignored. The calcic carbonate must first be totally converted into sulphate before any action can be looked for on the phosphate. The action upon the carbonate is expressed in the equation—

$$CaCO_3 + H_2SO_4 = CaSO_4 + H_2O + CO_2.$$

We thus see that there is to be a loss of acid due to the carbonate of calcium, and which takes place first, and is, therefore, unavoidable. There is, however, another side to look upon in regard to this reaction, and it is this, that whilst the phosphate action with sulphuric action is slow and dead, giving off little heat, and yielding a heavy sodden mass unequally acted upon, that the carbonate action is brisk, much heat is generated, and the mass is left open and porous for the phosphate action. So much does this action aid in the manufacture of dissolved phosphate, that where the material to be dissolved contains little carbonate it is customary to add a low-class raw phosphate, solely for the carbonate it contains.

In the manufacture of dissolved manures the substances—raw material and acid—are brought together in a "mixer," and, after incorporation, are discharged into the "den."

One of the best known "mixers" is "Vickers'." It consists of a cylinder in which is a double revolving arm, composed of two gratings. There is an opening at the upper part for admission of the charge (about 15 cwt.), and a valve below opening into the "den."

During the manufacture large quantities of vapour are given off. These gases consist of carbonic anhydride (CO_2), sulphurous anhydride (SO_2), sulphuretted hydrogen (H_2S), vapours of hydric chloride (HCl), and sulphuric acid (H_2SO_4), along with other substances, amongst which are arsenuretted hydrogen (H_3As) and silicon fluoride (SiF_4). These gases are removed from the pit and mixer by means of an exhaust fan, and are condensed, as, from their noxious character, they cannot be passed into the atmosphere. One of the best apparatus I have seen for this purpose is one which was planned and erected by Mr. John Morrison, of Newcastle-on-Tyne. I am indebted to that gentleman for a tracing of the plant, which is seen in plan No. 2.

(*See* PLAN No. 2, p. 89.)

The vapours are first conducted through a long wooden flue, after which they pass to the apparatus proper. This apparatus consists of towers which are made of brick, and watertight. These are packed with crossed layers of wood constructed to yield the largest possible surface. Two or more towers are linked together, and at the summit of each is a watertight tray pierced to receive a number of tubes. The gases are passed upwards through the wood, which is kept in a moist state by means of water from the upper tray. The effluent water passes by means of a trapped drain to the sewer.

The depositing flue removes a portion of the impurities, especially the tetrafluoride of silicon, which, on coming in contact with the water vapour also escaping from the "den," is decomposed into gelatinous silica and silico-fluoric acid, the equation being—

$$3\,SiF_4 + 4\,H_2O = 2\,H_2SiF_6 + SiO_2,\ 2\,H_2O.$$

This is the main object of the flue, but a secondary result is the cooling of the gases, and consequent less water and tower space is required than where flues are not constructed. Where room cannot be found for the flues, then a series of boxes in circuit are substituted, on the principle of large Woulfe's bottles with the connecting tubes simply entering the necks; or again, he constructs two extra towers with zigzag sloping boards of wood, which are moistened with water, and over which the gases travel before entering the scrubbers proper—the great point being to remove the silica of the fluoride as completely as possible before the gases pass to the washing apparatus. Where this is not done the gelatinous silica tends to clog up the apparatus, which would thus be rendered useless. The results obtained are most satisfactory, the water from the last tower being practically acid-free.

The manure when it comes from the "den" is liable to be very moist, and should be allowed to age, after which, if it be made from bone or fish, &c., it requires to have added to it some substance to lick up the excess of water and acid (if present). In the higher class of manures this drying process is carried out by the addition of bone dust, degelatinised bone, bone ash, &c., but in the cheaper and lower-classed manures various other bodies are added, such as the native mineral selenite (gypsum), waste gypsum from various chemical processes, calcined phosphates of low class, and occasionally lime.

Gypsum.—The first of these bodies, gypsum, is obtained in large quantities in various deposits, but that near Rouen is the one generally used. The composition of the body shows nothing of actual manurial value except the lime salt, and that is generally present in the dissolved manure in abundance.

TABLE Z.

GYPSUM AS USED FOR DRYING MANURES FROM THE "DEN."

Hydrated sulphate of calcium	82·76
Phosphates Iron and alumina	1·08
Alkaline salts	1·68
Silica	1·52
Moisture, &c.	12·96
	100·00

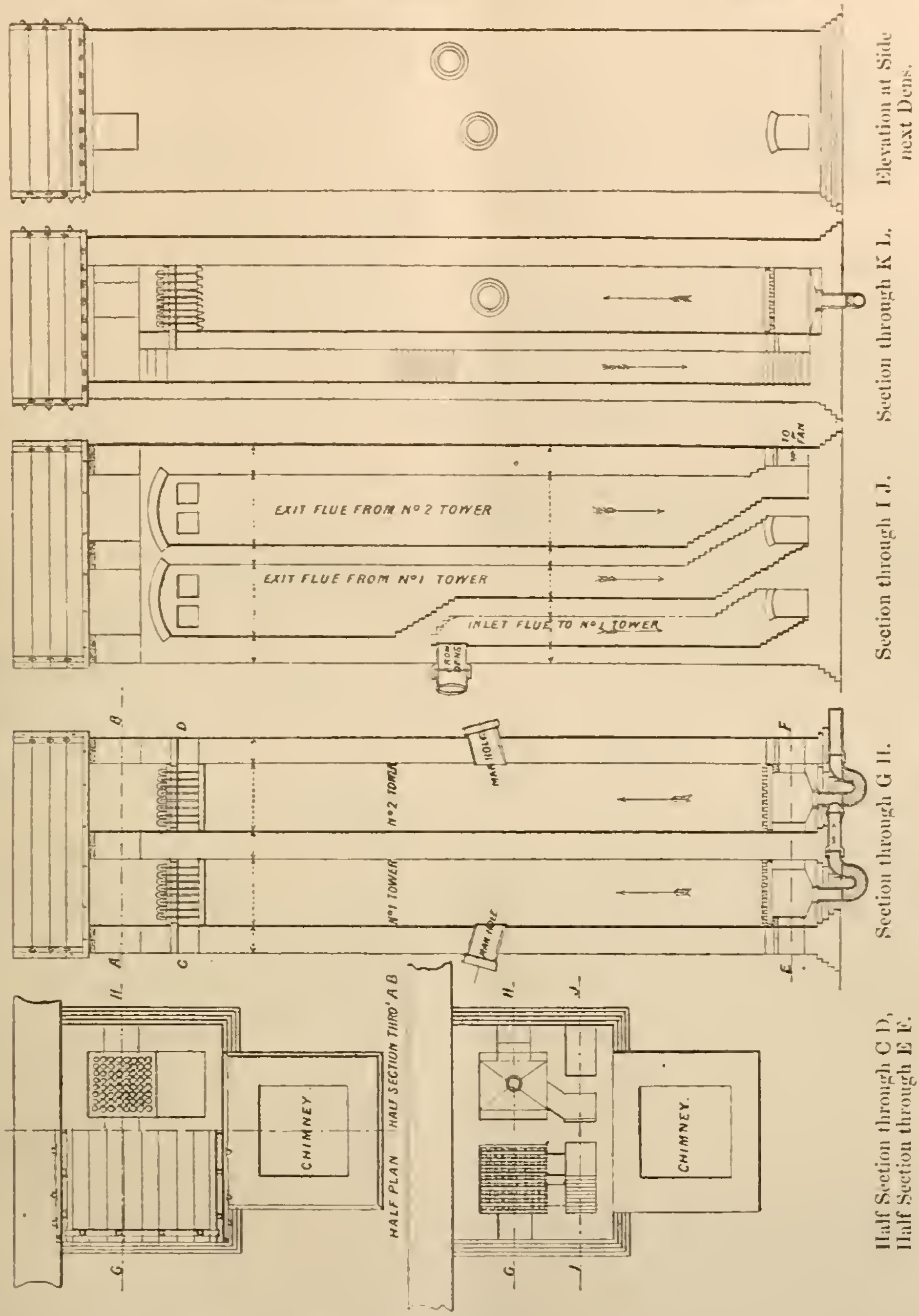
The refuse gypsum frequently contains some organic matter—poorly nitrogenous—and may give half a per cent. or so of ammonia. The following is analysis of one sample :—

TABLE AA.

COMPOSITION OF REFUSE GYPSUM.

Sulphate of calcium	59·64
Phosphates	5·37
Oxide of iron, &c.	1·59
Organic matter	19·84
Insoluble matter	11·52
Moisture	2·04
	100·00
Ammonia	0·68

Calcined Phosphates.—These are low-class materials containing some considerable proportion of carbonate of calcium. When calcined they lose water and part of their carbonic anhydride, and so become alkaline from the presence of caustic lime.



Plan No. 2.
Morrison's Fluorine Scrubber.

Table BB.

Composition of Calcined Bordeaux Phosphate.

Moisture	0·44
Phosphates	22·93
Carbonate of lime and caustic lime	72·02
Oxide of iron, &c.	2·16
Silica	2·42
	100·00

The action of this substance is twofold: (1) it absorbs some of the water, and (2) it takes up the excess of sulphuric acid to form calcic sulphate. It requires to be added with great care, as if an excess is present over and above what is required to neutralise the vitriol, then the further action proceeds of the caustic or carbonate of lime combining with the soluble phosphate of the manure and "reverting" it back to the insoluble state according to the equation—

$$CaH_4\,2\,PO_4 + 2\,CaO = Ca_3\,2\,PO_4 + 2\,H_2O,\ \text{ or}$$

$$CaH_4\,2\,PO_4 + 2\,CaCO_3 = Ca_3\,2\,PO_4 + 2\,H_2O + 2\,CO_2.$$

Lime.—The form of lime usually employed is known as "lias lime," and is obtained from the south of England. This variety contains nothing that is not present in the ordinary varieties of lime, and can give no better results. Its composition is as follows:—

Table CC.

Calcined Lias Lime.

Lime	73·88
Oxide of iron	3·56
Alumina	12·16
Magnesia	2·88
Phosphoric anhydride	0·52
Carbonic anhydride	3·52
Insoluble matter	3·48
	100·00

The substance must be added in very minute proportions, say from 1 to 1½ per cent. of the manure, else it will react on the phosphates as before explained (under calcined phosphate), and "revert" them. It is not applicable for very wet manures, such as are made from fresh blood and fish offal, although the practical result at first sight is very pleasing to look at, as the product becomes so very dry and friable.

The practical result of the addition of this drier will be noticed from the analyses given below of two samples of the same manure, the first being of the body as removed from the "den," and the second, the same substance after the addition of 6 per cent. of lias lime.

Table DD.

Dissolved Fish Manures.

——	As from the Den.	Dried with 6 per Cent. Lias Lime.
Soluble phosphate	12·79	6·21
(Equal to Bone phosphate rendered soluble	19·96	9·68)
Insoluble phosphate	2·04	13·12
Hydrated sulphate of lime	28·61	34·61
Alkaline salts	3·92	7·02
Siliceous matter	3·91	3·96
*Organic matter and ammonia	24·45	16·64
Moisture	24·28	18·44
	100·00	100·00
* Ammonia	1·45	1·52

The results show that in the comparatively short space of time (14 days) that the lime had been mixed with the manure the soluble phosphates had been reduced by one-half, whilst the water had been partly transferred from water of moisture to the condition of water of combination in hydrated sulphate of lime.

I have made a series of tests, on the small scale, with this fish manure, and have employed as "driers" several substances, but principally (1.) diatomite, a body found in many dried-up lake basins in Scotland, and composed of the siliceous valves of minute diatomaceæ. Being purely siliceous it can only act as an absorbent. (2.) Lias lime. (3.) Castor dust, which is the refuse external covering of the castor bean. It contains from 5 to 7 per cent. of ammonia, derivable from nitrogenous albumenoids, and has from 2 to 3 per cent. of phosphate. It contains only about 1 to 1½ per cent. of carbonate of lime, and can practically only act as an absorbent. At the same time, containing nitrogen and some phosphate, it will not dilute the manure so much as a purely siliceous absorbent. Its composition is as follows:—

Table EE.

Composition of Castor Dust.

Moisture	10·52	11·26
*Nitrogenous organic matter	83·36	82·54
Alkaline salts	0·85	0·75
Phosphates	2·32	2·47
Carbonate of lime	1·54	1·62
Insoluble matter	1·41	1·36
	100·00	100·00
* Ammonia	5·62	6·40

(4.) *Peat Litter.*—The composition of this substance has been already given.

Table FF.

Results of Experiments on the Action of various Substances in "drying" Fish Manure.

——	Green (no Drier).	5 per Cent. Diatomite.	5 per Cent. Lias Lime.
Soluble phosphates	19·96	17·36	10·12
Insoluble phosphate	2·04	3·34	10·58
Total	22·00	20·70	20·70
Ammonia	1·45	1·64	1·61
Condition	Damp	Fair	Dry

——	10 per Cent. Castor Dust.	5 per Cent. Castor Dust.	5 per Cent. Peat Litter.
Soluble phosphates	16·60	17·44	17·41
Insoluble phosphate	3·06	3·26	3·28
Total	19·96	20·70	20·69
Ammonia	1·85	1·74	1·68
Condition	Damp	Damp	Fair

The results, as given on Table FF., show that the lias lime is the only one of the set which "reverts" the phosphates. The castor dust is too hard and close to absorb well, but the diatomite and peat litter act splendidly. The only objection I can see to the latter is the fact that it remains visible, but, possibly, on the large scale, and working with a disintegrator to mix the bodies thoroughly, this difficulty might be overcome. The diatomite is at present too expensive, but it is possible that if a demand arose the coarser and more vegetable varieties of the substance could be sent into the market. The objection to gypsum is that it requires such a large amount to do the work. For fish manures about 10 per cent. is required.

Vitriolated Bones.—This material should consist of pure bones and acid only, the mixture being dried with bone meal, degelatinised bone, or bone ash. When well made it is a brown, greasy, and oily-smelling mass. When made from steamed bone it is lighter in colour. The soluble phosphates run from 5 to 14 per cent. These figures are equivalent to an amount of original bone phosphate = 8 to 22. In dealing with these dissolved manures it is the custom of the trade to refer to the amount of phosphate originally present in the raw material, and which has been converted into soluble phosphate, as the "'soluble phosphate," although strictly it is not so, but is the amount of insoluble phosphate which has been rendered soluble. Thus, a manure in which 8 per cent. of its phosphate has been dissolved to the equivalent or 5 per cent. of soluble phosphate, is sold as "8 per cent. soluble." This custom is an acknowledged and well-known one, and both the seller and the buyer proceed on that understanding.

The following Table GG gives the analyses of manures to be in the market this season :—

TABLE GG.

COMPOSITION OF VITRIOLATED BONES.

Soluble phosphate	14·94	13·48	9·52	12·97	8·92
(Equal to bone phosphate rendered soluble	23·32	21·04	14·86	20·24	13·92)
Insoluble phosphates ..	20·48	16·56	21·52	19·76	19·84
Hydrated sulphate of lime	28·27	33·45	30·36	30·27	30·28
Alkaline salts	3·28	3·44	3·28	3·02	2·46
Silica	2·71	2·79	2·15	3·03.	1·29
Organic matter and ammonia*	18·86	16·36	19·63	18·64	24·73
Moisture	11·46	13·92	13·54	12·31	12·48
	100·00	100·00	100·00	100·00	100·00
* Ammonia	2·05	2·56	3·24	2·54	2·56
Soluble phosphate	9·64	11·87	11·46	12·89	17·13
(Equal to bone phosphate rendered soluble	15·44	18·52	17·88	20·12	26·72)
Insoluble phosphates ..	25·92	14·86	22·16	15·92	5·96
Hydrated sulphate of lime	34·28	31·48	34·21	29·32	27·24
Alkaline salts	2·87	3·14	3·04	3·14	3·12
Silica	1·08	1·86	2·39	5·64	2·87
Organic matter and ammonia*	14·77	23·81	13·88	23·63	28·32
Moisture	11·44	12·98	12·86	9·46	15·36
	100·00	100·00	100·00	100·00	100·00
* Ammonia	3·42	3·14	2·24	2·96	3·12

Dissolved or Ammonia Fixed Guanos.—The nitrogenous guanos, especially Peruvian guano, are frequently "touched" with acid. This process stops any decomposition of the substance and consequent loss of ammonia, and at the same time increases the soluble phosphates. Not unfrequently some sulphate of ammonia is also added to increase the amount of ammonia. The ammonia varies from 7 to 10 per cent., the soluble phosphate (commercial) from 14 to 22 per cent., and the insoluble phosphate from 2 to 18 per cent., but is rarely higher than 10 per cent. in *pure* samples. There is often a small amount of nitrate present, and potash equal to sulphate of potash from 2 to 5 per cent. Table HH. gives the analyses.

TABLE HH.

COMPOSITION OF DISSOLVED PERUVIAN GUANO.

Soluble phosphate......	10·82	13·09	13·13	9·76	13·98
(Equal to bone phosphate rendered soluble	16·88	20·42	20·48	15·23	21·82)
Insoluble phosphate ...	7·84	11·34	2·21	8·26	12·36
Hydrated sulphate of lime	19·82	30·48	25·83	20·56	19·47
Alkaline salts	10·48	6·84	8·24	7·85	6·68
Silica	4·63	6·03	7·31	9·24	4·41
Organic matter and ammonia*............	36·05	20·84	32·74	27·73	31·82
Moisture...............	10·36	11·38	10·54	11·37	11·28
	100·00	100·00	100·00	100·00	100·00
* Ammonia............	9·42	6·24	9·03	9·63	7·03
Nitrogen in nitrates equal to ammonia	..	..	..	..	..
Potash equal to sulphate of potassium	4·86	0·54	..	..	3·75
Soluble phosphate......	10·51	13·05	11·18	9·31	11·73
(Equal to bone phosphate rendered soluble	16·48	20·36	17·44	14·52	18·32)
Insoluble phosphate ...	7·72	10·52	8·12	18·76	5·64
Hydrated sulphate of lime	23·48	22·16	19·56	15·92	24·68
Alkaline salts	9·14	6·89	8·68	10·54	6·46
Silica	6·97	5·19	2·78	6·73	7·43
Organic matter and ammonia*	30·32	30·27	37·24	27·46	35·54
Moisture...............	11·86	11·92	12·44	11·28	8·52
	100·00	100·00	100·00	100·00	100·00
* Ammonia	7·84	9·84	10·04	8·26	10·02
Nitrogen in nitrates equal to ammonia....	0·48	..	..	0·23	0·43
Total nitrogen as ammonia	8·32	..	..	8·49	10·45
Potash equal to sulphate of potassium.........	2·56	..	..	5·28	1·94

Guano Superphosphates.—As already stated, the phosphatic guanos are frequently dissolved so as to render the greater proportion of their phosphate soluble. They give very high class manures, containing from 30 to 45 per cent. or more of soluble phosphate, accompanied by about one-half per cent. of ammonia. Three analyses are given on Table I I. of Mexillones superphosphate.

TABLE II.

COMPOSITION OF MEXILLONES SUPERPHOSPHATE.

Soluble phosphates	20·97	28·37	22·13
(Equal to bone phosphate rendered soluble	32·72	44·26	34·52)
Insoluble phosphates	8·54	2·48	8·27
Hydrated sulphate of lime..	43·27	52·17	43·76
Alkaline salts..............	2·98	1·52	2·92
Silica	1·36	0·48	1·16
*Organic matter, ammonia, and water	22·88	14·98	21·76
	100·00	100·00	100·00
*Ammonia..................	0·73	0·33	0·43

Besides the manures which yield both phosphates and ammonia, there are many substances used which give only phosphate or ammonia. In this class we have many important fertilisers, such as bone charcoal, bone ash, mineral phosphates, and slag phosphate, which yield phosphate only; and sulphate of ammonia, nitrate of soda, wool, hair, blood, &c. which give ammonia; besides salts of potassium, sodium, and magnesium for special ingredients.

Bone Black or Animal Charcoal is used in many cases to decolorise liquids, and after it ceases to have this power it is employed as manure. It contains from 50 to 70 per cent. of phosphates. It is usually mixed in dissolved manures, especially in those used for the sugar-cane. It gives to the manure a black colour which is objected to in this country.

Bone Ash is principally obtained from South America, especially from those districts which export tallow and hides. The substance is not purely derived from bones, but is the ash of the whole carcase of the animals. In many of the tallow-raising districts fuel is very scarce, and the flesh, &c., after being boiled for the tallow, is dried in the sun and burned under the boiler for fuel. The material contains from 60 to 80 per cent. of phosphates. Analyses are given on Table KK.

TABLE KK.
COMPOSITION OF BONE ASH.

Moisture	8·08	13·24	19·43	7·51
Carbonaceous matter ...	0·74	0·61	0·64	0·71
Alkaline salts...........	0·76	0·72	0·69	0·62
Phosphates	67·32	72·54	62·48	63·36
Carbonate of lime, &c....	11·06	6·13	7·04	10·12
Silica	11·44	6·76	9·72	17·68
	100·00	100·00	100·00	100·00
Moisture................	7·32	7·52	7·28	4·56
Carbonaceous matter ...	0·71	0·76	0·89	0·48
Alkaline salts...........	0·69	0·64	0·62	0·56
Phosphates	72·76	73·72	77·53	80·64
Carbonate of lime, &c. ..	8·68	12·72	8·56	10·32
Silica	9·84	4·64	5·12	3·44
	100·00	100·00	100·00	100·00

Mineral Phosphates.—These substances are found in many geological formations. In some cases the material consists of the fossil guano of extinct Saurian reptiles, or of the bones or teeth of such, but the deposits are more usually massive. A very large number of these substances are known, and I do not propose to exhaust the list, but only to give prominence to a few of the more important.

Apatite.—This substance is a compound of phosphate of calcium with chloride of calcium or fluoride of calcium. The compound contains three of the phosphate along with one of the chloride or fluoride. Sometimes, however, both chlorine and fluorine are in the same sample.

Norwegian Apatite frequently reaches 90 per cent. of phosphate of calcium. It is one of the highest class phosphates.

Canadian Apatite is generally beautifully crystallised, and has a fine green or red colour. It is found in volcanic rocks in New York and New Jersey, and in the Laurentian limestones of Canada, as in the Ottawa district. It gives from 80 to 95 per cent. of phosphate. It is frequently dissolved, and yields a superphosphate containing from 30 to 35 per cent. of soluble phosphate, with from 6 to 8 per cent. of insoluble phosphate. Containing little iron, it is not so liable to "revert" after manufacture as many of the other phosphates.

Phosphorite or Estramadurite.—This is a Spanish phosphate containing 76 to 82 per cent. of true phosphate. Occasionally it falls below 50 per cent., and in such cases will contain either limestone or quartz.

Welsh Phosphorite is found in the Silurian system (lower). It gives 50 to 60 per cent. phosphate; it is dark in colour, and often contains much carbonate of calcium.

Nassau or German Phosphate is from the Devonian system of Nassau. It varies much in composition, running in phosphates from 30 to 75 per cent. It contains a considerable proportion of iron (up to 6 per cent. of ferric oxide) and alumina (often 4 per cent.), and is therefore not in great repute on account of the large amount of "reverted" phosphate formed in the superphosphate.

Coprolite (*Cambridge*).—This material is obtained from the Upper Greensand formation in Cambridgeshire. The phosphate runs from 50 to 60 per cent., and averages 54 per cent. It contains much carbonate of calcium, but little iron, in the ferric condition. The superphosphates manufactured from the material are permanent and little liable to "revert." They contain from 28 to 35 per cent. of soluble phosphate.

Coprolite (*Buckingham*).—From the same formation as the Cambridge variety, and very similar in composition. They average 60 per cent. phosphate.

Coprolite (*Suffolk*).—These coprolites are not so valuable for the manufacture of superphosphate as the two previous varieties, as the iron they contain is in the ferric state, and liable to "revert" the soluble phosphate. The phosphate varies from 48 to 60 per cent., but averages 54 per cent. They are of Tertiary formation.

Coprolite (*Potton or Bedford*).—The average amount of phosphate in these coprolites is about 50 per cent. In some cases they may, however, run up to 60 per cent., and in others may not exceed 45 per cent. They belong to the Lower Greensand formation. The ferric iron frequently is as high as 4 per cent., and the alumina as much.

Russian Phosphate comes from the Chalk, and occurs in curious rounded masses. It contains from 28 to 35 per cent. of phosphate, but may run up to 69 or 70 per cent.

Boulogne Phosphate is a coprolite containing much silica and from 40 to 45 per cent. of phosphate. It yields permanent dissolved compounds.

Sombrero Phosphate.—This is one of the best of the many phosphates yielded us by the Windward Islands of the Carribean Sea. It is practically free from iron, and yields the highest class of superphosphates. The phosphate contained is equal to from 65 to 78 per cent., and averages high.

Charleston or Carolina Phosphate occurs as rough nodular masses in the beds of several rivers, especially the Bull and Ashley Rivers in South Carolina. Land phosphate is also obtained from the same district. It is sometimes as high as 60 per cent. in phosphate, but is more usually from 46 to 48 per cent.

Navassa Phosphate or Cooperite consists of a mixture of phosphate of calcium and magnesium, of which it contains from 47 to 56 per cent. It also contains from 4 to 5 per cent. of ferric iron and from 8 to 10 per cent. of alumina, and is, therefore, of low class for dissolving.

Antwerp or Belgian Phosphate is imported in a fine state of division. It is a low-class phosphate of from 30 to 35 per cent.

Aruba Phosphate, from the Windward Islands, is a phosphate very free from iron, and dissolving well. It is of very high-class quality, yielding from 75 to 85 per cent. of phosphate, and giving a superphosphate of from 35 to 37 per cent. soluble phosphate.

Curaçoa Phosphate is also of very high-class quality, giving from 80 to 88 per cent. of phosphates. It dissolves well to a first-class compound of from 40 to 45 per cent. soluble phosphate.

Fossil Guano Phosphate, obtained in a fine state of division, varies much in its composition. Of two analyses given below, one contains only 22 per cent. of phosphate, whilst the other holds 58 per cent.

Cuban Phosphate, contains from 45 to 60 per cent. of phosphate, accompanied by from 1½ to 2½ per cent. of iron and alumina. It also gives about one per cent. of ammonia.

Redonda Phosphate, from the Leeward Islands, is a hydrated phosphate of alumina, containing about 44 per cent. of phosphoric acid (which is equal to about 70 per cent. of calcium phosphate), about 6 per cent. of ferric iron, and 20 per cent. of alumina. It is the subject of several patents, which had for their object the conversion of the body into sulphate of alumina and phosphate of calcium.

Table LL.

Composition of Coprolites.

—	Bucks.	Cambridge.	Suffolk.	Bucks.
Moisture	2·84	2·16	1·52	1·54
Organic matter .	0·82	1·94	3·15	0·46
Alkaline salts ...	0·32			0·51
Phosphates	62·52	60·98	51·38	64·65
Carbonate of lime	22·82	21·84	24·91	20·76
Silica, &c........	10·68	13·08	19·04	12·08
	100·00	100·00	100·00	100·00

Table MM.

Composition of Raw Mineral Phosphates.

—	Charleston.		Sombrero Phosphate.	
Phosphates	60·64	60·64	76·68	76·84
Iron and alumina	2·56	1·55	1·02	1·31
Carbonate of lime	21·28	25·94	16·87	14·28
Alkaline salts	0·76	0·42	0·42	0·38
Silica	13·48	9·92	2·02	4·16
Moisture, &c.	1·28	1·52	2·69	2·43
	100·00	100·00	100·00	100·00

—	Fossil Guano Phosphate.		Bull River Phosphate.
Phosphates	57·84	22·12	60·92
Iron and alumina	3·28	0·92	1·24
Carbonate of lime	26·18	71·84	27·28
Alkaline salts	0·24	0·16	0·16
Silica	11·42	2·61	8·24
Moisture, &c.	1·04	2·32	2·16
	100·00	100·00	100·00

—	Belgian Phosphate.	
Phosphates	31·04	34·64
Iron oxide and alumina	2·16	2·48
Alkaline salts	0·32	0·36
Carbonate of lime	56·44	50·26
Silica	9·48	10·92
Moisture	0·56	1·34
	100·00	100·00

—	Cuban Phosphate.	
Phosphates	60·48	49·82
Iron and alumina	1·86	1·72
Carbonate of lime	13·06	17·86
Alkaline salts	0·82	0·64
Silica	2·28	2·44
Moisture	15·08	15·84
Organic matter	6·42	11·68
	100·00	100·00
Ammonia	0·96	1·04

These phosphates are used both in the raw and in the dissolved state. The first process in either case is to get the substance into a very fine state of division. The "cracker" for the first breaking must have plain rollers of great power.

Dissolved Bone Ash.—This very high-class superphosphate contains from 30 to 45 per cent. of soluble phosphate, with 3 to 5 per cent. of insoluble phosphate. Its composition is shown on Table XX.

TABLE XX.

COMPOSITION OF DISSOLVED BONE ASH OR BONE ASH SUPERPHOSPHATE.

Soluble phosphate	20·46	25·48	28·92	25·48	22·58
(Equal to bone phosphate rendered soluble	31·92	39·76	45·12	39·76	35·23)
Insoluble phosphate ...	5·06	0·68	2·36	4·28	8·78
Hydrated sulphate of lime	49·19	49·74	50·96	46·42	46·37
Alkaline salts	2·51	2·32	1·26	2·17	2·91
Silica	7·08	6·07	2·12	5·23	4·62
Organic matter, ammonia, and water	15·67	15·71	14·38	16·42	14·74
	100·00	100·00	100·00	100·00	100·00
Ammonia	0·06	0·04	0·03	0·12	0·12
Soluble phosphate	22·97	22·47	24·13	24·68	24·31
(Equal to bone phosphate rendered soluble	35·84	35·06	37·64	38·52	37·92)
Insoluble phosphate ...	7·52	3·96	1·28	5·84	1·76
Hydrated sulphate of lime	47·12	49·36	51·62	48·17	49·64
Alkaline salts	2·34	1·74	2·48	1·38	2·86
Silica	4·03	6·13	2·96	4·99	4·17
Organic matter, ammonia, and water	16·02	16·34	17·53	14·93	17·26
	100·00	100·00	100·00	100·00	100·00
Ammonia	0·14	0·02	0·03	0·03	0·02

Mineral Superphosphates are generally obtained from a mixture of raw mineral phosphates. The soluble phosphate contained runs from 24 to 35 per cent. or over, with from 1 to 4 per cent. of insoluble phosphate. The composition is shown on Table OO.

TABLE OO.

COMPOSITION OF MINERAL SUPERPHOSPHATE.

Soluble phosphate	15·78	20·56	18·56	17·66	18·82
(Equal to bone phosphate rendered soluble	24·62	32·08	28·96	27·56	29·36)
Insoluble phosphates ..	3·56	2·74	0·94	1·34	1·58
Hydrated sulphate of lime	54·12	52·88	53·85	54·25	54·27
Alkaline salts	2·25	2·08	2·32	2·28	2·36
Silica	8·27	6·12	8·26	4·66	6·25
Organic matter, ammonia, and water	16·02	15·62	16·07	19·81	16·72
	100·00	100·00	100·00	100·00	100·00

TABLE OO—*cont.*

Soluble phosphate	18·11	19·45	18·05	25·11	15·97
(Equal to bone phosphate rendered soluble	28·72	30·34	28·16	39·16	24·92)
Insoluble phosphates ..	4·86	1·54	3·72	0·58	7·04
Hydrated sulphate of lime	53·24	54·36	54·32	52·12	53·38
Alkaline salts	2·85	2·87	1·76	2·24	1·43
Silica	4·58	4·36	5·78	1·06	5·42
Organic matter, ammonia, and water	16·06	17·42	16·37	18·89	16·76
	100·00	100·00	100·00	100·00	100·00

Slag Phosphate.—This substance is obtained in the Thomas-Gilchrist process of steel making. The crude phosphoric iron is placed in converters lined with magnesian-lime bricks, and during the fusion the slag floats up. It is removed, cooled, and disintegrated by special machinery, being first crushed and afterwards ground under edgestones. The material contains from 10 to 19 per cent. of phosphoric acid; from 45 to 60 per cent. of calcic oxide (lime); about 13 per cent. of iron oxides, of which some 9 to 10 per cent. is ferrous; 4 to 5 per cent. of manganese; about 3 to 4 per cent. of magnesia, and under one per cent. of alumina. Its composition is shown in four analyses on Table PP.

TABLE PP.

COMPOSITION OF SLAG PHOSPHATE.

Moisture	0·56	0·63	0·45	0·71
Phosphoric anhydride* .	17·59	16·44	15·44	11·37
Lime	51·22	52·33	53·39	56·81
Magnesia	3·47	4·21	3·16	3·82
Ferrous oxide...........	9·86	9·28	9·73	8·25
Ferric oxide	2·16	2·12	2·43	2·71
Alumina	0·87	0·85	0·78	0·82
Manganous oxide	4·86	4·53	4·62	4·76
Sulphur, &c.	0·49	0·35	0·16	0·54
Silica	8·92	9·26	9·84	10·21
	100·00	100·00	100·00	100·00
* = Tribasic phosphate of calcium	38·39	35·88	30·79	24·82

NITROGEN SOURCES.

Blood.—This substance is employed in three states:—(1) in the natural liquid condition; (2) in clot; (3) dried. The blood differs much in composition according to the animal from which it is obtained, and also according to the age of the animal. The clot also differs from the liquid part. These facts are shown in the analyses given on Table RR.

TABLE RR.

COMPOSITION OF SHEEP BLOOD.

—	Young Animals.		Whole Blood.
	Clot.	Liquid.	Prime Animals.
Water	68·156	90·121	87·42
* Nitrogenous organic matter	31·491	9·301	11·38
Alkaline salts	0·162	0·438	1·20
Phosphates	0·073	0·037	
Oxide of iron, &c.	0·091	0·103	
Carbonate of lime, &c.	0·027		
	100·000	100·000	100·00
* Containing Nitrogen = Ammonia	5·811	1·589	1·732

Ox blood is frequently treated with acid, and the clot so obtained employed for manure. The following is an analysis of this material, which shows 7¼ per cent. of ammonia : —

COMPOSITION OF CLOT BLOOD.

Moisture	30·56
Nitrogenous organic matter	52·43
Alkaline salts	4·52
Phosphates	2·21
Carbonate of lime	4·72
Iron, &c.	2·35
Silica	3·21
	100·00
Nitrogen = Ammonia	7·22

The dried blood is a dark red-brown solid, containing nitrogen equal to from 12 to 17 per cent. of ammonia. Four analyses gave of ammonia 13·56, 12·25, 16·43, and 15·34 per cent. The following analysis shows the proportions of water, organic matter, and salts in one sample :—

DRIED BLOOD.

Water	10·56
Nitrogenous organic matter	86·92
Saline matter	2·52
	100·00
Nitrogen = Ammonia	17·21

Ground Horns and *Hoofs* yield from 9 to 15 per cent. of ammonia. If the pith of the horn is included, then from 9 to 11 per cent. of phosphate will also be present. For ammonia, four samples of pure horn gave 14·22, 15·84, 13·42, and 14·82 per cent., whilst a mixture of pith and horn gave 9·63 per cent. *Keronikon* is the filings and turnings of horn from comb works. It gives about 15 to 16 per cent. of ammonia. Two analyses of ground horn are given.

GROUND HORN.

—	Horn and Pith.	Horn and Hoof.
Moisture	11·32	15·84
* Nitrogenous organic matter	61·61	79·28
Alkaline salts	0·75	0·81
Phosphates	10·33	0·84
Carbonate of lime	6·61	1·95
Silica	6·32	1·28
	100·00	100·00
* Nitrogen equal to Ammonia	9·63	11·82

Flock Dust and Shoddy are the dust from the dressing machines of the woollen factories. Four samples of flock dust gave of ammonia 9·05, 7·32, 12·84, and 9·02 per cent. ; whilst five samples of shoddy gave 3·92, 3·62, 4·12, 3·34, and 1·42 per cent. An analysis of *Ground Wool* is given below :—

Moisture	7·92
Organic matter	70·52
Alkaline salts	0·56
Phosphates	0·92
Oxide of iron Alumina	3·96
Carbonate of lime	5·54
Sand	10·58
	100·00
Ammonia	7·56

Occasionally samples of "acidified shoddy" are met with. The following analysis gives the composition :—

ACIDIFIED SHODDY.

Moisture	20·72
*Organic matter	50·46
Alkaline salts	1·76
Phosphates	1·64
Iron, &c.	2·84
Sulphate of lime	5·68
Free sulphuric acid	2·38
Silica	14·52
	100·00
*Ammonia	3·64

White Whale Cork, or the outer thick skin of the white whale, is a fair source of nitrogen. It is usually bought in the fresh or uncured state and mixed with farmyard manure, and allowed to rot.

WHITE WHALE CORK.

Moisture	61·51
*Organic matter	32·09
Alkaline salts	5·73
Phosphates	0·36
Carbonate of lime	0·13
Siliceous matter	0·18
	100·00
*Ammonia	4·38 per cent.

CALCULATED FREE FROM MOISTURE.

Ammonia .... 11·40 per cent.

Rape Dust yields about 4½ per cent. of ammonia. It also contains about 2 per cent. of phosphates. Coarse rape-seed cake is also employed as a cheap source of nitrogen.

Rape Dust.

Moisture	9·84
*Organic matter	78·32
Alkaline salts	2·44
Phosphates	2·28
Carbonate of lime	1·24
Sand	5·88
	100·00
*Ammonia	4·41

Soot contains variable proportions of ammonia salts. The analyses of two samples are given below. It is frequently used as a "top dressing," and acts also as an insecticide.

Soot.

Moisture	6·68	12·48
*Organic matter, carbon, &c	77·76	58·04
Alkaline salts	1·86	4·38
Phosphates	0·81	0·78
Oxide of iron, &c.	1·11	1·84
Carbonate of lime	1·64	4·12
Sand	10·14	18·36
	100·00	100·00
*Ammonia	6·12	4·26

Sulphate of Ammonia is the great source of ammonia. It is largely manufactured from (1) the liquor obtained during the destructive distillation of coal in gasworks; (2) from the liquid obtained from the vapours proceeding from the iron blast furnaces; and (3) from the water got during the distillation of shales for paraffin tar. The latter works obtain from 10 to 75 lbs. of sulphate of ammonia from each ton of shale distilled. The salt contains ammonia equal to about 25 per cent., and rarely falls below this, whilst 25½ per cent. is common. Table SS. gives analyses of this season's make.

Table SS.

Composition of Sulphate of Ammonia.

Sulphate of ammonia pure and dry*	93·25	93·84	98·92	97·37	97·18	97·67	98·13	98·19	97·41
Insoluble matter	0·78	Trace	0·04	0·21	0·06	0·14	0·12	0·06	Trace
Moisture	5·73	5·04	1·04	2·42	2·63	2·19	1·75	1·75	2·35
Sulphate of soda, &c.	0·24	1·12	..	..	0·13	..	..	..	0·24
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
* Containing ammonia.	24·02	24·17	25·47	25·08	25·03	25·16	25·28	25·29	25·09

Nitrate of Soda.—This salt is obtained from Peru. When found naturally it is mixed with much earthy impurity and with common salt. It is treated with water, decanted from insoluble matters, and the common salt crystallised out. It contains nitrogen equal to from 19 to 19½ per cent. of ammonia; five parts of nitrate of soda being equal to one of ammonia. The analyses of the material show from 94 to 98 per cent. of pure nitrate.

Table TT.

Analyses of Nitrate of Soda.

Nitrate of soda pure and dry	96·27	96·61	97·88	96·89	94·23
Chloride of sodium	1·08	0·48	0·21	1·71	4·54
Insoluble matters	0·14	0·26	0·02	0·18	0·15
Moisture	2·06	2·62	1·86	1·08	0·95
Sulphate of sodium	0·45	..	..	0·14	0·13
	100·00	100·00	100·00	100·00	100·00
Nitrate of soda pure and dry	98·44	98·02	97·45	96·77	95·94
Chloride of sodium	0·14	0·28	0·28	0·32	1·06
Insoluble matters	0·04	0·13	0·35	0·27	0·86
Moisture	1·38	0·78	1·92	2·61	2·14
Sulphate of sodium	..	..	..	..	..
	100·00	100·00	100·00	100·00	100·00

Potassium Salts.

The salts used for manurial purposes are sulphate and chloride of potassium, kainit, and mixed potash salts.

Sulphate of Potassium. — This salt is usually guaranteed to contain at least 50 per cent. sulphate. It always contains some chloride of magnesia, and from 18 to 25 per cent. of common salt. The composition is given on Table UU.

Table UU.

Analyses of Sulphate of Potash.

*Sulphate of potassium	64·34	56·32	55·91
Chloride of magnesium	7·86	9·24	6·46
Sulphate of calcium.........	..	..	1·68
Chloride of sodium..........	18·43	23·71	22·82
Insoluble matter............	1·21	1·46	1·86
Moisture....................	8·16	9·27	11·27
	100·00	100·00	100·00
* Containing potash	34·76	30·43	30·21

Chloride of Potassium or Muriate of Potash should contain 80 per cent. of pure chloride. It sometimes contains chloride of magnesium, and invariably common salt. The composition is given on Table VV.

Table VV.

Analyses of Muriate of Potash.

Chloride of potassium pure and dry*	82·44	77·93	80·76	81·04	80·68
Chloride of sodium.....	5·26	10·57	11·42	9·13	10·91
Chloride of magnesium.	2·50	7·26	..	..	..
Sulphate of magnesium.	..	1·86	4·26	4·16	4·58
Sulphate of soda	..	..	1·32	1·08	1·24
Insoluble matter, &c. ..	2·28	0·94	0·38	1·28	0·97
Moisture...............	7·52	1·44	1·86	3·31	1·62
	100·00	100·00	100·00	100·00	100·00
* Containing potash ...	52·01	49·16	50·95	51·12	50·94

Nitrate of Potassium or Nitre is employed to a slight extent. It varies much in composition, the two analyses quoted showing 58½ and 73¼ per cent. of nitrate. The salt is of double value, containing potash and nitrogen.

Nitrate of Potassium.

*Nitrate of potassium............	73·24	58·42
*Chloride of potassium...........	11·82	..
Chloride of sodium...............	8·91	39·46
Sulphate of sodium	2·81	0·92
Insoluble matter.................	0·58	0·04
Moisture.........................	2·64	1·16
	100·00	100·00
* Equal to potash................	41·40	26·63

Potash Salts contain both sulphate and chloride of potassium along with magnesium as chloride, &c.

Potash Salts.

*Sulphate of potassium .	39·15	35·84	20·66	28·16
*Chloride of potassium..	10·98	21·45	17·13	21·26
Chloride of magnesium .	14·26	19·78	16·84	14·42
Chloride of sodium......	18·23	16·67	24·31	29·59
Insoluble matter........	10·86	5·22	17·22	4·17
Moisture................	6·52	1·04	3·84	2·40
	100·00	100·00	100·00	100·00
* Equal to potash.......	28·08	32·89	21·97	28·62

Kainit is an impure natural salt of potassium, present in the sulphate state. It contains magnesium as chloride and sulphate, and much common salt. A good sample will contain at least 12 per cent. of potash. The analyses are given on Table WW.

Table WW.

Analyses of Kainit.

*Sulphate of potassium	39·98	27·17	25·47
Sulphate of magnesium.....	15·87	18·96	16·12
Chloride of magnesium	10·48	11·31	10·12
Sulphate of lime............	1·21	2·34	1·46
Chloride of sodium..........	22·87	31·45	41·65
Insoluble matter............	0·86	0·92	1·82
Moisture....................	8·73	7·85	3·36
	100·00	100·00	100·00
* Containing potash	21·58	14·68	13·76
*Sulphate of potassium	25·16	25·73	23·25
Sulphate of magnesium	12·42	22·96	10·32
Chloride of magnesium......	8·16		9·62
Sulphate of lime	1·36	2·17	1·65
Chloride of sodium..........	43·14	45·73	41·76
Insoluble matter............	1·52	3·23	0·64
Moisture....................	8·24	0·18	12·76
	100·00	100·00	100·00
* Containing potash equal to	13·59	13·90	12·56

Magnesium and Soda salts are also occasionally employed, but the proportions of these bodies contained in kainit, &c. are usually sufficient for all practical purposes.

Compound Manures.

The single ingredient substances are most usually worked up into compound manures. Of these the most common is *Dissolved Bones or Dissolved Bone Manure*, which originally, as its name suggests, was made from bones and acid alone. Gradually, however, it has become more and more mixed, until what is now generally accepted as dissolved bones is in reality a mixture of a high-class mineral phosphate, a low-class phosphate, bone meal, and acid, with probably blood and Liebig guano to run up the nitrogen. The resulting compound gives from 19 to 25 per cent. of soluble phosphate, from 10 to 18 per cent. of insoluble phosphate, and from 2 to 4 per cent. of ammonia.

TABLE XX.

DISSOLVED BONE MANURE.

Soluble phosphate	14·56	12·21	16·56	12·48	11·74
(Equal to bone phosphate rendered soluble	22·72	19·06	25·84	19·48	18·32)
Insoluble phosphate ...	10·02	4·52	12·08	14·08	11·58
Hydrated sulphate of lime	32·43	35·04	39·53	38·13	36·17
Alkaline salts	3·27	3·28	2·52	3·82	3·32
Silica	4·53	6·38	4·96	4·91	9·46
Organic matter and ammonia*	22·51	26·26	15·03	11·12	14·37
Moisture	12·68	12·31	9·32	15·46	13·36
	100·00	100·00	100·00	100·00	100·00
* Ammonia	2·15	1·85	2·05	1·74	1·93

Soluble phosphate	14·54	12·23	12·25	12·71	9·69
(Equal to bone phosphate rendered soluble.....	22·68	19·08	19·12	19·84	15·12)
Insoluble phosphate ...	5·32	10·46	16·64	18·84	15·68
Hydrated sulphate of lime	36·23	34·91	31·83	33·23	30·24
Alkaline salts..........	2·61	2·87	2·92	2·84	3·82
Silica	4·56	4·98	3·32	3·48	2·26
Organic matter and ammonia*	20·62	18·99	17·53	16·34	26·83
Moisture...............	16·12	15·56	15·51	12·56	11·48
	100·00	100·00	100·00	100·00	100·00
* Ammonia	1·86	2·33	2·76	1·63	3·92

Fish Manure, and Blood, Fish, and Bone Manure.—These manures have a basis of mineral phosphate mixed with fish alone, or a mixture of blood clot, fish gut, and bone meal. They form good general manures.

TABLE YY.

DISSOLVED FISH MANURE.

Soluble phosphates	6·59	7·57	6·21	12·79
(Equal to bone phosphate rendered soluble......	10·28	11·82	9·68	19·96)
Insoluble phosphate	10·02	6·38	13·12	2·04
Hydrated sulphate of lime	28·58	52·25	34·61	28·61
Alkaline salts...........	6·64	7·08	7·02	3·92
Silica	4·36	5·11	3·96	3·91
Organic matter and ammonia*	20·85	8·69	16·64	24·45
Moisture	22·96	12·92	18·44	24·28
	100·00	100·00	100·00	100·00
* Ammonia.............	2·24	1·15	1·52	1·45

TABLE YY—*cont.*

Soluble phosphates	13·56	4·07	11·61	9·97
(Equal to bone phosphate rendered soluble......	21·16	6·36	18·12	15·56)
Insoluble phosphate	6·14	14·28	1·64	7·32
Hydrated sulphate of lime	38·47	32·67	32·98	34·89
Alkaline salts...........	5·16	7·76	3·72	3·36
Silica	3·42	3·23	3·64	4·36
Organic matter and ammonia*	16·97	20·83	22·93	19·38
Moisture................	16·28	17·16	23·48	20·72
	100·00	100·00	100·00	100·00
* Ammonia	1·32	1·52	2·04	1·43

TABLE ZZ.

BLOOD, FISH, AND BONE MANURE.

Soluble phosphates	10·91	0·71	10·61	14·43	7·54
(Equal to bone phosphate rendered soluble	17·02	1·12	16·56	22·52	11·72)
Insoluble phosphate ...	9·96	22·96	8·42	10·88	19·04
Hydrated sulphate of lime, &c.	35·24	25·37	32·98	34·53	22·61
Alkaline salts	2·96	10·42	3·01	3·26	5·36
Silica	4·93	3·24	4·89	2·94	3·12
Organic matter and ammonia*...........	22·78	19·82	17·81	21·04	20·89
Moisture...............	14·12	17·48	22·28	12·92	21·44
	100·00	100·00	100·00	100·00	100·00
* Ammonia............	2·46	1·24	1·62	2·31	2·12

Special Manures are also manufactured for special crops. These vary much, depending upon the character of the soil and the special ideas of the individual farmer. The wide range of composition is well seen on Table AAA.

TABLE AAA.

SPECIAL TURNIP MANURE.

Soluble phosphate......	17·74	13·16	13·12	16·87	11·71
(Equal to bone phosphate rendered soluble	27·68	20·54	20·48	26·32	18·26)
Insoluble phosphate....	4·08	17·82	10·64	6·20	17·84
Hydrated sulphate of lime	39·18	31·05	35·52	38·38	32·86
Alkaline salts	3·36	3·08	7·63	3·28	5·24
Silica..................	4·62	6·58	6·65	4·71	2·49
Organic matter and ammonia*............	16·04	14·83	12·03	15·01	19·72
Moisture	14·98	13·48	14·41	15·52	10·14
	100·00	100·00	100·00	100·00	100·00
* Ammonia.............	1·77	1·75	2·29	1·81	4·03
Potash = sulphate of potassium..........	..	..	2·94	..	2·96

Table AAA—*cont.*

Soluble phosphate......	7·64	15·23	4·97	6·82	4·75
(Equal to bone phosphate rendered soluble	11·92	23·76	7·76	10·64	7·42)
Insoluble phosphate....	14·68	3·28	24·78	17·72	10·26
Hydrated sulphate of lime..................	25·76	34·76	19·16	11·76	19·42
Alkaline salts	11·56	8·12	8·55	36·61	3·14
Silica....................	2·74	4·98	3·17	8·37	3·28
Organic matter and ammonia *	17·48	21·95	24·68	8·65	40·91
Moisture...............	20·14	11·68	11·38	10·04	18·24
	100·00	100·00	100·00	100·00	100·00
* Ammonia............	2·46	3·42	4·18	2·03	7·64
Nitric nitrogen equal to ammonia.........	..	..	..	6·23	..
Total nitrogen as ammonia......	..	..	..	8·26	..
Potash = sulphate of potassium	..	4·59	4·12	..	..

Table BBB.

Special Manures.

——	Bean Manure.	Grain Manure.	Potato Manure
Soluble phosphate	1·21	7·74	6·48
(Equal to bone phosphate rendered soluble	6·56	12·08	10·12)
Insoluble phosphate	2·84	12·12	18·29
Hydrated sulphate of lime ..	34·22	26·68	21·47
Alkaline salts	10·52	8·16	12·27
Silica	4·43	4·72	4·69
Organic matter and ammonia*	5·42	27·86	25·56
Moisture....................	8·36	12·72	11·24
	100·00	100·00	100·00
*Ammonia	0·37	5·35	4·72
Nitric nitrogen = ammonia .	0·14	..	..
Total nitrogen as ammonia	0·51	..	..
Potash = sulphate of potassium......................	38·12	4·86	8·58

——	Sugar-Cane Manure.	Barley Manure.	Grass Manure.
Soluble phosphate	8·64	4·56	5·33
(Equal to bone phosphate rendered soluble	13·48	7·12	8·32)
Insoluble phosphate	6·92	12·68	21·48
Hydrated sulphate of lime ..	24·40	23·87	18·64
Alkaline salts	17·83	19·92	23·56
Silica	3·41	4·30	2·13
Organic matter and ammonia*	23·22	25·62	16·92
Moisture	15·46	8·96	11·64
	100·00	100·00	100·00
* Ammonia	2·62	6·06	3·06
Nitric nitrogen = ammonia.	..	1·11	4·03
Total nitrogen as ammonia	..	7·17	7·09
Potash = sulphate of potassium	8·39	3·71	..

Supersulphated Manures.—The following analysis will give a general idea of these manures:—

Patent Supersulphated Wheat Manure.

	Per Cent.
Nitrogen equal to ammonia.........	2·56
Soluble phosphate	4·16
Insoluble phosphate	18·24
Sulphate of lime.....................	22·48
Sulphates of potash and soda, &c....	11·42
Containing sulphate of potassium...	4·57
Organic matter.......................	20·08

From the large number of high-class substances now used in compounding manures, it might be supposed that nothing but first-class compounds would be known to the market. That this is not so every chemist is well aware. One analysis which I have now before me contains only 1⅓ per cent. of soluble phosphates, 1½ per cent. of insoluble phosphate, and nitrogen equal to 1½ per cent. of ammonia. What this special compound is intended for it would be very difficult to make out. The importance of buying all manures on analysis cannot be too strongly urged.

Analysis.—It is not my intention to state processes or give details, but I should very strongly urge upon the Society the necessity for a convention of skilled analytical chemists who would be empowered to make experiments and frame a series of standard processes. This has been very fully and well done by the Association of Official Agricultural Chemists of America, the results of whose observations have been published by the Department of Agriculture at Washington. The chemists of this country could not go far wrong by taking a leaf from the book of their brethren on the other side of the Atlantic.

Valuations.—Since 1882 the Highland and Agricultural Society have published a set of valuation units from year to year. These have completely taken the place of the private valuations previously made up by associations and chemists. That this is a step in the right direction there can be little doubt. Manufacturers complain that the units are too low, and possibly in some cases this is so, but in the main they seem to be right. This year's units are attached.

Items to be Valued.	Ichaboe Guano.	Peruvian Guano. (Riddled.)			Fray Bentos and Fish Guanos.	Bones.		
		Genuine.		Fortified.				
Classes		a.	b.			a.	b.	c.
Phosphates:—	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Dissolved	..	..	..	..	..	..	..	..
Undissolved .	1 9	1 10	1 8	1 9	1 6	1 8	1 6	1 4
Ammonia	13 6	11 0	13 0	11 0	10 0	10 0	10 0	10 0
Potash.........	..	3 0	3 0	3 0	..	..	..	..

Items to be Valued.	Steamed Bone Flour.	Pure Vitriolated Bones.	Superphosphates.		Dissolved Compounds		
Classes	a.		a.	b.	From	To	Average.
Phosphates:—	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Dissolved	..	3 0	2 0	1 8	1 9	2 6	2 2
Undissolved ..	1 6	1 6	..	..	1 0	1 6	1 3
Ammonia	10 0	10 0	..	..	8 0	12 0	10 0
Potash	..	..	..	..	3 0	3 6	3 3

AVERAGE MARKET PRICES (for last Three Months).

MANURES.

—	Guarantee.	Price Per Ton.			Unit.		
	Per Cent.	£	s.	d.		s.	d.
Sulphate of ammonia, 97 per cent.	24 Am.	12	15	0	Ammonia =	10	6
Nitrate of soda, 95 per cent.	19 Am.	9	0	0	„	9	6
Castor cake dust	5·5 Am.	3	10	0	„	12	6
Rape cake dust	4·5 Am.	4	5	0	„	17	0
Horn dust	14 Am.	7	7	0	„	10	6
Shoddy and ground leather	12 Am.	3	10	0	„	6	0
Dried blood	15 Am.	8	0	0	„	10	9
Muriate of potash, 80 per cent.	50 Pot.	8	0	0	Potash =	3	3
Sulphate of potash, 50 per cent.	27 Pot.	4	10	0	„	3	3
Kainit	12 Pot.	1	13	0	„	3	0
Nitrate of Potash, 85 per cent.	14 Pot. 40 Pot.	16	10	0	Am. = Potash =	12 4	6 0
Ground Charleston Phos.	54 Phos.	2	5	0	Phos. =	0	10
Basic Slag Meal	40 Phos.	1	12	6	„	0	10

Manure manufacturers and others are deeply interested in the working of the "Merchandise Marks Act, 1887," and which says that no article is to be sold under a name which would lead the buyer to consider that he was purchasing a pure article in place of a mixture. Whether "dissolved bones" is or is not known to be a mixture, or whether the title truly represents the article sold, I have not space to discuss. The trade is undoubtedly divided on the question, and many manufacturers have now ceased to sell "dissolved bones," and instead thereof deal in "dissolved bone manure."

Birmingham and Midland Section.

Chairman: Charles Hunt.

Vice-Chairman: W. A. Tilden.

Committee:

G. S. Albright.
T. Barclay.
T. Bayley.
Horace T. Brown.
J. F. Chance.
B. Dawson.
E. W. T. Jones.
F. E. Lott.
G. H. Morris.
W. W. J. Nicol.
E. P. Peyton.
Howard Ryland.
T. Turner.
W. A. Wiggin.

Treasurer: C. O'Sullivan.

Local Secretary:
A. Bostock Hill, 14, Temple Street, Birmingham.

The next meeting will be held on March 7th, 1888.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held at Mason College, Birmingham, on the 14th December 1887.

MR. CHARLES HUNT IN THE CHAIR.

DISCUSSION ON MR. A. WILSON'S PAPER ON WATER GAS FOR HEATING AND ILLUMINATING.

THE CHAIRMAN, after expressing the indebtedness of the meeting to the author for his interesting paper, stated that in America water gas entered largely into competition with coal gas, and was rendered luminous by admixture of hydrocarbon vapour derived from oil, the use of which was made possible by its occurrence as a natural product. The conditions were thus very different from those which obtained in this country. There oil was cheap and coal was dear; here oil was cheap but coal was relatively cheaper; and thus it was improbable that water gas could compete with coal gas in this country. Having witnessed the experiments with a "Strong" apparatus, described by the author that evening, he was satisfied that the apparatus possessed great simplicity: it appeared well adapted for the production of water gas on a moderate scale, and would probably find a place where the use of water gas for heating purposes proved to be an advantage. Where this was the case it might also be used for lighting purposes by adopting one of the incandescent systems now in vogue, and thus a manufacturer might render himself independent of all outside sources of supply. Speaking as a gas manufacturer, he was not disposed to look upon such a system with a jealous eye, because a non-caking fuel such as gas-coke would have to be used. A ready market for their coke was of quite as much importance to gas manufacturers as an extension in the use of gas, and he was therefore disposed to hail with satisfaction the introduction of systems such as had been described that evening. He was not as clear as the author appeared to be as to the superiority of incandescent lighting. Theoretically it appeared as though more light could be obtained by utilising the heat of combustion than from the inherent luminosity of the flame; but the light was of a different and peculiar character. It exceeded coal gas, burnt in the ordinary way, in intensity, but its diffusibility was inferior, and, having regard to the balance of advantages, he must confess himself as still in favour of the luminous flame.

Mr. A. E. TUCKER asked the author to explain why, during the first period of use, magnesia cones gave a light of 22 candle power, in the second period they fell to 15, and in the third to 10? It might be that if the cones burnt away they would tend to stop up the burner or drop dust on to whatever was beneath them. He would also like to know whether the D-valve was sealed or whether it was simply water which formed the joint. With regard to the producers themselves, he saw no arrangement shown for "barring down." In his experience he had found it continually necessary to "bar down," to prevent the formation of spaces through which gas or steam could pass. In his title the author had spoken of water gas "as applied to lighting and heating purposes." He thought it would be of interest if the author would point out how it could be applied to the heating of private houses.

Dr. TILDEN inquired whether any other form of producer had been tried, and whether any attempts had been made to make the process continuous by burning a portion of the gas for the purpose of heating a closed chamber or retort containing the coke, through which steam could be passed. The intermittent system seemed clumsy, and required a considerable amount of attention.

With regard to the employment of the gas for domestic purposes, every one was probably aware that the use of water gas had been suggested many times. But one objection that had generally been urged against it was the fact that while practically odourless, it contained about half its volume of a poisonous gas. Whether or not this danger was less feared than formerly, the fact remained that carbonic oxide was very poisonous, and this was a point about which the public mind would have to be satisfied before the system was likely to meet with general favour.

Mr. Smith said that he had seen the whole of the process, described by the author, in operation at the Essen works. He saw the gas lighted in the restaurant, and it appeared very satisfactory; but one difficulty with which they had to contend there was the risk of the small films falling out after a certain time and setting fire to the premises. He tested the light and found it equal to 17·30 candles when burning at the rate of 6 ft. per hour. The carbonic oxide was the greatest danger, and they had some difficulty in persuading people to use the gas, but at last they used ammonia to scent it, which seemed quite satisfactory. With regard to cost, he had gone into the figures and found that 1,000 ft. would cost 8½*d.*, or about 1*s.* 2*d.* per 2,000 ft., as against 1*s.* 4*d.* per 1,000 ft. of coal gas, as it took double the quantity of water gas to represent the same power of coal gas. The heat derived from water gas could melt a piece of platinum wire in one second. The danger in using water gas was the pressure at which it was worked. This pressure was about double the normal pressure of coal gas, so that the leakage was considerable; and for this reason it could never compete with coal gas, though no doubt it had a great future.

Mr. Hack quite endorsed the Chairman's remarks as to the advantage to gas manufacturers of an outlet for their coke, but in Birmingham, where all could be so readily supplied with gas from the mains, he hardly expected that it would be appreciated. Manufacturers might use it for heating, and even under certain circumstances for illuminating purposes, but in the latter case the carbonic oxide present would entail risk and consequent responsibility. As a gas engineer he must oppose incandescent systems of lighting. At present they were fairly well off for light, and if the public were dissatisfied their duty would be to increase the candle power.

Mr. Clayton said that he had come to learn something of the adaptability of water gas for lighting country houses, and would like to know if the apparatus was one which a manservant or gardener could manage? Secondly, whether the question of carbonic oxide had been satisfactorily settled? Thirdly, what candle power was the light giving then, and how much gas was being consumed?

Mr. Turner said that all must feel that the author had been severely criticised. They must, however, remember that the process was yet in embryo, though it had been worked successfully in a number of cases. For his own part he would like to express his great interest in the paper, and his appreciation of the author's work. The name of Wilson was familiar to all who had to do with steel making, and in the name of this Section he must again express his appreciation of the paper.

Mr. Wilson said, in reply, I think the first gentleman who raised a matter for reply was Mr. Tucker, with reference to the wear of the burners. I can only say that I suppose the wear of the burners is due to the intense heat. The wearing out of them is very gradual, and, as regards the portion of the magnesia which does wear away, Mr. Tucker suggested that it might be supposed by anyone that it would fall off or cause dust to drop, but nothing of that kind occurs. I have burners in my house that have been working for several months and have never been touched, and if any dust does come away we never find it.

The D-valve is not sealed by any liquid at all. It is simply a valve on a metal face, and the water is used to keep it cool.

Then as regards the question of barring down, it is always necessary for ordinary gas producers. In these producers it is not at all necessary, and no doubt the explanation is that the fuel is dry.

Mr. Tucker asked a question about heating houses. I scarcely remember the drift of his remarks, but I may say that for heating asbestos they are very satisfactory; the quantity of gas burnt is, of course, more than town gas, but you get a more satisfactory fire and it is not more expensive.

Dr. Tilden referred to the subject of keeping the fuel hot so as to make gas. It would very much simplify the apparatus if this could be done; but when it is carried on on a large scale the difficulty becomes too serious, the amount of outside heat would be too great to make gas; and although this appears somewhat complicated, it possesses more advantages than the others, as only an attendant is required to charge the apparatus.

Several gentlemen referred to the question of the poisonous nature of the water gas, because it contained carbonic oxide. There is no doubt that it is perfectly true, but, for the purposes of poisoning, town gas is as bad as this. I do not know that any stronger answer can be given to that point than to say that in America there are more than 200 towns in which water gas is used. Of course 200 towns represent a wide distribution of gas, and if there was a liability to accident it would be found out.

There it is due to economical considerations which do not apply to this country, but, at any rate, in practical uses its poisonous properties are not at all to be feared.

One gentleman was asking about the power of these burners. When the cones are new the candle power is stated to be about 20, and when they have been burning 50 hours the wear and tear of the cone reduces the light to about 15 candles.

Mr. Clayton referred to the application to small houses, and asked whether it required skilled labour. Any labourer can do all that is necessary after a day or two's teaching, and as regards the proportion of carbonic oxide in ordinary coal gas, that would be about 8 per cent.

Mr. Turner referred to what he stated was somewhat strong criticism. Of course you may expect it if you bring anything new before the public, as the gas industry represents a very large amount of invested capital. It is not to be supposed that the revolution would be made in a short time. These matters have to go very slowly and step by step, and it is only criticism that eventually brings out the truth.

Nottingham Section.

Chairman: Lewis T. Wright.
Vice-Chairman: Frank Clowes.
Committee:
L. Archbutt.
Jas. H. Ashwell.
J. B. Coleman.
H. Doidge.
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E. Francis.
T. W. Lovibond.
S. J. Pentecost.
H. J. Staples.
E. B. Truman.
R. L. Whiteley.
Treasurer: W. H. Parker.
Hon. Local Secretary:
Jno. R. Ashwell, Midanbury Lodge, Bentinck Road, Nottingham.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held at Nottingham on December 21st, 1887.

MR. LEWIS T. WRIGHT IN THE CHAIR.

PORTLAND CEMENT.

BY CHARLES SPACKMAN.

In Portland cement we possess a constructive material, the manufacture and applications of which have made rapid progress during the past few years. Much attention has been devoted to the investigation of its chemical and mechanical properties by many experimenters both in our own and other countries, while improved methods of manufacture have tended to greatly reduce the cost of production, to improve its quality, and to make it from materials which, although possessing ultimately the same chemical composition, require in the earlier stages of the process of manufacture very dissimilar treatment. In the present paper I propose to briefly describe the systems of manufacture in general use and some of the more important properties of this material.

The raw materials requisite are carbonate of lime and clay, which, it is needless to say, are very widely distributed. Pure clay is not necessary, but it is essential that it should be free from sand. An intimate mixture of these in certain proportions, and in a fine state of division, is submitted to calcination at a temperature sufficiently high to yield a product that has just undergone vitrification, and this, when reduced to powder, is Portland cement. The proportion of carbonate of lime to clay is of the utmost importance, and any serious error here cannot be corrected in subsequent stages of the manufacture. What these proportions should be will depend to some extent on the nature of the materials used, but they will only vary within very narrow limits, whatever be the materials. Chalk and Medway mud are extensively used in this country. With these the best results are obtained with a mixture containing in the dry state from 75 to 76 per cent. of carbonate of lime, with some other materials from 72 to 73 per cent. will give the best results. It is necessary at the outset to clearly understand that mixtures of carbonate of lime and clay do not occur in nature in suitable proportions and in sufficient quantity to render them of any importance to the cement maker, who has entirely to rely upon an artificially prepared compound.

The historical part of the subject I must pass over briefly. It has been very fully treated in an article by Mr. G. R. Redgrave, published in the *Building News* on December 24th, 1880, which will well repay perusal by those interested in this question. For my own information I am indebted to this article.

Vicat, a French engineer, experimented with mixtures of pure limestone and clay, his object being the production of hydraulic lime, and in 1818 published an account of his experiments, of which work we have an English translation by Capt. Smith, R.E. In our own country, Gen. Sir C. Pasley, R.E., worked in a similar manner with the view of obtaining by artificial means a cement resembling the Roman cement then so largely used, and which was burnt from natural stone. Both these workers stopped short of fusion in the calcination of their mixtures. Pasley, indeed, distinctly states that all the vitrified or overburnt pieces were carefully picked from his samples before they were ground; the calcination, as in the case of Roman cement stone, being only carried sufficiently far to expel the carbonic acid.

On October 21st, 1824, a patent was granted to Joseph Aspdin, of Leeds, bricklayer, for the manufacture of a cement obtained by calcining a mixture of limestone and clay, to which he gave the name of Portland cement. We have no evidence that at this time he carried the calcination as far as vitrification, but he undoubtedly did at a later period, and was the first to do so. He established works at Wakefield which are still in existence, and which he was himself conducting on a small scale as late as 1853. For many years the new cement did not make much progress, but it seems to have been used to a considerable extent in the neighbourhood of the Wakefield works, and about 1828 by Brunel in the Thames Tunnel. At that time the price was from 20*s*. to 22*s*. per cask at the Wakefield works. In 1843 we find William Aspdin, son of the inventor of Portland cement, in London, associated with the firm of Maude, Son, and Co., at Rotherhithe, and in 1848 at Northfleet as Robins, Aspdin, and Co. About this time Portland began to supersede Roman cement, and the Roman cement industry, at that time an important one, has so dwindled away that it will probably at no distant date become extinct. Gen. Sir C. Pasley published the result of his labours in 1837, a second edition appearing in 1847, at which time he was continuing his experiments. It is a singular fact that although he lived at Chatham, in the immediate neighbourhood of the early Portland cement works, he never heard of this material until he was introduced to William Aspdin at the Exhibition of 1851. In 1848, besides the original one at Wakefield, there were probably not more than three Portland cement manufactories in existence. Since that time this industry has enormously increased in England, and has extended to most continental countries, but has made little progress in our colonies or in America.

In describing the manufacture I will take as a typical process the original method of treating chalk and clay which is still in general use, then deal with some of the most important improvements that have been made in this process, and finally describe some methods of treatment adopted when dealing with materials of a different character.

The original process consists in washing together the chalk and clay with a large excess of water, allowing the mixture to settle in reservoirs or backs until sufficiently stiff to be dug out, and completing the drying on heated floors. The dry material is then burnt in kilns with coke as fuel, the resulting clinker, as it is termed, being crushed and afterwards finely ground. The mixture of chalk, clay, and water is made in a washmill. This is a circular tank of brickwork about 5 ft. deep and from 15 to 25 ft. in diameter constructed below ground. In the centre is a circular mass of brickwork carried above the overflow level of the mill, on which is fixed the footstep bearing of a vertical shaft driven by a pair of bevel wheels at a speed of from 20 to 30 revolutions per minute. To this shaft are attached arms from which are suspended cast-iron harrows filled with wrought-iron tines or teeth. The raceway of the mill is paved with granite setts or old millstone burrs, bedded and jointed in cement. In some cases a beam with iron knives is substituted for harrows; in others, heavy edge runners similar to those of a mortar mill. The latter are preferable when using some of the upper beds of the grey chalk, which are very hard and resist the action of harrows. The operation of washing is a continuous one. A stream of water flows into the mill, and the quantities of chalk and clay are fed in from waggons or barrows, the water being so adjusted that the mixture shall contain from 60 to 70 per cent. The slurry, as it is called, flows out through a vertical strainer of copper-wire gauze, containing not less than 900 meshes to the square inch, into a channel leading to the backs. In the channel are arranged catchpits into which the coarser particles of chalk subside, and which are from time to time cleaned out. The removal of this coarse chalk is a matter of importance. If allowed to remain the particles do not undergo fusion in the kiln, and are only converted into lime, but become covered with a skin of the more fusible silicate, and in this condition they appear in the cement, being only partially broken up by the process of grinding. When such cement is used the work sets, continues to harden, and for a time remains sound. Sooner or later moisture penetrates the skin enclosing the lime, which becomes hydrated, the consequent expansion disintegrating and destroying the work. The backs are from 4 to 5 ft. deep, and usually contain sufficient slurry to make from 500 to 1,000 tons of cement. The water is drained off from time to time by a sluice, and the deposit is stiff enough to be dug out in from 6 to 10 weeks, the time, of course, depending on the season of the year. Where the arrangement of the work will permit, the slurry flows from the washmills to the backs; when this is not possible it is collected in a small reservoir and thrown up by a pump.

The proportions in which the raw materials should be used require, in the first place, careful adjustment. The quantity of lime in an average sample of Portland cement may be taken as 60 per cent. An analysis of the materials and a simple calculation will give the weight of each required to produce a cement containing the same percentage, which, however, may not be the true one for the materials under investigation. Magnesia may be considered as replacing lime. Its presence is said to be injurious, but all cements contain it in greater or less quantity, some that have stood the test of many years use containing as much as from 2 to 3 per cent.; but any attempt to use dolomitic limestone would probably be attended by failure. The evidence we have on this point, however, is by no means conclusive. A sample of cement is prepared from the calculated proportions, and others containing slightly higher and lower percentages of lime. These are submitted to careful tests, and from a determination of lime in the one giving the best results the proportions are re-calculated. This sampling requires much skill, and great experience is necessary in order to be able to accurately and rapidly draw correct conclusions from the results obtained.

The following analyses give the composition of various Portland cements made from different materials. Nos. 1, 2, 3, 4 are analyses of German cements, and are taken from a paper by Mr. John Grant, C.E., published in the Minutes of Proceedings, Inst. C.E., Vol. 62, p. 66. No information is given respecting them, but I should consider, No. 4 from the high percentage of lime and magnesia and low percentage of silica present, to be an exceedingly dangerous cement. No. 5 is the analysis of a Russian cement from a factory at Riga. It was published in a circular issued by the proprietor in 1874. The remainder are from my own practice. No. 6 made from white chalk and Medway mud, No. 7 from grey chalk and gault clay, No. 8 from white chalk and clay, No. 9 from a mixture of chalk marls and clay. Nos. 10 and 11 from mixtures of blue lias limestones and clay, and No. 12 from materials taken from the Channel Tunnel boring. Whatever may be said as to the merits of this undertaking, the intention of its promoters was certainty a novel, and at the same time a perfectly feasible one. They proposed to line the tunnel with concrete, using the material excavated—possibly forced out through pipes in the state of slurry—to make the cement, and obtaining shingle from the beach for the aggregate. With the view of proving the suitability of the material, I prepared some cement from it, of which No. 12 is an analysis.

—	Insoluble Residue.	SiO_2.	F_2O_3.	Al_2O_3.	CaO.	MgO.	SO_3.	K_2O.	Na_2O.	Water and CO_2.
1	1·17	23·29	2·47	5·43	62·68	1·10	1·03	0·36	0·49	1·42
2	0·67	22·82	3·52	2·69	63·21	3·00	1·12	1·26		1·12
3	0·57	22·58	2·82	6·52	62·02	1·13	1·15	..	1·70	1·71
4	1·38	19·80	3·22	6·73	63·27	2·02	1·08	1·22	0·26	1·00
5	1·4	22·60	3·20	11·10	57·3	3·1	..	1·3		..
6	2·894	21·307	5·386	6·593	61·459	·419	1·422	·437	·429	..
7	2·031	21·335	4·173	9·171	61·068	1·322	·801	·730	·404	..
8	2·173	24·055	6·285	5·766	58·886	·408	1·99	·437	·291	..
9	1·658	21·793	4·629	6·712	61·386	1·653	·805	·892	·531	..
10	4·909	18·583	5·108	7·226	61·040	1·565	·763	·754	·271	..
11	3·302	19·156	4·678	7·193	58·137	3·101	2·811	1·327	·440	..
12	1·674	23·832	3·127	6·058	63·129	1·206	·398	..	..	..

The quantities may be either measured or weighed into the washmill, each method has its adherents. If the materials were in the dry state there could be no question as to which would give the most accurate result, but in their normal condition they contain water, and they are also very absorbent; the quantity of water present consequently varies with the state of the weather. I have made careful experiments with both methods, and prefer to use a measure of volume. If equal quantities of each material were used and each was equally absorbent, it is evident that weighed quantities might be used in all weathers; but the quantity of chalk being, in round numbers, three times that of the mud or clay proportions adjusted for use in dry, would, if used in wet weather, result in an over-clayed mixture. As the materials do not alter in volume by absorption of water, measured quantities will practically always contain the same amount of solid matter, and may be used in both dry and wet weather.

The correctness of the mixture should be checked at least daily. In some works this is entirely neglected, in others it is occasionally done by sampling. Slurry is taken from different places in the back, evaporated to dryness, and burnt in a trial kiln. From the behaviour of the cement ground from his sample the operator judges whether chalk or clay is in excess, and corrects his proportions accordingly, the contents of the back being from time to time luted or stirred together. This is rather a haphazard process, and a correct opinion as to the properties of the sample cannot be formed in less than 24 hours after it has been gauged, while during this time and that required to prepare the sample, the washing is being continued perhaps in incorrect proportions. When using Medway mud irregularity is sometimes caused by the presence of peat, although this is to some extent guarded against by care in its selection. A system of analysing the mixture has of late become general in many works. It is sometimes done by a volumetric determination of the carbonic acid by Schiebler's calcimeter, which is described in Fresenius, Sutton, and Crooke's Select Methods. For my own part I prefer to make a direct determination of the lime present as often as possible, especially when dealing with materials which admit of very little deviation from the normal proportions.

After becoming sufficiently stiff in the backs to admit of being barrowed or waggoned out, the drying of the slurry is completed on floors heated by coke ovens, the waste gases from which pass along flues covered by fireclay slabs. In some works the crowns of the ovens are only so covered, cast-iron plates being used farther back where the heat is not so great. The ovens are drawn and charged, and the flues stripped and covered every day. The kiln used on this system is what is known as an open one, and consists of a vertical cylinder of brickwork, about 12 feet in diameter, of greater or or less height, drawn in at the bars, which are about two feet above the ground, to a shape much like that of an ordinary teacup, and surmounted by a slightly tapering cone. They are lined with 9 ins. of refractory firebrick in contact with, but not tied into the common brickwork at the back on which the cones rest. The burning is an intermittent process. Brushwood faggots are laid on the bars, followed by alternate layers of coke and dry slurry broken into rough lumps. The coke from the ovens is supplemented by gas coke. The kiln is loaded up to the base of the cone and is then lit up and allowed to burn out. Before being charged the surface of the interior is daubed or plastered with stiff slurry from the backs. This prevents the clinker from adhering to, and breaking away the firebrick lining, which will last twice as long as it would if this precaution was neglected.

Opinions differ as to the capacity of kilns. As a considerable quantity of fuel has to be used at the bottoms to properly light them up, and at the tops to clinker the upper layers of the charge, it would appear that the higher the kiln, and consequently the greater the quantity of material burnt between the extra fuel at the top and bottom, the more economical must be the process. This is no doubt correct, considered from the fuel point of view, but high kilns, although used to some extent in the North of England, have not become very general. They take a long time to load, burn off, and draw, while the cost of elevating the material to load them must be considered. It is found more economical to use smaller kilns, the extra cost of fuel being more than compensated by the rapidity with which they can be burnt off and got round again. Kilns capable of burning about 25 tons of clinker are most generally used. Starting in the morning with an empty kiln, the burner and his assistants will strip the flats and cover them again with wet slurry from the backs, load the kiln, and light it before leaving at night. On the morning of the fourth day following it will be cool enough to draw, and this can easily be completed the same day. Thus in five days a kiln may be loaded, burnt off, and drawn ready for loading again.

Although, as we shall see, the process of manufacture as previously considered may undergo many modifications, the method of treating the clinker when drawn from the kilns is common to every system, and may be briefly described here once and for all. It has to be crushed and ground to a greater or less degree of fineness. The crushing is done by various methods. Many manufacturers used the Marsden stonebreaker or one of its modifications, others prefer roller crushers, while in some cases both these machines are used, the clinker being first roughly broken with the stonebreaker and then passed through rollers. In some of the older works powerful edge runners are employed. The crushed clinker is elevated to the floor above the grinding mills by an endless belt carrying cups. The grinding is effected under horizontal millstones specially built of French burrs for cement grinding, and driven from below by very powerful gearing. This system is almost universal, and at present there seems little possibility of its being superseded. Many forms of pulveriser have been tried with little success, the objections to most of them being the high speed at which they run, with consequent wear and tear, and the fact that they do not yield a soft floury product, but only granulate the cement. Until quite recently cement was rarely sifted after grinding, but latterly increased importance has been attached to fineness, and this is best obtained by sifting, the core, or portion that does not pass through the sieve, being returned by an elevator to the mills to be re-ground. Various methods of sifting are in use. In some cases a rocking sieve is connected with each pair of stones, in others the cement from several pairs is collected by screws and discharged upon the uppermost of a series of such sieves arranged one above the other, suitable arrangements being provided for separating the sifted cement and core, and returning the latter to the mills. Some manufacturers prefer revolving sieves. These are generally hexagonal in cross section, the length varying with the quantity they are required to sift. They are set at a slight inclination, the core is collected at the lower end and returned by an elevator to the mills, the cement falls into a channel below, and is pushed out at one or both ends by a screw. A sieve on this principle, working at a factory on the Medway, is 35 feet long, and sifts the cement from six pairs of stones. From the sifting machinery, or the spouts of the millstones where sifting is not practised, the cement is distributed on the floor of the warehouse, and is then ready to be packed for the market.

One of the earliest improvements on this system has come into very general use, and is known as Goreham's process, Patent No. 1963, 1870. It consists in preparing the slurry with just sufficient water to make a thick mud, in such condition that it can be pumped and delivered through pipes to the drying flats without being allowed to settle in backs. The chalk and clay are roughly mixed in a washmill with the required quantity of water, the product being a soft mud with coarse pieces of undisintegrated chalk and clay. This mixture escapes from the washmill through a coarse grating to a small reservoir. From this it is lifted by an elevator or a scoop wheel to a shoot which feeds it into horizontal mills somewhat similar to those used for grinding the crushed cement clinker. These thoroughly grind up the coarse pieces of chalk and clay, and mix the slurry, which passes into a reservoir, and is from thence pumped to the drying flats. Another process for preparing thick slurry is V. D. de Micheles', Patent No. 3530, 1877. By this the whole operation is effected in a modified form of washmill, from which the slurry passes in fit condition to be pumped upon the drying flats. The washmill arms that carry the harrows have also attached to them a flat iron ring, which is carried round by the arms and which rubs upon a similar ring that forms a rim to the washmill. The roughly-mingled mud flows out from the mill between the rubbing surfaces, which effectually grind and mix it. This process saves the cost of grinding under millstones, and the consequent skilled labour, but the slurry requires to be prepared with more water than in Goreham's process.

At an early period attempts were made to utilise the heat from the kilns for the purpose of drying the slurry for the next charge. Drying on flats heated by coke ovens is a costly process, the production of coke being quite a secondary matter, as the manufacturer can buy it much cheaper than he can make it. The chief end is that of drying in 24 hours sufficient wet material to charge a kiln; and if from any cause the drying is not proceeding satisfactorily, the ovens are opened and stirred up, with consequent reduction in the yield of coke, while the annual cost of repairs to a set of ovens and flats is very great. For many years the only method in use for utilising the heat from the kilns was by passing the waste gases along flues covered with plates, upon which the wet slurry was spread; and this, so far as I know, was only practised in one works. By this means only a portion of the next kiln charge can be dried, and it is necessary to supplement the kiln-heated flats by others heated by coke ovens. The problem of making each kiln, while burning off, dry sufficient slurry to load it again, was solved by Mr. I. C. Johnson, whose chamber kiln, Patent No. 1583, 1872, is now most extensively used. The original form of cup kiln is retained, but without the cone. At the level of the top of kiln, and of about the same width, a floor is constructed of suitable length, inclining slightly towards the kiln; this is enclosed by walls, continued also round the top of kiln, and the whole is arched over, the chamber being of such a height that men can conveniently work in it. The waste gases pass over the wet slurry on the floor of the chamber, which is of sufficient length to dry the quantity necessary to re-charge the kiln. These kilns are generally arranged in double rows, the chambers running back to back between the rows. The draught is obtained by a powerful chimney, with which all the chambers are connected by a gathering flue, the communication between each chamber and this flue being made by a damper. At Mr. Johnson's own works the kilns all discharge into a shaft 300 ft. high and 11 ft. in diameter at the top. The delivery pipe from the slurry pumps is arranged above the chambers, and from this branch pipes discharge into each chamber. In De Michele's improved Johnson kiln the length of the chambers is reduced, and they are covered with a roof, the tops of the arches being used for drying a portion of the charge.

Unless the contour of the ground is favourable, the Johnson chambers have to be supported on arches. In Burge's bonnet kiln a portion of the chamber is at the ground level, and the remainder but little above it. Its usual length is about 80 ft. The first 20 ft. of the floor is arranged somewhat below the top of the kiln, the next 20 ft. below this again, while the remaining 40 ft. is at the level of the ground. The top of the kiln is arched over, the next 40 ft. of arch slopes downward and joins the arch covering the part of the floor at the ground level. Cross walls retain the slurry on the two upper floors, and regulate its thickness. As in Johnson's chamber, the products of combustion pass over the surface of the wet stuff. The kiln itself is broader, and not so high as the ordinary form, while the charge, instead of resting on bars, is supported on a brick floor of large area, intersected by air channels, by which it is claimed more perfect combustion is secured.

The Wilson process of drying differs somewhat from those previously mentioned. The products of combustion pass along broad shallow flues covered with movable iron plates, and dry a layer of slurry spread on the bottoms of the flues by over heat, and another on the top of the iron plates by under heat. This method is carried still further in Glover's kiln, in which the waste gases pass under and over successive layers of wet material spread on floors of iron plates one above the other. In both these systems it is, of course, necessary to take up and replace the iron plates every time the kiln is charged.

In chamber kilns, or in those arranged in connexion with drying floors, the products of combustion are usually passed through the chambers or over and under the floors during the whole time the kiln is burning. As soon as the kiln has been loaded it is therefore necessary to charge the chambers or floors with the wet slurry before lighting it. This causes loss of time, while for many hours after a kiln has been lit no heat passes out of it, that evolved from the combustion of the lower portions of the charge being absorbed by the layers above, the work of drying really only commencing when the fire comes through the top. I have walked without inconvenience on the top of the contents of a 25-ton kiln 24 hours after it had been lighted, and four hours before the fire came through. At this time cold clinker could have been drawn at the bars. An improvement by Watson and Spoor is applicable to any form of chamber kiln, and allows the burning to commence immediately the kiln has been charged. A special flue in communication with the shaft is arranged above the chambers, and through this the products of combustion pass, until the chamber is charged or it is desired to commence the drying of the slurry, when connexion is made with the chamber, and the special flue is closed.

Continuous or running kilns, into which unburnt material and fuel are charged at intervals at the top, clinker being drawn at the bottom, and which are thus kept continually working, have been occasionally used. R. A. Gibbons, Patent No. 2514, 1878, has combined this form of kiln with drying chambers. He arranges two chambers in connexion with an ordinary cup kiln through either of which the products of combustion can be passed. The method of working them is best described in the inventor's own words. "The kiln being in action, its hot gaseous products are directed into one of the flues, the floor over which has been, by pumping or otherwise, charged with slurry, which thus becomes dried. When this charge is dried the hot products of the kiln are shut off from this flue chamber and directed into another charged with slurry, and, while the latter is being dried, the dried slurry of the chamber formerly mentioned is stripped and taken to the upper part of the kiln to be burnt. Thus, in succession, the several chambers are charged with slurry and have their contents dried by the waste heat then discharged into the kiln, which is kept continuously working, the cement burned in it being removed from time to time in quantities taken from the bottom."

The Dietzsch kiln is a continuous one, the invention of a German manufacturer, and is extensively used on the Continent. It consists of three chambers. From the lower or cooling chamber the clinker is drawn. Above this is the calcining chamber, and above this again, but not directly over it, the "pre-heating" chamber, through which the products of combustion pass. Into this chamber the dry slurry is charged, and becomes heated. A horizontal channel connects the pre-heating with the calcining chamber. The heated slurry falls into this channel, from which it is fed with shovels, into the calcining chamber, through suitable openings, with small coal as fuel. A very large output is claimed for this kiln, together with a great saving of fuel, but the slurry must be first dried on flats. The Hoffmann, or ring kiln, I shall refer to when speaking of the dry process, for which it is best adapted.

We have hitherto been dealing with materials which admit of reduction and intimate mixture by trituration with water. Other materials, quite as suitable, but which cannot be so treated, occur in nature, prominent among which are the limestones and clays of the lias formation. As far back as 1848 Gen. Pasley refers to artificial cement made from a mixture of blue lias lime and clay by Mr. Richard Greaves, of Warwick, but it was many years later, probably about 1864, before Portland cement from lias materials could hold its own with that made in the London district from chalk and mud. The method at first adopted for its manufacture was what is known as the double kiln process. The stone was first converted into lime, and was then ground with water and the required quantity of clay, the resulting mixture being dried and burnt in the usual manner. This has been superseded by the dry process, which consists in reducing the roughly-mingled mixture of raw materials in the correct proportions, and, in a dry condition, to an extremely fine state of division and intimate mixture by suitable machinery. Limestones will, as a rule, admit of this treatment without preliminary drying; the clay must be first dried.

The resulting fine powder or dust, as it is termed, has now to be got into suitable condition for the kiln. This may be effected by either of three methods. By the first the dust is pugged with just sufficient water to make a stiff mud, which is dried on heated floors or in chambers, as in the wet process, and is finally broken into rough lumps and loaded into the kilns. This method gives very unsatisfactory results. The dried mud is very friable, depending for its tenacity upon the added clay—often only a very small quantity—which binds the finely-divided non-plastic limestone. The result is that much dust is formed during the loading of the kilns, which interferes with the draught and the proper calcination of the material. By the second method the pugged dust is delivered through dies and wire cut off into bricks, which are dried and burnt. This, if carefully conducted, gives good results, but the bricks are very friable and require careful handling, to avoid dust. By the third method sufficient water only is added to the dust to cause it to adhere together when tightly squeezed in the hand, the quantity necessary being from 8 to 10 per cent. The damp dust is then moulded under pressure into bricks, which are very dense, and will stand much rough usage without crushing or breaking, even in the damp state. Although containing so small a per-centage of water, it is necessary to dry these bricks before burning them. When designing some kilns for this modification of the dry process a few years ago, I arranged a simple system of drying by hot air in chambers connected with the kilns, which, as it proved very successful, I may be pardoned for briefly noticing.

The ordinary cup-shaped kiln has the top of its dome fitted with an iron cover, which, by a lever arrangement, can be raised or lowered at will, and at the back of each kiln a chamber is constructed about 14 ft. square and 12 ft. high, which is of sufficient size to contain the number of bricks required to charge a 30-ton kiln. Apertures in the kiln communicate with the chamber, all the chambers being connected by a gathering flue with a powerful shaft. The kiln is burnt as an open one, the products of combustion passing off through the dome. While this is proceeding the chamber is filled with damp bricks stacked with air spaces, and, when combustion in the kiln is at an end, its cover is shut down and it is put in communication with the chamber, the external openings of which are closed. The dampers connecting this chamber with the gathering flue and shaft are opened, the effect of which is to draw a current of air through the hot clinker. The heated air then passes through the damp bricks, which are rapidly and effectually dried.

By an improvement on this process, for which letters patent have been granted to me, the bricks are dried in the kiln itself, chambers being entirely dispensed with. The domes of ordinary open kilns are provided with covers, as in my chamber system; an iron flue of ample capacity is fixed along the outside of the domes, and from this branch pipes fitted with a simple valvular arrangement for opening and closing them, communicate with the interior of each dome. At the ground level a main pipe is connected with an exhausting fan, and from this pipe branches, with suitable arrangements for opening and closing them, lead to the space beneath the bars of each kiln. The loading and drawing holes of each kiln are also fitted with shutters of light iron plate. The pressed bricks are taken from the moulding machine direct to the kiln, and are there loaded with alternate layers of coke just as if they had been previously dried. The drying is effected as follows: We will suppose that one kiln of a series is burning off, and that another is loaded ready for drying. When combustion in the burning kiln is quite at an end, the covers of both are closed and the valves placing them in connexion with the upper flue opened, the other valves being closed. The pipe leading to the exhauster from the kiln containing the wet charge is opened and all the others closed; the loading and drawing holes of this kiln are also closed by the iron shutters. The exhauster is now set working, and a current of air drawn upwards through the hot clinker in the burnt-off kiln. The heated air passes along the connecting flue at top and downwards through the mass of wet material in the other kiln to the exhauster, which discharges it loaded with moisture, the operation being continued until dry air is delivered. This process saves the first cost of chambers, the bricks are only once handled instead of twice in passing from the moulding machine to the kiln, while the hot kiln is very rapidly cooled down.

Of the comparative merits of the wet and dry systems I do not propose to enter into any discussion. Much may be said for and against each; but while all materials may be treated by the dry process, only those which are soft and easily reduced by trituration with water admit of treatment in the wet way, while cement of equally good quality may be made by either.

I have previously referred to the Hoffmann kiln, which, although not now used in England for cement burning is, under certain conditions, the best kiln for this purpose. Its form is that of a circular low waggon vaulted passage divided into 12 or more chambers, from the bottoms of which a flue leads to a central smoke chamber surrounding a lofty shaft. The fuel, either small coal or breeze, is fed through apertures in the crown of the vault into openings arranged in the material to be calcined. The calcination proceeds onward from chamber to chamber, the products of combustion from those undergoing full firing passing through and heating the contents of the chambers in advance which contain raw material, and are successively fired while the supply of air is heated to a high temperature by being passed through the chambers in which combustion is at an end. The process is thus a continuous one, the kiln being constantly kept working, and this renders it only available where a steady and fairly large output can be depended on. To ensure proper combustion it is absolutely necessary that the slurry of the wet process should be moulded into bricks or other regular forms, and the cost of doing this at a factory on the Thames was found to exceed the value of the fuel saved, which is undoubtedly great, and the kiln was abandoned. In this country, however, labour is comparatively dear and fuel cheap, while in Germany the converse of this is the case, and the Hoffmann kiln is successfully used at many factories there. At one of them a portion of the slurry is dried on flats; this is pugged with another portion taken from the backs and is then moulded into bricks. For the dry process this kiln leaves nothing to be desired, as the bricks moulded under pressure with a minimum of water can be at once passed on to the chambers without any preliminary drying.

The experience gained by the practical use of Portland cement for upwards of 40 years, and the experiments and tests made by many engineers who have had the control of work in which it has been extensively used, have resulted in a good general knowledge of its physical properties.

Much information on this subject will be found in the proceedings of the Institute of Civil Engineers in papers and communications by Messrs. Scott and Redgrave, Grant, Colson, Mann, and others. A paper on cement testing by Professor Unwin will be found in the *Journal of the Society of Chemical Industry* for April 1886, in which the scientific aspect of the question is most exhaustively dealt with. On the present occasion I shall confine my remarks, which must be brief, to commercial cement testing, dealing only with the tests made by the manufacturer to check the quality of the product of his works, and by the consumer to assure himself that he is getting what will fulfil his requirements.

The question then may be asked, what constitutes a true Portland cement, and what conditions should it fulfil? Unfortunately in this country there are no standard rules by which this question may be answered, and it is almost impossible to find two persons holding the same opinions, or two engineers' specifications requiring the same conditions. Generally the conditions are, a given weight per bushel, a certain degree of fineness, and a certain tensile strength, the cement being gauged with water and moulded into test pieces which are submitted to tensile strain at the expiration of a given time. This all seems simple enough; but to show the confusion that exists, I will refer to a communication made by a cement manufacturer to the Institution of Civil Engineers, and published in Volume LXII. of their proceedings. After urging the necessity of greater uniformity in tests for cement, he goes on to say that out of a number of specifications that had come into his hands in the ordinary course of business, he selected 21 at random. In these, 10 different weights per bushel were specified, 13 different degrees of fineness, and 13 varieties of tensile test, 21 specifications with 36 varieties of test.

Now, although it would be scarcely possible to find two manufacturers making an exactly similar cement, the difference in some cases being well marked, in others so slight as to be only capable of detection by an expert, it is possible to define certain conditions to which all Portland cement shall conform. Exhaustive experiments and tests have been made with this object in Germany. Concerted action has been taken by the Associations of Engineers, Architects, and Cement Manufacturers, and their standard rules, published under the authority of the Minister of Public Works, have received general assent, and have done more than anything else to improve the quality of cement in Germany. In England there seems at present to be no possibility of any unanimity of opinion.

The weight per bushel test was one originally adopted by the manufacturer to prove whether his cement was lightly or heavily burnt. Apart from the question of burning, considerable variations in this test are caused by the shape of the measure, the method of filling, and the fineness of the cement, the more coarsely this is ground the greater being the weight of a given volume. If adopted, it is necessary to stipulate, in addition to the fineness of the cement, how the measure shall be filled, and this should be done as lightly as possible. A good plan is to allow the cement to slide down a shoot set at a given angle and distance above the measure until it is slightly heaped up, and then striking off the excess with a straight-edge. A favourite weight to specify was formerly 118 to 120 lbs. per bushel. This corresponds to a cement so coarsely ground as to leave a residue of from 15 to 20 per cent. on a sieve having 2,500 meshes per square inch. Great importance is now attached to finely-ground cement, and where this is demanded the weight per bushel should be reduced. A bushel of cement ground from well-burned clinker so finely as to leave a residue of from 3 to 5 per cent. on a 2,500 sieve, would weigh from 110 to 112 lbs. This requirement has been discarded by the German authorities, who rightly assume that fineness of grinding and high tensile strength are the true tests. The weight per bushel coupled with the sieve test will, without doubt, detect lightly-burnt cement, but this can never attain great strength.

With reference to its fineness, Portland cement may be considered to be a mixture of particles ranging in size from an impalpable powder up to grains as large as the apertures of the sieve through which it has been passed. If passed through a sieve of fine silk the portion remaining on the sieve has no value as a cement until it has been again ground, and a portion of it reduced to an impalpable powder. The more impalpably cement is ground the greater is the proportion of sand that may be mixed with it. The only limit is one of cost, and it is found cheaper to use a larger proportion of moderately fine cement with a given quantity of sand than a smaller quantity ground at an increased cost to a greater fineness. An ordinary commercial sample of English Portland will leave a residue of from 5 to 10 per cent. on a sieve having 2,500 meshes per square inch. The German rules require a residue of not more than 10 per cent. on one of 900 meshes per square centimetre (5,806 per square inch). Even when tested by a sieve of this fineness, of two cements, the one giving the greatest residue may, if tested by a silk of, say 170 meshes per lineal inch, give by far the largest quantity of impalpable powder, and be, consequently, the best-ground cement of the two. The one may have been carelessly ground and to a great extent granulated, while the other has been well milled. Even when sifting is resorted to in a manufactory, the greatest care should be exercised in the grinding.

The usual test for strength is that of submitting briquettes, moulded with the cement, to tensile strain; but while a piece of metal may be cut from a bar and at once inserted in the testing machine, cement must undergo preliminary manipulation, and on this the success of the test depends. A great deal of skill and practice are required to get even moderately good results; and while the most expert manipulator will fail to get good results from bad cement, good cement may be condemned as faulty by careless or ignorant treatment. In this country tests are usually made with pure cement, the following being a good mode of procedure. The quantity of water required to gauge the sample under investigation must first be determined. This will vary with nearly every cement, and is influenced by the age, fineness of grinding, chemical composition, and temperature at which it has been burned.

A weighed quantity of cement, say 1 lb., is placed on the gauging slab, which should be smooth and of non-porous material, the water being contained in a graduated glass filled to the mark. Water is now added to the cement in small quantities and it is at the same time well worked and beaten with the trowel until it is brought into a stiff pasty homogeneous mass with the smallest possible quantity of water. It is then spread on several small squares of glass and worked into cakes about ½ inch thick and 2½ inches square, which are thinned down at the edges. These are set aside and will serve to test for soundness and time of setting. The quantity of water requisite being arrived at, the briquettes may be made. The moulds should rest on metal plates or pieces of smooth plate-glass, and be slightly oiled. Sufficient cement should be taken to make the number of briquettes required, and the proper quantity of water as before ascertained added. The whole operation of gauging and filling the moulds should be performed as rapidly as possible, as although slow-setting cement may be worked longer than quick-setting, even in the former case the setting action commences soon after the water is added. If from an examination of the previously made pats the cement shows signs of setting quickly, it is better to add a little more water than the ascertained quantity, and so get through the operation of filling the moulds quickly, or else to render it slower setting by exposing it to the air for a day or two before moulding it. The gauged cement should be heaped up in the moulds, which should be well shaken by rapping them on the bench. The surfaces should then be levelled off and the moulds set aside until the briquettes are sufficiently set to be taken out and immersed in water, where they should remain until the moment of testing. Briquettes of neat cement when removed from water continue for a time to lose a portion of their strength, which is afterwards regained; those made with sand and cement withstand a higher strain by being kept in air some time before testing. If gauged with an excess of water the strength is greatly reduced. The German rules prescribe a much less quantity for neat tests of slow-setting cement than we should consider fair in England, and they advise that the mixture should be made with a pestle and mortar. Some experimenters argue that as cement is often used in a soft state as mortar it should be so tested. The fact, however, remains that excess of water diminishes the strength, and this has been proved over and over again. It must at the same time be remembered that in practice this excess is in many cases absorbed by the bricks or stones with which the mortar is used. If it is desired to gauge the cement in a soft condition Dr. Michaelis recommends that the moulds should be laid on porous slabs of plaster of Paris, which absorb the excess of water. The same end may be attained by placing several folds of blotting paper on the non-porous metal or glass plates. By either method very much higher results are obtained than are possible by gauging with a minimum of water.

To return to the pats on glass and the time of setting and soundness, the latter being defined as freedom from tendency to undergo change of form, the German rules define a cement as set when a cake made as before described resists a slight pressure with the finger nail. No doubt when it has reached this condition it could not be used practically without being worked up with the addition of more water, would only set again after the lapse of a long period of time, and would contract badly in setting, as all re-gauged cement invariably does. An English authority, Mr. H. Faija, does not consider a cement set until the pats, when placed in water, will, when examined 24 hours later, show no tendency to crack or lift from the glass—in fact, remain sound. This is, I think, the correct view, but with reference to the test for soundness the German rules specify that the samples must be allowed to thoroughly harden in air before immersion.

With this explanation we can now deal with our pat samples. When it is judged that they are set, one should be placed in water, the number of minutes that have elapsed since it was gauged being written on it. An hour later another should be so treated, and so on, leaving one in air to test the colour. They are from time to time examined. Failure will first show itself by hair-like cracks round the thin edges, and the cement will lift from the glass. If the first shows signs of failure the later ones may not, but the examination should be continued for a lengthened period.

The number of minutes recorded on the first one immersed that remains sound is the approximate time the cement treated requires to set. If all the samples fail, even after prolonged hardening in air, the cement is faulty, either from careless manufacture or from being made with an excess of lime.

It is commonly asserted that Portland cement sets equally well in water and air. This is only true if it is allowed to set as before defined before immersion, when it will continue to harden much better in water than if left in air. This applies especially to slow-setting strong cements. Overclayed quick-setting cement that can never attain any great strength will, however, often set equally well in air or water.

Both the rate of setting and the ultimate strength of cement are influenced by peculiarities of the raw materials and the proportions in which they are mixed, by the temperature of the atmosphere and that of the water used for gauging, by the age of the cement, the state of oxidation of some of its constituents, and other causes; but this subject is a wide one, and can only be hinted at here.

Portland cement, when tested without admixture with sand, attains a considerable portion of its ultimate strength in seven days, and for practical purposes the briquettes are usually tested when they have reached this age, the average of not less than four tests being taken as the true breaking strain. It is always advisable to reserve some for testing at a later period, and these should show a steadily increasing strength. The German authorities attach little importance to tests with neat cement, and prescribe one with three parts of sand made 28 days after moulding. Most explicit directions are given for making this test, which has this advantage for the manufacturer, that the finer he likes to grind his cement the better results will it show when tested.

It is much to be desired, in the interests of all concerned in the manufacture and use of cement, that some uniform standard of quality and method of testing should be adopted in this country.

Journal and Patent* Literature.

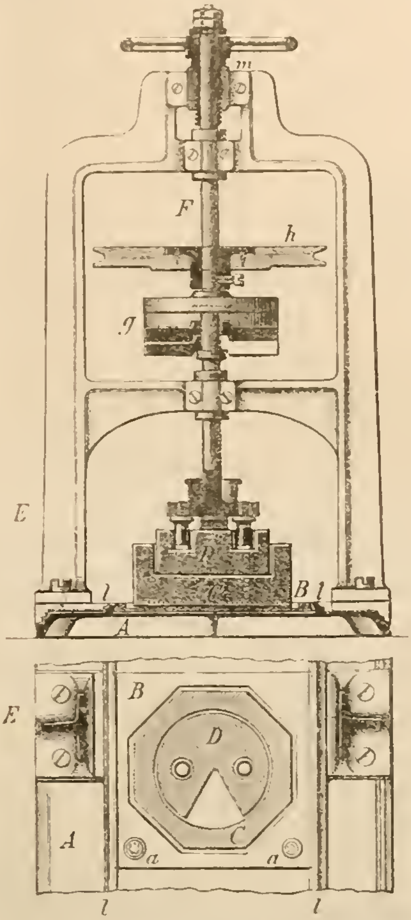
I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

A Mineral Mill. Karl Zulkowsky. Ber. 20, 2664—2669.

For grinding minerals the author recommends the use of a mill similar in construction to those employed in porcelain and stoneware manufactories.

A is a foundation, fastened by the clamps *l*, *l*. B is a brass plate which can be pushed in and out; it is held in position by two screws.

C is a cup-shaped agate socket fastened on to the brass plate B. D is a revolving agate plate, 10 cm. in diameter, in which there are two depressions for the somewhat loosely-fitting driving-rod; a sector-shaped piece is cut out and the substance is inserted into this aperture; the right-hand edge of the plate is sharply rounded underneath. F is the axle in connexion with the driving-rod, it is supported by the framework E, and provided with a lubricating cup; *g* are four moveable plates for regulating the pressure; *h* is a grooved wooden driving-wheel; *m* is a screw in connexion with a hand-wheel, by turning which the axle is put in or out of connexion with the revolving plate. The machine may be used either as a dry or a wet mill; its weight is 22 kilos., and its height 52 cm.; it is driven by a water-motor similar to those employed for sewing machines, &c., 2—3 atmospheres pressure being sufficient. Braunite (10 g), placed in the mill for one hour, was so finely divided that it dissolved at once and completely in oxalic and sulphuric acid; the same quantity of chrome-iron ore, after an hour's grinding, left no residue when treated by any of the ordinary fusion methods.—F. S. K.



Improvements in Apparatus for the Separation of Solutions of Metallic Salts from Pulverised Material mixed therewith. C. T. J. Vautin, London. Eng. Pat. 15,575, November 14, 1887. 8*d*.

Filtration is assisted by a suction pump, which should by preference be lined with an alloy of lead and antimony when chlorides or bromides are under treatment. In order to prevent the choking of the filtering medium by deposited matter, communication is made by a comparatively narrow channel between the two sides of the pump valves; so that, after drawing a charge of liquid into the cylinder, the return stroke forces back a small portion of the same through the side channel and upward through the filter, which thus becomes slightly agitated. The main portion of the liquid is passed as usual to the exhaust.—W. G. M.

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*.	½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*.......	1*d*.
„ 1*s*. 6*d*., „ „ 2*s*. 4*d*.......	1½*d*.
„ 2*s*. 4*d*., „ „ 3*s*. 4*d*.......	2*d*.

A Process for Generating Carbonic Acid Gas and Apparatus connected therewith. J. Magoall, Manchester. Eng. Pat. 1832, February 5, 1887. 8*d*.

The carbonate from which the carbonic acid is to be prepared is ground up with water and allowed to run into a gas generator, while the acid used for decomposing the carbonate is periodically supplied to the generator by means of a partial vacuum and trapped pipes. The amount of acid brought into contact with the carbonate should be just slightly more than is required for neutralising the latter. In order to regulate this automatically the waste liquor runs off in a continuous stream from the gas generator, and whenever it contains too much free acid, an electro-magnet comes into play and shuts off the further supply of acid, until a nearly neutral reaction is restored in the waste liquor.—S. H.

Improvements in Bicarbonate Columns. W. B. Cogswell, Syracuse, U.S.A. Eng. Pat. 1973. February 8, 1887. 8*d*.

This invention relates to the construction of a column used in the manufacture of bicarbonates. Its object is to partially cool the liquid contents of the column. It consists in the use of internal. or partly internal and partly external cooling pipes, with the exterior internal surface of which the hot liquid comes into contact. The column is tubular in form and provided with flanges, which are secured to the preceding and following sections, as the column is built up of successive super-imposed sections (Fig. 1). B are rectangular nozzles opening outwards and into the interior of the section. These nozzles are located opposite to each other and in the same horizontal plane. C are the flue-sheets which receive the flue-pipes D. E and E^1 are the covers provided with partition walls *b b* upon E and *d* upon E^1, which walls stand at right angles to the inner faces of the covers, and when placed in position form the chambers 1, 2, 3, 4, and 5 (Fig. 2). F and F^1 are the couplings for the water pipes. The water enters the chamber 1, passes thence transversely through the flues into 4, thence into 2, thence across into 5, and lastly into 3, whence it passes out through F^1. Fig. 3 shows a column in which several sections are coupled together, all taking the water from a single stand-pipe *m*.—S.H.

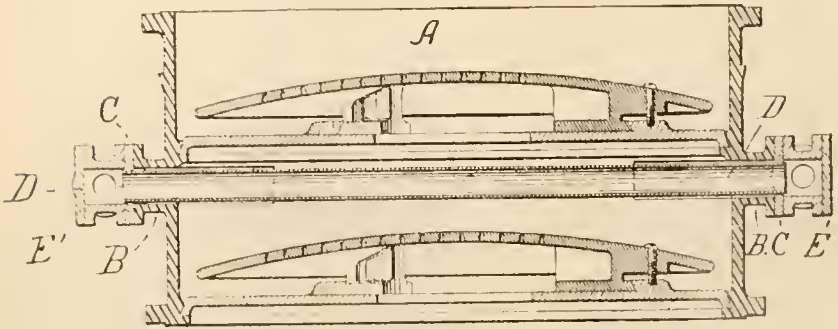


Fig. 1.

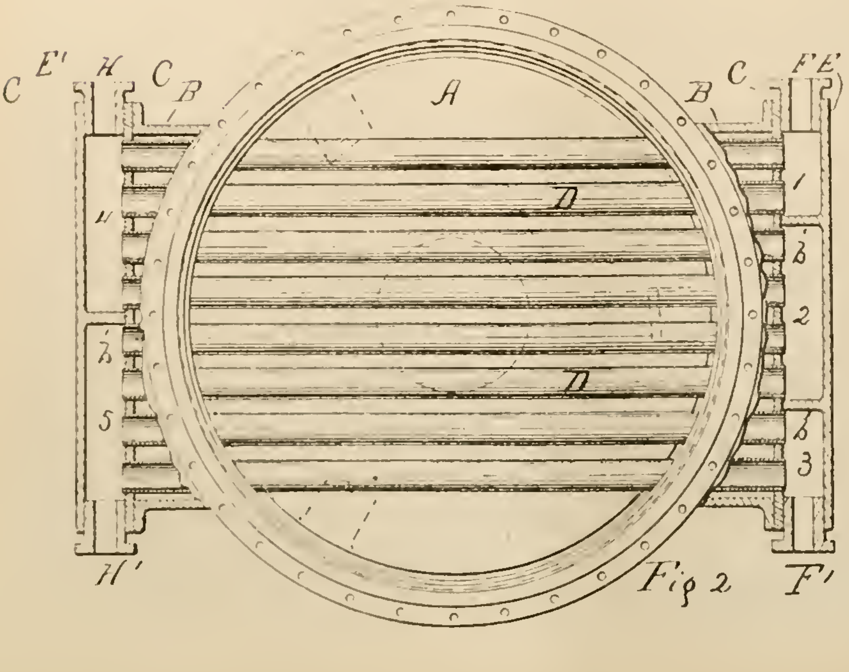
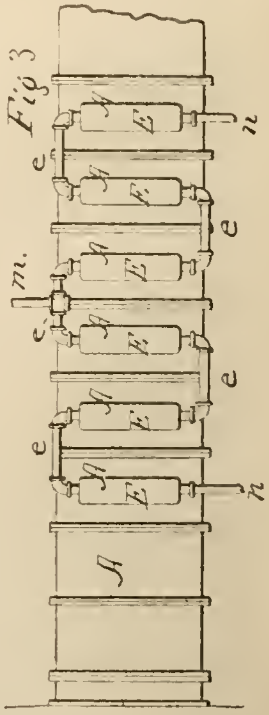


Fig 2



II.—FUEL, GAS, AND LIGHT.

Servian Coal. S. M. Losanitsch. Ber. **20**, 2716—2718.

Coal is very widely distributed in Servia, and occurs in large quantities in many localities, but at the present time only a few mines are constantly at work. The strata vary in age from that of the carboniferous to that of the tertiary formations. The author has examined all specimens of importance, and his results are given in the following table. The percentage of volatile matter and coke was estimated by igniting the sample in a covered crucible, corrections being made for the hygroscopic water and ash it contained; the calorimetric results were obtained by calculation.

Source.	100 Parts of Coal contain					Volatile Constituents.	Coke.	Calories.
	C.	H.	O (and N).	H_2O.	Ash.			
1.—Graphite.								
Stol	92·59	..	..	0·46	6·95	..	..	..
2.—Coal from Carboniferous Formation.								
Mustapie-Mišljenovac	82·61	3·99	6·48	0·95	5·96	17·17	75·92	7725
Osipaonica	76·40	3·73	1·89	1·34	13·73	18·39	66·54	7215
Kladuroro	74·34	3·69	4·80	1·12	16·77	..	..	7007
3.—Coal from Jurassic Formation.								
Prljita	86·42	3·81	4·06	1·18	4·53	10·94	83·35	8089
Dobra	77·58	4·11	12·28	3·05	2·68	30·90	63·37	7168
Boljetin	61·93	4·04	7·89	2·49	23·65	15·22	58·64	5995
Milanovac donji	64·54	3·40	11·04	1·89	19·29	17·23	61·77	5845
Krivi vir	69·91	3·67	8·38	1·32	16·72	23·93	58·03	6493
Brsa-Palanka	80·14	4·50	9·88	2·84	2·64	27·61	66·91	7524
4.—Coal from Chalk Formation.								
Senje	58·12	3·78	20·73	13·32	4·05	35·75	46·88	4910
Sisevac	59·48	3·90	21·30	12·30	3·02	..	..	4987
Sikole	58·85	3·62	21·57	14·16	1·80	35·73	48·31	4865
Židilje	55·53	3·59	22·19	14·40	4·29	39·18	42·12	4554
Jelovac	51·75	3·47	21·39	13·08	10·31	37·02	39·59	4257
Mrtvica	63·42	4·60	18·55	6·10	7·33	37·12	49·45	5771
Leskovac	57·06	3·63	21·76	14·22	3·33	37·78	36·67	4715
Jelašnica	51·53	3·85	17·46	18·62	8·54	35·97	36·87	4533
Subotinci	55·46	4·50	20·77	14·39	5·68	33·88	46·05	4932
Cićevac	53·89	3·80	19·74	13·25	9·32	38·46	38·97	4621
Vina*	64·56	4·18	2·16	1·27	17·98	29·43	51·32	6517
Orašac†	56·38	3·50	12·94	12·85	11·09	32·34	43·72	5055
5.—Coal from Tertiary Formation.								
Kostolac	53·59	3·37	20·11	17·08	5·85	34·98	42·76	4412
,,	43·45	3·10	19·19	24·93	8·71	39·61	27·65	3497
Bela reka	49·91	3·27	23·11	16·01	7·70	40·23	36·05	3937
Vojnik	54·32	3·60	21·93	12·74	8·01	37·84	41·11	4483
Miliva	59·44	4·14	24·73	10·33	1·36	40·70	47·61	5158
Misača	61·95	3·93	20·85	9·77	3·50	..	..	5254
Orašac	52·51	3·35	20·82	14·16	9·16	33·97	46·68	4254
Otročka reka	51·14	4·21	23·62	15·29	5·74	54·91	41·96	4339
Poljanačka Planina	50·22	3·72	19·37	17·40	9·29	39·90	33·41	4300
Ravnaja	55·69	3·50	21·58	14·38	4·85	35·37	45·20	4713
Sibnica	47·50	3·54	28·21	15·07	5·68	41·12	38·08	3592
Ćclije	45·33	3·42	23·83	18·30	9·12	40·30	32·23	3570

* Contains 10·05 per cent. sulphur.

† Contains 3·24 per cent. sulphur.

Source.	100 Parts of Coal contain					Volatile Constituents.	Coke.	Calories.
	C.	H.	O (and N).	H_2O.	Ash.			
			6.—PARAFFIN SHALE.					
Subotinci	47·23	6·80	12·13	3·90	29·94	49·36	16·80	5541
Mijonica	17·09	2·32	12·60	1·70	66·23	29·61	2·48	..
Orašac	39·26	5·24	10·94	2·20	42·36	..	..	..
Bovan	34·84	4·77	8·82	0·93	50·87	..	..	..

Paraffin shale from Subotinci gave, on dry distillation:—Tar, 24 per cent.; H_2O, 8 per cent.; ash, 29·25 per cent.; carbon (in the ash), 17·28 per cent.; gas, 11·47 per cent. Poorer specimens gave from 7–31·5 per cent. of tar.—F. S. K.

On Lamps for Kerosene Oil. M. Alibegow and W. Dolinin. Dingl. Polyt. Journ. **266**, 223.

THERE being no works for the manufacture of lamps in Russia, the latter must be obtained from abroad, where they are chiefly adapted for the burning of American petroleum. The authors wished to examine whether these lamps are also suitable for Caucasian petroleum, the specimens used being Nobel's kerosene, of 0·822 specific gravity, and a flashing point at 29° C., and Ragosin's pyronaphtha of 0·858 specific gravity. Their results were as follow:—Kerosene burns better in all the lamps than pyronaphtha. A lamp may be considered suitable for Caucasian petroleum if it consumes no more than four grms. of kerosene per hour per candle-unit. A 14 and 10 mm. burner ought to give a light equal to 10 and 8 candle-units respectively. Fifteen lamps out of 27 of different construction fulfilled these conditions. The same number proved to be suitable for burning pyronaphtha, and at a consumption of 4·5 grms. of oil per hour per candle-unit, a 14 and 10 mm. burner yielded a light of 9 and 6 candle-units respectively. Although a number of lamps seemed suitable on the point of illumination, they were altogether bad as regards security from explosion. In every case the reservoir became too warm after a few hours' burning. The opinion sometimes held that the more volatile constituents of the kerosene were first attracted by the wick and burned, while the heavy oils remained behind in the reservoir, is erroneous, as the specific gravity of the kerosene remained unaltered throughout the whole time the lamp was burning.—S. H.

Comparison between Water Gas, Illuminating Gas, and Generator Gas. F. Fischer. Zeits. Chem. Ind. **1887**, 147.

THE author considers in detail the present position of the gas question. He is of opinion that foundries and chemical works having cheap coke smalls at their disposal are likely to make use of water gas, and that this is applicable to Siemen-Martin's furnaces, to welding furnaces, to sugar manufactories for burning limestone, to the manufacture of glass, of fireproof stones, and to the decomposition of such substances as magnesium chloride, where the high temperature and steam would be of special advantage; further, that it also has a future for laboratory use on account of its high temperature and freedom from smoke. The water gas industry is likely to develop as soon as coal can be applied directly for the purpose, and this can be best attained by first distilling the coal, and thereby obtaining the valuable by-products, and mixing the illuminating gas with the water gas to be obtained from the residual coke. A much lower temperature could then be employed than is used at present, as the volume of gas obtained ceases to be of so much moment, and the present complex methods of gas manufacture might be replaced by a form of continuous machinery whereby the coal, after partial decomposition, could be transferred direct to the generators. For supplying districts with gas for lighting, heating, and motive power, illuminating gas is of little value, for it only yields about 20 per cent. of the calorific power of the coal, whilst it necessitates much manual labour, and only certain kinds of coal can be used. Water gas yields 40 per cent. of the calorific power of coke and anthracite (generator gas 42 per cent.) and 45 per cent. of that of the coal; it is pleasanter as an illuminant when employed in Fahnehjelm's magnesia burner; for heating purposes it is handier, and, in most cases, cheaper than illuminating gas. Since only 20—30 per cent. of the available heat of the fuel is obtained in ordinary stoves, and hardly 5—10 per cent. in cooking-stoves, the cheaper water gas, with its freedom from smoke and dust, is sure to be preferred. With regard to its being poisonous on account of the carbon monoxide contained, carburetted water gas has been in use in 150 towns of the United States for two years, and no prejudicial effects have been observed. The author considers water gas specially applicable for motive power on the large scale, and capable of replacing steam power to advantage. The generator gases obtained as a by-product could be used for heating, boilers supplying the motive power for electric lighting purposes.—C. A. K.

Improvements in the Gas Industry. W. Leybold. Dingl. Polyt. Journ. **267**, 31—37, 85—93.

On the Manufacture of Gas from Tar.—W. Bäcker (*Journ. f. Gasbeleucht.* 1887, 910) states that he has obtained 50—60 cb.m. of gas of about 30 candle power, and 120—125 kilos. of good coke from a mixture of 100 kilos. of tar mixed with a like weight of coke; a mixture of 100 kilos. of tar with 100 kilos. of slaked lime yielded 100 cb.m. of gas of equal value. His theory is that in the former case the C of the coke combines with the H of the tar, while in the latter it is the C of the tar which unites with the H of the calcium hydrate; and he considers that, instead of firing the retorts with tar to make coal gas, the latter should be used to produce the gas from the tar. Early failures in obtaining a gas of high value from coke are due to the want of incorporation of the tar with the added material. Leybold re-asserts that good gas cannot be made from tar, since the luminous constituents have been already removed in the gas; and if Bäcker has produced such excellent gas from tar, it indicates that the gas, of which the latter was a by-product, was not of the value it should have been. A. Grebel (*Journ. des. usines à Gaz*, 1887, 343) treated two mixtures: one of tar 100 kilos., sawdust 100, and lime 20; the other of tar 100 kilos. and coke dust 250; and these yielded respectively 76 and 21 cb.m. of gas, of which 42·9 litres of the former and 31·4 litres of the latter were used *per* candle power *per* hour in a French (Bengel) normal Argand burner. In neither case was the rising main choked, and the tar pitch and naphthalene weighed less than the yield from 120 kilos. of coal. But the luminosity was only 25—33 per cent. of that of a normal coal gas, of which 10·4 l. should be required per candle power per hour. Experiments were made in the same direction near Paris, with 13·36 kilos. of tar mixed, in the first case, with 375 of Marles coal, 9 of sawdust, and 2·61 of lime; and in the second, with 125 of Marles coal, 250 of Ferfay coal, 9·6 of sawdust, and 2·64 of lime. The former yielded 128 cb.m. of gas, giving, after three-quarters of an hour, 1·23 carcels, with a flame 130 mm. high, and, after three hours, 0·95 carcel, with a flame

100 mm. high. When tested by Jouanne's apparatus, after allowing for the mean gas-producing power of the coal (31 cb.m. per 100 kilos.), and of the sawdust (23·1 per 100), the tar alone is found to have yielded 72·38 cb.m. per 100 kilos. The second mixture yielded 122 cb.m. of gas, which, after the necessary deductions, is equivalent to 64·9 cb.m. per 100 kilos. of tar. The author considers that the gas-producing power of the sawdust is here understated, and therefore that that of the tar is somewhat excessive.

Comparisons of Kitson's Albo-Carbon Lamp and the Siemens'-Lungren Regenerative Burner.

These measurements are given in the Journal of the Franklin Institute.

Burner.		Gas used per Hour. in Litres.	Luminosity in C.P.	Candle Power per cb.m.	Direction of Measurement.
1. Albo-carbon lamp...........................	1......	135·5	29·7	219	..
	2......	139·8	41·1	294	..
Coal gas used, in the 140 l. burner		..	17·25	123	..
2. Siemens-Lungren burner, with vertical flame	1......	1445	364·65	252	Horizontal.
	2......	1445	463·11	320	"
	3......	1355	396·52	292	"
Coal gas used, in the 140 l. burner		..	17·71	125	..
3. Siemens-Lungren burner, with inverted flame	1......	464	124·71	269	Horizontal.
	2......	504	155·84	309	"
	3......	487	157·62	323	"
	4......	457	197·16	431	45° downwards.
	5......	471	231·78	492	"
	6......	486	230·64	474	"
	7......	452	223·86	495	Vertically downwards.
Coal gas used, in the 140 l. burner		..	18·60	133	..

The naphthalene required for the albo-carbon burner was 4·61 kilos. per 100 cb.m. of gas; and the light was then equal to 200—250 per cent. of that of the unenriched gas.

On the Use of Lime in the Manufacture of Coal Gas.—Opinions differ greatly as to the efficacy of the Cooper process of liming coal, in fixing the sulphur. and in increasing the yield of ammonia. Spice, in a treatise published in 1884, has shown that the effect may vary from an increase of 100 per cent. of NH_3, down even to a decrease of 7 per cent., by the addition of lime to various English and American coals. And now Schilling has observed similar differences among German coals; many Bohemian coals showing no improvement, whilst Westphalian samples have yielded an increase of 11 per cent., English of 31 per cent., and Saxon of 84 per cent. Walton Clark has also made a 25 days' trial of limed English coal in the gasworks of Jefferson City, using the purifying apparatus customary in smaller works. The coal during the first half of the time was crushed smaller than had been usual, and this was found to be advantageous. Three per cent. of lime was first tried, but the proportion was subsequently reduced to 2·7 without injury, the sulphur in the coal amounting to 1·13 per cent. Neither the yield of gas nor its luminosity were in any way impaired, but the yield of NH_3 per 1,000 kilos. of coal was increased from 2·36 to 3·30 kilos., or of $(NH_4)_2SO_4$ from 9·13 to 12·79 (= 39·8 per cent. improvement). The sulphur in 100 cb.m. of gas, before and after scrubbing, had fallen from 887 and 656 grm. to 567 and 377 grm. respectively, and in the finished gas from 35 to 15 grm., whilst the CO_2 in the latter was reduced by 22 per cent. Less work was thus required from the purifiers, which were enabled to treat 50 per cent. more gas than had been possible previously. The tar pitch contained no lime. The coke, however, showed numerous white spots of 0·5 to 0·6 mm. diam., or in places a whitish ring of about 25 mm. diam.; a greater quantity of slag was produced on the fire bars in burning, but this was compensated for by the increased facility in breaking it up.

Photometric Value of New Gas Burners.

These numbers are given by Fischer in the *Gesundheitsingenieur*, 1887, 585.

Burner.		Gas used per Hour, in Litres.	Luminosity in Normal Candles.	Normal Candles per 100 l.	Direction of Measurement.
Siemens' Regenerative, German Pat. 8423	No. 0	2,000	400	20·	Horizontal.
	" 1	1,700	300	18—19	"
	" *2a*	1,100	200	18·5	"
	" *2b*	800	150	18·5	"
	" 3	420	63	15·	"
O'Neill Lamp		660	90—100	13·6—15·	Various.

PHOTOMETRIC VALUE OF NEW GAS BURNERS—*cont.*

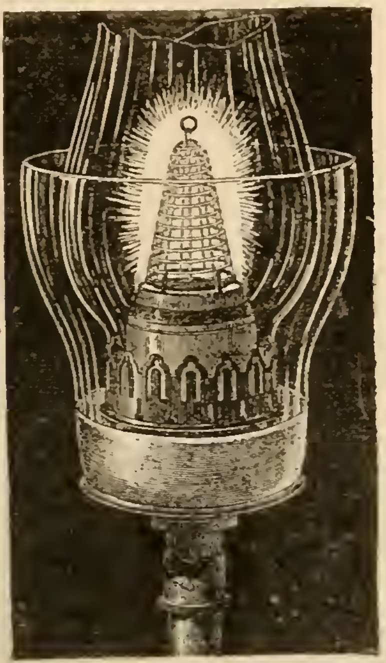
Burner.		Gas used per Hour, in Litres.	Luminosity in Normal Candles.	Normal Candles per 100 l.	Direction of Measurement.
Bower Lamp. German Pat. 29,326 ..	Mean of 2 *a* ...	260	44·5	18·6	26° and horizontal.
	Mean of 2 *b* ...	408	73·7	18·1	" "
	c ...	950	199·	21·	26°.
	d ...	910	225·	24·6	Horizontal.
Butzke-Westphalia, without reflector. German Pat 21,809	Small	350	90·	25·5	Vertically beneath.
			85·	24·	45°.
			64·	18·	Horizontal.
	Large	450	130·	29·	Vertically beneath.
			107·	24·	45°.
			80·	18·	Horizontal.
Wenham Lamp. German Pat. 25,359	No. 0	105	20·	19·	Vertically beneath.
			17·8	17·	30°.
			10·5	10·	Horizontal.
	" 2	299	95·	31·6	Vertically beneath.
		302	43·	14·	Horizontal.
	" 3	312	87·	25·5	Vertically beneath.
Smallest size Sugg burner		48	5·2	10·75	Vertically beneath.
			5·4	11·25	40°.
			5·4	11·25	30°.
			4·5	9·3	Horizontal.

Observations with Normal Candles.—E. Voit has experimented with the candles usually employed for measurements. The luminosity of any given candle varies with the thicknes of the wick. Further, it is found that although the error in measurement varies with different observers (being greates with the inexperienced), and also with the degree of luminosity, yet it is practically constant at any given brightness with any single observer. As the result of a series of trials, he finds that taking the Münich stearin candles with a normal height of flame of 52 mm. as 100, the value of German paraffin candles at 50 mm. is 96, and of English spermaceti candles at 44·5 is 94·2. In a given period a variation in the height of flame may occur which may amount to several mm., but the average departure from the mean rarely exceeds ± 2 mm.

The Production of Ammonium Phosphate from Gas Liquor.—Some years since it was suggested in the *Chem. Zeit.* that the working up of the ammonia of gas liquor into acid ammonium phosphate might prove lucrative. Raupp now describes in the *Ber. ü. d. Versamml. d. Mittelrh. Gasind. in Karlsruhe* a trial of such a process. A commercial phosphoric acid (= 50 per cent. P_2O_5) was allowed to deposit the calcium phosphate in suspension; and, having been placed in a suitable vat, ammonia was introduced through a leaden tube. Energetic action, with much frothing, ensued, but soon subsided, leaving a greyish green limpid liquid, which gradually thickened and finally solidified to a white fatty mass. This was dried in lead pans to a non-hygroscopic grey white mass, of which 68 per cent. was soluble in cold water: the total N was 9·6 per cent., that as NH_3 8·7, total P_2O_5 52·3, and soluble P_2O_5 42·9 per cent. The insolubility of a portion of the phosphoric acid was due to the use of raw P_2O_5. The solution is stable at a boiling temperature, the tri- and di-ammonium orthophosphates decomposing on heating into the mono-orthophosphate and free ammonia. When crushed this salt should possess considerable value as an addition to manures of low grade.

Heating and Melting Experiments with Water Gas.—These are described in the *Gesundheitsingenieur*, 1887, 342. During the years 1883–84 Wilson gas was employed at the gold and silver works at Frankfort; but, although very suitable for heating the boilers, and muffles for firing porcelain, and for work generally not requiring very high temperatures, it was not successful as applied to melting the noble metals, owing to the large amount of nitrogen contained (analysis:—CO = 18, H = 10, N = 68, CO_2 = 4 per cent. by volume). The air and gas are, however, well under control, and with the latest improvements the gas is now in use for melting glass, and in England, even steel. But since 1885, at the Frankfort works, water gas, supplied by the adjacent gas-works, has been in use. The composition is CO = 36, H = 51, N = 7, CO_2 = 4, H_2O = 1 per cent. by volume. It is found amply sufficient for the work required of it, melting gold, silver, or copper with facility; and, in a Rössler gas furnace, it will fuse Prinsep's alloy (70 per cent. gold and 30 per cent. platinum), the melting point of which is estimated at 1255°. Experiments as to the comparative cost of the gas showed that to raise a given volume of water, contained in a copper vessel, from 15°—100°, the volumes of water gas, of the luminous gas of the local company, and of the coal gas of the English Imperial Continental Gas Association, required were 10 : 4 : 5 cb.m. respectively, the respective costs being 10 : 20 : 14 marks. So also two kinds of enamel flux melted in a Perrot gas furnace required an expenditure of 4·6 and 6·5 m. for water gas, or 19·6 and 26·8 for Frankfort lighting gas. Similar quantities of copper and silver, fused in the same furnace, gave an outlay of 4·3 and 5·7 m. for the water gas, against 16·7 and 21·7 m. for the illuminating gas.

New Pattern of Clamond's Incandescent Burner.—The accompanying block sufficiently indicates the improvement. The unsightly air heater is dispensed with, all the air being now warmed by passing downward between the two glass shades and the brass fittings beneath the burner. A magnesia cone is used and the gas is lighted from above. A statement of the gas consumption and luminosity is appended.



No.	Gas used per Hour, in Litres.	Luminosity.	
		Carcels.	Candles.
1	135	2·	19·6
2	190	3·86	37·9
3	300	5·5	54·
4	600	9·	88·4
5	1,200	18·	176·7

The No. 2 burner is chiefly used, and requires 50 litres *per* carcel.—W. G. M.

An Improved Means for Straining Gas Tar to be used as Fuel in Gas and other Works. A. Thomas, West Cowes. Eng. Pat. 16,048, December 8, 1886. 6*d.*

A METAL dish similar in form and size to an ordinary tea saucer, has its top covered with wire gauze, while in the bottom is a hole screwed to take ¾-in. bore pipe. The strainer is placed in the tar supply tank, and is connected with the delivery pipe (which passes through the side of the tank) by a swivel, so that it can be raised at will to facilitate cleaning. Another form of the apparatus consists of two of these dishes placed face to face, holding the wire gauze between them. In this case the strainer can be placed at any convenient point of the supply pipe.—A. R. D.

Improvements in the Method of and Apparatus for Manufacturing Gas from Fluid Hydrocarbons. A. G. Meeze, Redhill. Eng. Pat. 1479, January 31, 1887. 8*d.*

THESE improvements consist mainly in maintaining a partial vacuum in the retorts. Any convenient gas generating apparatus may be used, but preference is given to those wherein deflectors or impact surfaces are employed. By conducting the gas generation under reduced pressure, it is claimed that the gas can be made and fixed at a much lower temperature than under ordinary circumstances, and the formation of obstructive deposit is prevented. The use of an exhauster also makes it easier to admit another gas for purposes of dilution or otherwise, and a governor, consisting of a gas pressure holder suitably connected, allows the operation to be carried on with the utmost regularity and uniformity.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

A Di-Terebene. A. Renard and Berthelot. Compt. Rend. **105**, 865.

THE resinous oils obtained by the distillation of collophonium consist almost entirely of a hydrocarbon $C_{20}H_{30}$, which may be isolated by washing with caustic soda (to remove resinous products) and water, and then fractionating. It is a colourless oil boiling at 343°—346° and having a sp. gr. of 0·9688 at 18°. Its specific rotatory power is +59° for a 10 cm. layer of liquid. It resembles the terpenes in its properties, and is probably di-terebene $H_{15}C_{10}-C_{10}H_{15}$. A thin layer exposed to the air for some time absorbs oxygen and forms a sticky varnish. It is oxidised almost completely to carbon monoxide and carbon dioxide by a hot acetic acid solution of chromic acid. With potassium permanganate, carbon dioxide and formic, acetic and propionic acids result. Treated with fuming nitric acid in the cold, a tri-nitro-derivative $C_{20}H_{27}(NO_2)_3$ is formed; this is a yellow powder soluble in alcohol and ether. A liquid hydrochloride $(C_{20}H_{30})_2HCl$ is obtained by treating the hydrocarbon with hydrochloric acid gas; bromine acts violently on di-terebene, and at −10° in carbon bisulphide solution yields a di-substitution product, which is decomposed on evaporating off the carbon bisulphide, with liberation of hydrobromic acid. Direct treatment with bromine yields a hexabromine derivative, $C_{20}H_{24}Br_6$, a dark brown solid melting below 100° and soluble in alcohol and ether. Treated with ordinary sulphuric acid a mono-sulphonic acid is got, $C_{20}H_{29}SO_2OH$, a brown-black mass, soluble in water, alcohol, ether, &c. Its solution is fluorescent, appearing brown by direct, green by reflected light. The acid decomposes the carbonates of the alkalis and of the alkaline earths.—C. A. K.

The Decomposition of Naphtha by Heat. K. Lissenko and Rosenbladt. Berg. Journ. Russ. 1887. 349.

NAPHTHA residues, on distillation in a hard glass flask provided with a dephlegmator consisting of a tube to which four exit tubes were attached at different heights, give the best yield of lower boiling products between 434° and 457°. (Zinc m.p. 400°, silver bromide m.p. 434° silver chloride m.p. 457°, and lead chloride m.p. 501°, were used to indicate the temperature.) 64 per cent. of a distillate of sp. gr. 0·805, and which yielded on fractionating 50 per cent. below 225°, and 80 per cent. below 305° was obtained from naphtha residues at the above temperature. This distillate, after washing with sulphuric acid and alkali and fractionation, forms an excellent illuminating oil which does not become yellow on exposure to the air. The naphtha residues also give 30 per cent. of a distillate of sp. gr. 0·860, from which solid hydrocarbons separate on cooling, and 4 per cent. of a carbonaceous residue.—C. A. K.

Decomposition of Petroleum by Heating. K. Lissenko. J. f. Berg. u. Hüttenw. **1887**, 349.

PETROLEUM-NAPHTHA on distilling is not only decomposed into constituents of different boiling points, but the high boiling oils are split up into those of a lower boiling point. The longer the naphtha is exposed to heat, the larger is the yield of low boiling oils. The yield of kerosene from Caucasian petroleum may be increased from 30 per cent. to 60 per cent. by simply altering the temperature and duration of the operation of distilling. Alexejew took out a patent, which depends upon this principle by carrying on the distillation in an atmosphere of hydrocarbons. As regards the temperature of the decomposition, it is very likely that different oils require a different temperature to give the most favourable result. Petroleum residues seem to yield most kerosene when distilled at a temperature of 431° to 501° C. Sixty-four per cent. of the distillate stood at 0·805, and 30 per cent. at 0·860. Nobel found for the petroleum residues the most favourable temperature of distillation to be 400° C. The distillate which stood at 0·805 yielded, after purification with sulphuric acid and sodium hydrate and a second distillation, an excellent colourless oil, which did not turn yellow, even after long standing. But the greater yield of kerosene from naphtha does not seem to be economical, since, under the conditions of a long-continued heating, a still could only do one-twentieth of the work it would perform under ordinary circumstances.—S. H.

On Retene. E. v. Boyen. Chem. Zeit. **11**, 1297.

Retene, $C_{18}H_{18}$, was described by Bamberger and Hooker as methyl-propyl-phenanthrene. It occurs in high boiling tar-oils, derived from resinous pine-wood, and forms a faintly yellow, glittering, crystalline powder, which melts to a yellow oil. It can be melted together with different oils, fats, and hydrocarbons, and raises or lowers their melting point accordingly. It can also be obtained by distilling resin oil with sulphur. The fossil resin of the coniferae, as found in Switzerland, Bavaria, and Denmark, contains retene as its principal constituent. It appears, indeed, very probable that the hydrocarbon is in every case derived from the coniferae.—S. H.

Improvements in Production or Recovery of Cyanogen Compounds from Coal Gas and other Gases. O. Knublauch, Cologne, Germany. Eng. Pat. 15,164, November 7, 1887. 6*d.*

Gas-mixtures containing cyanogen, such as the crude illuminating gas from coal, are passed through a liquid containing an alkali or an alkaline earth and iron in the form of oxides or hydrates. The cyanogen always finds in the liquid the requisite proportions of iron and alkali to form a ferrocyanogen salt, which dissolves in the liquor. When the liquid becomes very rich in ferrocyanogen compounds it is removed for further treatment. If an excess of iron over alkali is present, the cyanogen compounds are precipitated.—S. H.

Improvements in Methods of Producing Combustible Gases from Liquid Hydrocarbons, and in Apparatus therefor. B. H. Thwaite, Liverpool. Eng. Pat. 16,053, December 8, 1886. 2*s.*

This patent specification, which is provided with 63 drawings, is not suited for useful abstraction.—S. H.

Improvements in the Method and Means of Refining Crude and Refuse Petroleum and the like. Percy Haddon, London. From G. L. Benton, Titusville, U.S.A. Eng. Pat. 1922, February 7, 1887. 8*d.*

This invention consists in a method of producing light hydrocarbons from the refuse of petroleum oils, tar oils, and other heavy mineral oils. The apparatus serving for this purpose consists of a long range of pipes placed in a furnace in which they are heated. The pipes communicate at one end with a force-pump, and at the other end with a vapour chamber. Before the latter a stop-valve is applied, so that it is possible to maintain a very considerable pressure in the pipes. The oil is forced through the pipes, where it is heated under great pressure. It then passes into the vapour chamber, which may be exhausted to a certain extent, where a rapid evaporation of the heated hydrocarbons takes place. The vapours pass out at the top to a condensing apparatus, while the heavier liquids, not evaporated, flow off at the bottom.—S. H.

Improvements in Apparatus for Treating or Purifying Paraffin Wax. N. M. Henderson, Broxburn. Eng. Pat. 1291, January 27, 1887. 11*d.*

In carrying out this invention an improved "sweating" process is used, in which the paraffin in a melted state is run into a series of horizontal trays, each provided with a strainer of wire gauze, which is covered with a woven fabric or felt. Whilst the melted paraffin is being run into the trays, the strainers and spaces beneath are filled with water, which prevents the paraffin from passing through them. After the paraffin has been run into the trays it is cooled to solidify it. The water is next run off from beneath the strainers, and then the paraffin is subjected to the sweating heat, which causes the liquefied impurities to drain through the strainers, and pass off by the outlets beneath the strainers. Each charge of paraffin may be subjected to one or more sweating operations before being removed from the trays, the paraffin being re-melted by the application of sufficient heat previous to each sweating operation. Whilst the paraffin is in a liquid state, the space beneath the strainers is filled with water, to prevent the paraffin from running through. When the paraffin has been sufficiently treated in the trays, it is melted and run off through the strainers. The trays are arranged in vertical sets in a stove or chamber, which can be heated, and is provided with doors for the passage through it of cool currents of air when required for cooling and solidifying the paraffin. The trays have overflow outlets, which are alternately at opposite ends. For filling the trays, the paraffin is melted in a tank, placed at a high level, and the melted paraffin is run from the tank into the top tray of each set, and overflows into the next lower one, until all of a set are filled. The trays are supported on horizontal pipes, which are also used for applying the heat required for melting the paraffin in the trays.—S. H.

IV.—COLOURING MATTERS AND DYES.

Colouring Matters from Anthraquinone-disulphonic Acid. Chem. Zeit. 1887, **11**, 1530.

Reference has already been made in this Journal (1888, 32) to certain dyes obtained by W. Walder, and produced by the action of nitrite on strongly acid solutions of the sulphonic acids of phenol, naphthol, anthraquinone, &c. The colour obtained from the disulphonic acid of the last-named body is sold as a 25 per cent. paste, insoluble in water and acids, but dissolving in alkalis with a deep red-brown colour. Cotton is dyed after previously mordanting with acetate of alumina or iron. The shades resemble alizarin, and are fairly fast to soap and chlorine. The tinctorial value is, however, exceedingly small, 2 grms. of the above paste not giving as deep a tint as 0·3 grms. of a 20 per cent. alizarin paste.—A. R.

New Method for the Production of Substituted Safranines. P. Barbier and L. Vignon. Compt. Rend. **105**, 670.

Paranitrosodimethylaniline hydrochloride, heated with aniline in alcoholic solution on the water bath, yields tetramethyldiamidoazobenzene (melting point 218°—220°) and dimethylphenosafranine, according to the following equation :—

$$3\ C_6H_4(NO)N(CH_3)_2HCl + 2\ C_6H_5.NH_2 =$$
$$C_{16}H_{20}N_4 + C_{20}H_{19}N_4\cdot Cl + 3\ H_2O + 2\ HCl.$$

The dimethylphenosafranine is identical with that obtained by the oxidation of dimethylparaphenylenediamine and aniline. The greater portion of the tetramethyldiamidoazobenzene separates from the alcoholic solution on cooling.—C. A. K.

A new Brasilin Derivative. C. Schall and C. Dralle. Ber. **20**, 3365—3366.

Tetramethyl-brasilin, $C_{16}H_{10}O_5(CH_3)_4$, is obtained by acting on brasilin with sodium ethoxide and methyl iodide. The product of the reaction is separated from the sodium iodide, taken up with ether, and the ethereal solution shaken with dilute soda until the latter is no longer coloured. After washing, filtering, and distilling-off the ether, a brittle, amber-yellow, transparent mass is obtained, which, on exposure to the winter-cold for one or two months, changed into a crystalline mass when ether was poured over it. By washing the powdered mass with ether, a yellowish-brown substance was isolated, which crystallised from boiling alcohol in snow-white crystals, melting at 138°—139°.

This compound behaves like a phenol-ether, gives no colouration with soda, but does so at once after boiling with concentrated hydriodic acid; it is not changed on exposure to the air, and seems to give an addition-product with ammonia and with bromine.—F. S. K.

Auramines. W. Fehrmann. Ber **20**, 2844—2862.

AURAMINE hydrochloride, $(C_6H_4N(CH_3)_2)_2 : C : NH . HCl$, is difficultly soluble in water, but readily in alcohol. It is decomposed by dilute mineral acids and hot water, tetramethyldiamidobenzophenone being produced. It colours tanned wool yellow. Auramine crystallises from alcohol in lemon-coloured needles, which are insoluble in water and ether. It is a monacid base, and forms a crystalline oxalate and picrate.

By heating auramine hydrochloride with various amines, hydrochlorides of substituted auramines were obtained, from which coloured crystalline bases were prepared.

When a warm alcoholic solution of auramine, or substituted auramine, is treated with sulphuretted hydrogen, tetramethyldiamidothiobenzophenone is formed, and this compound is also produced by acting on auramine or phenyl auramine with carbon bisulphide.—F. S. K.

A condensation Product of Cinnamic and Gallic Acids. Emil Jacobsen and Paul Julius. Ber. **20**, 2588—2589.

WHEN 10 parts of cinnamic and 17 parts of gallic acid (or tannin) are heated for two or three hours at 45°—55° with 150 parts of sulphuric acid, *styrogallol*, $C_{16}H_{10}O_5$, is formed. This substance is insoluble in all ordinary neutral solvents except boiling alcohol, acetic acid, and aniline, in which it is difficultly soluble. It dissolves in alkalis, forming a green solution, which turns blue and then red when heated, and gives a yellowish-red solution with sulphuric acid. By careful sublimation, large yellow needles are obtained, which do not melt at 350°. Styrogallol forms a yellow crystalline, *triacetyl derivative*, $C_{22}H_{16}O_8$, and yields with mordants shades similar to those obtained with nitroalizarin. When oxidised with dilute nitric acid, a considerable quantity of phthalic acid is obtained.—F. S. K.

The Production of Colouring Matters by Means of Hydrogen Dioxide. C. Wurster. Ber. **20**, 2934—2940.

HYDROGEN dioxide alone acts slowly on a mixture of phenol and ammonia, producing a blue colouration; in presence of acetone, oxalic acid, or alcohol, the reaction proceeds quickly, but best of all in presence of hydroxylamine. Phenolquinoneimide is thus obtained, but it could not be purified on account of its instability. All the monohydric phenols experimented upon, in which the para position with respect to the hydroxyl is free, give quinoneimides when treated as above, the most stable products being those obtained from thymol and cymophenol. Para compounds either give yellow dyes, or remain unacted upon.

Quinoneimides are also formed when ammonia is added to an excess of a phenol in which the corresponding quinone is dissolved. Tyrosine gives with quinone a ruby-red dye; this reaction may be employed as a test for tyrosine. An ammoniacal solution of resorcinol, when treated with hydrogen dioxide and boiled, turns blue owing to the formation of lackmoïd (resorcinol blue). Hydroxy-acids, orcinol, erythrin, phloroglucinol, pyrocatechol, guaiacol, phloridzin, salicin, orsellinic, and usninic acids all give coloured products when oxidised with hydrogen dioxide in alkaline solution.

When quinone is fused with resorcinol, and the product dissolved in ammonia, a deep green solution is obtained, which, on shaking with air, turns yellow, and becomes green again on shutting off the air. The changes in colour resemble very closely those undergone by many leaves, especially those of the Berberis species, the white, yellow, and red leaves of which contain considerable quantities of hydrogen dioxide, whilst the green ones contain very little or none at all. Arbutin and coniferin combine with quinone to form green compounds which turn red on exposure to air.

Many of the transitory colouring matters of leaves are turned red by acids, and blue, or (in presence of yellow) green by ammonia, and this is a general property of quinoneimides. Hydrogen dioxide is found in living protoplasm, in the sap, flowers, and seeds of many plants, in saliva, sweat, and innoxious matter; also in micro-organisms, especially the non-pathogenic varieties. Since ammonia and phenols occur among the decomposition products of albumen, it follows from the author's observations that the formation of vegetable colouring matters probably depends upon the presence of hydrogen dioxide. Phenolquinoneimide, moreover, agrees very closely with the description of pyocyanin which Lücke obtained from bluo matter; the formation of red and blue sweat is also attributed to the presence of hydrogen dioxide.—F. S. K.

On Styrogallol and its Analogues. H. v. Kostanecki. Ber. **20**, 3137—3145.

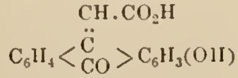
BY the condensation of gallic acid with cinnamic acid by means of H_2SO_4, Jacobsen and Julius have obtained a new dyestuff—*styrogallol*—which presents a great similarity to the colouring-matters of the hydroxy-anthraquinone group.

The author has previously shown that in the analogous condensation of the hydroxy-benzoic acids with benzoic acid, only those hydroxy-benzoic acids which have at least one OH group in the *meta* position to the CO_2H are capable of forming hydroxyanthraquinones. In a similar manner the condensation with cinnamic acid also proves to be general for all such meta hydroxy derivatives of benzoic acid. The products are analogues of styrogallol, and are formed according to the general equation:—

$$C_6H_{5-x}(OH)_x = CO_2H + C_6H_5.C_2H_2.CO_2H =$$
$$C_{16}H_8O_{2+x} + 2\ H_2O + H_2.$$

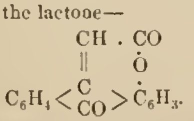
The simplest of these compounds $C_{16}H_8O_3$ is obtained from *m*-hydroxy-benzoic acid and cinnamic acid. It is insoluble in alkalis, in which it differs from its dihydroxy-derivative, styrogallol.

The first step in the condensation is probably the formation of the hydroxy-acid



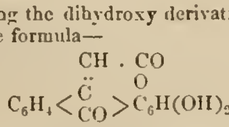
$$\begin{array}{c} CH.CO_2H \\ C_6H_4 < \begin{smallmatrix} \ddot{C} \\ CO \end{smallmatrix} > C_6H_3(OH) \end{array}$$

which then gives the lactone—



$$\begin{array}{c} CH\ .\ CO \\ \|\qquad \dot{O} \\ C_6H_4 < \begin{smallmatrix} C \\ CO \end{smallmatrix} > \dot{C}_6H_3. \end{array}$$

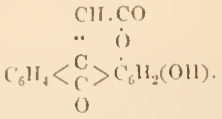
Styrogallol, being the dihydroxy derivative of this, would therefore have the formula—



$$\begin{array}{c} CH\ .\ CO \\ \qquad O \\ C_6H_4 < \begin{smallmatrix} \ddot{C} \\ CO \end{smallmatrix} > C_6H(OH)_2. \end{array}$$

The compound $C_{16}H_8O_3$ is prepared by heating molecular proportions of *m*-hydroxybenzoic acid and cinnamic acid with an excess of conc. H_2SO_4 upon the water-bath for some hours. The product is purified by precipitation with dilute ammonia, extraction with benzene, and sublimation or crystallisation from acetic acid. It is very similar in appearance to anthraquinone, subliming in large glistening yellow needles, and crystallising from acetic acid in small yellowish needles, which melt at 260°. It is slightly soluble in alcohol, with an eosin-like fluorescence. The solution in H_2SO_4 is yellow with a green fluorescence. It is insoluble in alkalis, but dissolves on boiling to a yellow solution with green fluorescence, probably forming a salt of the corresponding acid.

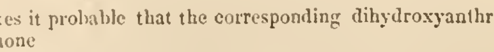
By heating cinnamic acid and the symmetric dihydroxybenzoic acid (equal mols.) with conc. H_2SO_4 at 60°, the compound $C_{16}H_8O_4$ is very readily formed. This is the *m*-hydroxy-derivative of the preceding body, and probably has the constitution—



$$\begin{matrix} CH.CO \\ \vdots \quad \dot{O} \\ C_6H_4<\genfrac{}{}{0pt}{}{C}{C}>\dot{C}_6H_2(OH). \\ O \end{matrix}$$

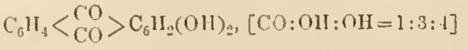
It sublimes and crystallises from acetic acid in yellow needles, which melt at 325°. It dissolves in alkalis or conc. H_2SO_4 with a yellow colour, but is insoluble in most other solvents. In cold baryta-water it dissolves, but on boiling forms the insoluble barium salt of the corresponding acid. Its acetyl derivative forms yellow felted needles of melting-point 255°.

The analogy of styrogallol with alizarin in its attraction for oxide-mordants is no doubt due to its containing two OH groups in the ortho position to each other. The fact that these hydroxyl groups are not in the same position with reference to the CO group as in alizarin—



$$C_6H_4<\genfrac{}{}{0pt}{}{CO}{CO}>C_6H_2(OH)_2, \ [CO:OH:OH=1:2:3]$$

makes it probable that the corresponding dihydroxyanthraquinone



$$C_6H_4<\genfrac{}{}{0pt}{}{CO}{CO}>C_6H_2(OH)_2, \ [CO:OH:OH=1:3:4]$$

when prepared will be found to have similar mordant dyeing powers.—A. G. G.

On Tetramethyldiamidothiobenzophenone. O. Baither. Ber. **20**, 3289—3298.

THE author has already described (Ber. **20**, 1731) the properties of this thioketone, $SC\{C_6H_4.N(CH_3)_2\}_2$, which was discovered by A. Kern. By heating with an excess of benzyl chloride it is converted into the dichloride $Cl_2C\{C_6H_4.N(CH_3)_2\}_2$. This is soluble in acetic acid, but scarcely soluble in benzene or chloroform. It is decomposed by water with formation of the ketone $OC\{C_6H_4.N(CH_3)_2\}_2$. The latter is also formed directly from the thioketone by treatment with phenylhydrazine. With aniline hydrochloride the thioketone gives phenylauramine, which crystallises from alcohol in small yellow crystals of melting point 171°. (Fehrmann, Ber. **20**, 2852, states that it begins to decompose at 80°). The thioketone is converted by conc. HNO_3 into the nitramine $OC\{C_6H_2(NO_2)_2.N(CH_3)(NO_2)\}_2$ not into trinitrodimethylaniline as previously given.

By heating with hydroxylamine hydrochloride this nitramine yields tetranitrodimethyldiamidobenzophenone $OC\{C_6H_2(NO_2)_2NHCH_3\}_2$, which melts at 196°.

The action of acetyl chloride, benzoyl chloride, and acetic anhydride upon the thioketone gives rise to products which could not be obtained in a pure state, and whose constitution is therefore doubtful.

A thioketone $SC\{C_6H_4N(CH_3)_2\}_2$ has also been obtained by Fehrmann (Ber. **20**, 2857) from auramine. This body, however, does not appear to be identical with the thioketone of Kern, from which it differs in its melting-point, 164°—166°, and in its platino-chloride.—A. G. G.

Isomeric Change of the Sulphonic Acids of β-Naphthylamine. A. Weinberg. Ber. **20**, 3353—3355.

By heating β-naphthylamine-γ-sulphonate with sulphuric acid at 160°, a mixture of the $\beta_1 \ \beta_3$ (or β), and the $\beta_1 \ \beta_4$ (or δ), sulphonic acid is obtained, of which the $\beta_1 \ \beta_3$-acid forms more than half. By heating either the pure α- or γ-sulphonate of β-naphthylamine with the same quantity of sulphuric acid to the same temperature they are both converted into a mixture of the same acids and in about the same proportions.

It is probable that the isomeric change is preceded by the formation of β-naphthylamine sulphate $C_{10}H_7.NH_3.SO_4H$.

The author considers that the observations of G. Schultz (Ber. **20**, 3158) completely confirm his contention that the acid described by Bayer and Duisberg as "δ" was a mixture of about equal quantities of the $\beta_1 \beta_3$ and $\beta_1 \ \beta_4$-acids. These isomeric acids cannot be separated by the method given by Bayer and Duisberg, viz., boiling with water, nor do the properties of the Ba salt, as given by them, correspond with those of the pure $\beta_1 \ \beta_4$-acid. The deltapurpurin 5 B consists chiefly of derivatives of the $\beta_1 \ \beta_3$-acid.—A. G. G.

Sulphonation of α-Naphthylamine. R. Manzelius. Ber. **20**, 3401—3404.

THE author shows that the sulphonic acid obtained by Witt (Ber. **19**, 578) by the action of fuming sulphuric acid upon α-naphthylamine hydrochloride at a low temperature, is identical with Cleve's α-amido-naphthalene-sulphonic acid. Witt's acid is readily obtained pure by re-crystallisation of the calcium salt; the crystallisation of the sodium salt as employed by Witt does not lead to a pure product. By boiling the diazo-compound with HCl a chlornaphthalene sulphonic acid was obtained, the potassium salt of which on distillation with PCl_5, gave γ-dichlornaphthalene, melting at 107°. The following salts of the amidonaphthalene-sulphonic acid were prepared:—$A'Na + H_2O$, very soluble needles; $A'_2Ca + 9H_2O$, large pearly tables, very soluble in hot water; $A'_2Ba + 6H_2O$, very soluble small plates; $A'_2Mg + 8H_2O$, tolerably soluble six-sided rhombic plates; $A'_2Zn + 9H_2O$, flat needles, rather sparingly soluble in cold water.—A. G. G.

Manufacture of Magenta by the Arsenic Acid Process. O. Mühlhäuser. Dingl. Polyt. J. **266**, 455—467, 503—517, 547—563.

THE preparation of magenta by heating crude aniline with arsenic acid was patented almost simultaneously by H. Medlock and by E. C. Nicholson, in January 1860. In May of the same year C. Girard and G. de Laire patented the same process in France, whilst in 1864 D. Dawson obtained an English patent for a slight modification. The proportions used by different manufacturers varied from 1·9 to 4·6 mols. of aniline oil to 1 mol. of As_2O_5. The proportion now used which is found to give the best result is rather less than 2 mols. of aniline oil to 1 mol. of As_2O_5. If the quantity of aniline exceeds 2 mols. phenylation is apt to take place. The aniline oil now usually employed, which has the sp. gr. 1·008 and boils at 190°—198°, is prepared by mixing 1 pt. of pure aniline with 2 pts. of crude toluidine. As the crude toluidine always contains about 36 per cent. of *p*-toluidine and 64 per cent. of *o*-toluidine, the composition of aniline-for-red is about 33·3 per cent. aniline, 24·0 per cent. *p*-toluidine, and 42·7 per cent. *o*-toluidine.

The normal red-melt contains the following bodies:—

(1.) *Arsenious and arsenic acids.*
(2.) *Magenta bases:* pararosaniline, rosaniline, rosotoluidine.
(3.) *Phosphine bases:* chrysaniline, chrysotoluidine.
(4.) *Indulines:* violaniline, mauvaniline.
(5.) *Brown colouring matters.*
(6.) *Humus-like substances* of unknown constitution.

The partial separation of the various colouring-matters is effected by means of their different solubilities in dilute acids and alkalis, and the products are brought into the market as *magenta* or *fuchsine crystals* (mixture of pararosaniline and rosaniline), *cerise* (mixture of rosanilines and phosphines), and *maroon* (mixture of mauvaniline, browns, and a small quantity of rosanilines and phosphines).

The Red Melt.—The operation is performed in vertical cast-iron pots A and A^1 (Fig. 1), each of which is

Fig. 1.

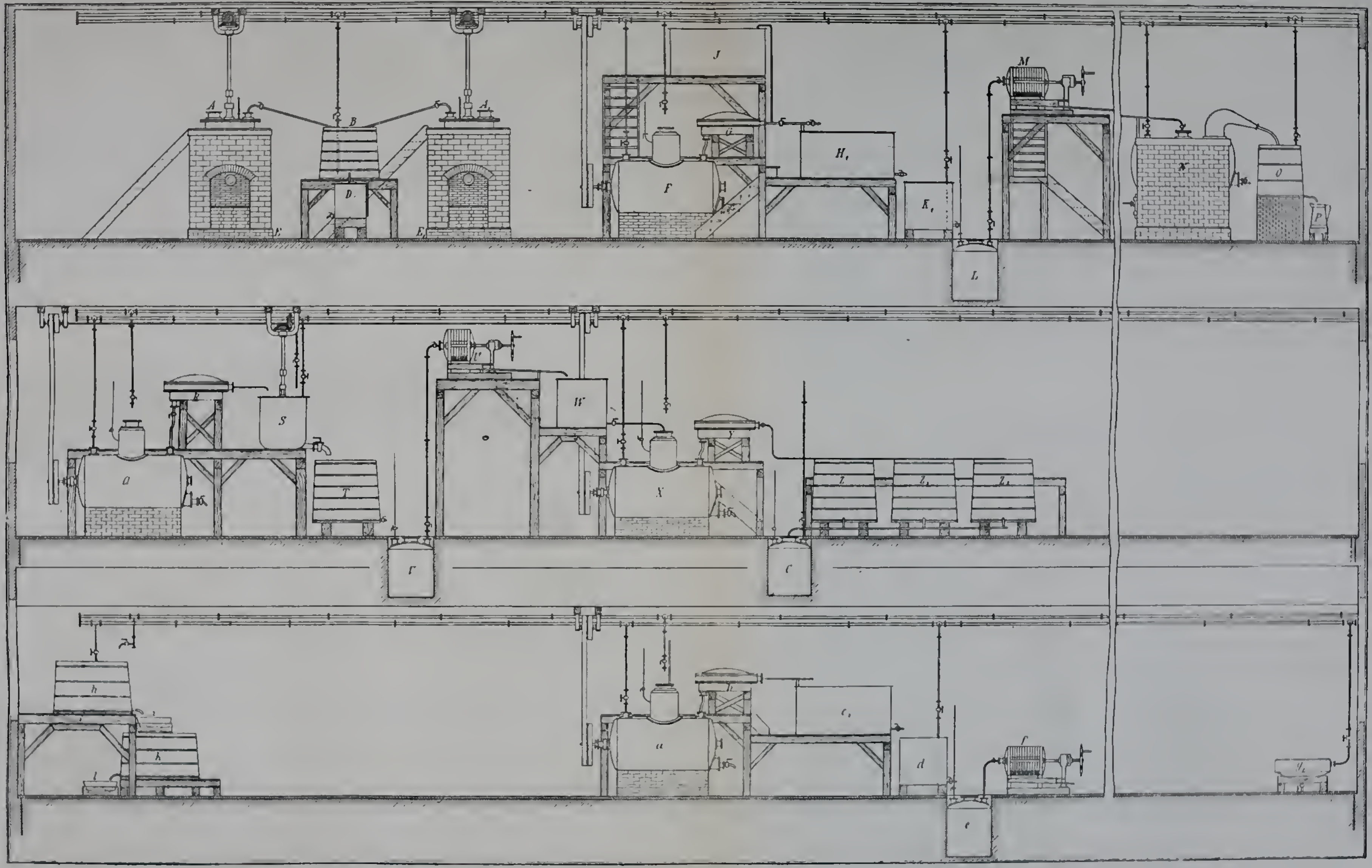
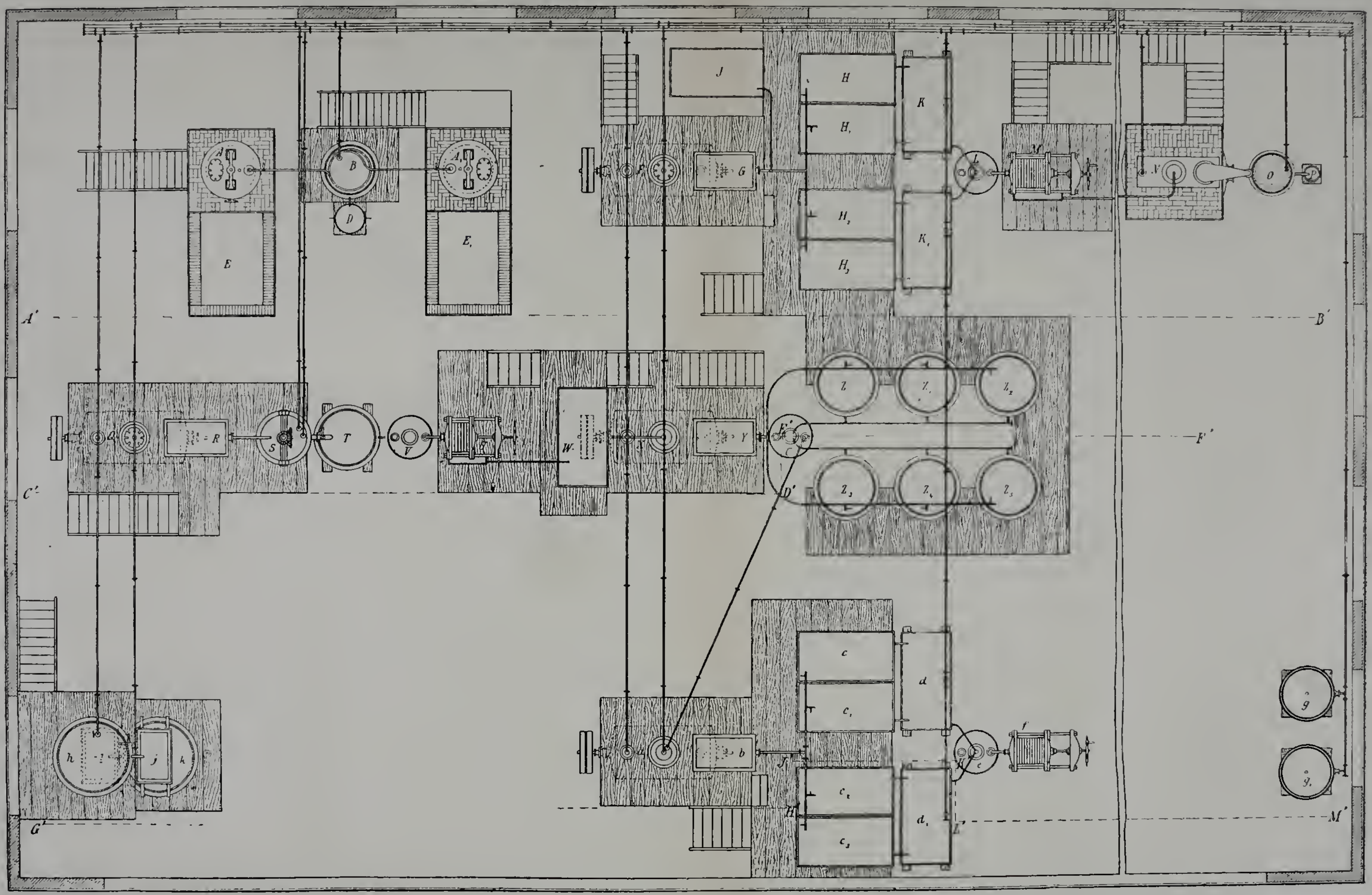


Fig. 2.



J
H
H₁
H₂
H₃
K
K₁
A
B
A₁
D
E
E₁
G
L
M
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O
P
A′
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Q
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Z₁
Z₂
Z₃
Z₄
Z₅
C′
D′
F′
c
c₁
c₂
c₃
d
d₁
b
f
g
g₁
h
j
k
G′
M′

provided with an agitator, a cover fitted with a manhole and a tube for reception of the thermometer, and a large hole at the bottom of the pot closed by a flap. The two pots stand in connexion with a worm-condenser B, in which the "échappés" are condensed and collected in the receiver D, which is fitted with a graduated water gauge.

The pot is charged with 570 kilos. of syrupy arsenic acid (74° B) and 340 kilos. of aniline-for-red (1·008 sp. gr. at 15°). The mixture, kept constantly stirred, is slowly heated to about 120°, then more quickly to 180°; this temperature is reached in about seven hours, and the heat is now regulated so that the oxidation comes to an end during the next two hours at a final temperature of 185°—189°. It is very important for the attainment of good yields and the easy working up of the melt, that the operation should be stopped at the right moment, which is ascertained by the volume of the mixed water and aniline which has distilled over, and by taking out dips of the melt on a rod. The flap door is then opened and the melt runs out into the brick chamber E, where it cools, and is broken up. The volume of the distillate should be about 330 litres. In order to separate the aniline 50 kilos. of salt are added, and the aniline (135—140 kilos.) is drawn off and added to the next melt in place of fresh aniline. The "échappés" from this second melt is not returned to the third melt (as its value in paratoluidine is now exhausted), but is used for the preparation of safranine or of azo-colours.

Boiling up.—This is performed in an iron cylinder F of about 4,000 litres capacity, provided with an agitator. The melt, broken up roughly, is added through the manhole to 2,400 litres of water or of "residue liquor" from a previous operation, which is kept boiling and agitated. The boiler is then closed and heated for an hour at 1½ atmosph. pressure; after two hours it is opened and allowed to stand for three hours to settle. The liquor is now forced through the filter-press G into the crystallisers H, H_1, H_2, H_3. The residue is boiled up a second time with 2,000 litres of water and 10 kilos. of arsenic acid, and the "residue liquor" stored in the tank J to be used for boiling up the next melt. The residue, which consists of mauvaniline, violaniline, humus-like bodies, and arsenious acid, is usually thrown away, but in a few works the arsenic is recovered.

The liquor which runs into the crystallising tanks is treated with 10 kilos. of hydrochloric acid (to keep the phosphine in solution) and 50 kilos. of salt. On standing for three days the crude magenta crystallises out. The cold liquor is then run into the crude cerise tanks K K_1, where it is warmed to 40° milk of lime (from 30 kilos. of lime) added, and the crude cerise precipitated by the addition of 20 to 25 kilos. of sodium carbonate. The crude cerise rises to the surface as a tar, and the liquor is run into the montejus L, from which it is forced by compressed air through the filter-press M into the still N. Here the liquor is distilled for the recovery of the aniline (6 to 8 kilos.) which it contains.

Preparation of Magenta Crystals.—The crude magenta contains besides rosanilines also phosphine, mauvaniline, and small quantities of violaniline, and humus-like bodies; if the melt was made with an excess of aniline it might also contain phenylated derivatives. The re-crystallisation is carried out in an exactly similar apparatus to that used for boiling up the melt.

The crude magenta from one melt or the corresponding quantity from some other source (cerise purification, &c.) is added to 2,500 litres of water (or "base-liquor") contained in the "fine boiler" X, which is kept boiling and agitated during the addition. After boiling for half an hour, and when the solution is complete, 10 kilos. of dry sodium carbonate are slowly added. The boiler is then closed and heated under ½ atmosp. pressure for two hours. The liquor is then forced through the filter-press Y into one of the crystallising tanks Z, Z_1, Z_2, Z_3, Z_4, Z_5, where it is treated with 18 kilos. of hydrochloric acid and 25 kilos. of salt, and left for two days to crystallise. The total yield of crystals is about 62 lbs., of which 46 lbs. are large crystals from the top and sides, and 16 lbs. are smaller crystals and slightly less pure from the bottom. The large are dried at 56°—60° and are ready for sale; the smaller serve for the preparation of rosaniline base.

The mother-liquors from which the crystals have separated are run into the montejus C, from whence they are forced into the "cerise boiler" A, to be employed for boiling up crude cerise. The insoluble residue forms the crude product for the preparation of maroon. If "base-liquor" (v. infra) is used in place of water for boiling up, 6 kilos. of Na_2CO_3 and 20 kilos. of hydrochloric acid must be employed.

Preparation of Rosaniline Base.—The preparation of pure rosaniline base (for blue, &c.) is carried out in an apparatus exactly similar to those employed for boiling up the crude melt, and for purifying the magenta crystals. Forty-four kilos. of small magenta crystals (from the bottom of the crystalliser) are slowly added to 2,000 litres of water, which is contained in the "base boiler" Q, and is kept boiling and agitated during the addition. When all has dissolved, 4 kilos. of dry sodium carbonate are added, and the liquor is forced through the filter-press R into the vessel S, of 3,000 litres capacity, which contains 5 kilos. of solid caustic soda in 100 litres of hot water. After mixing with the caustic soda the liquor and precipitated base is run out into the vat T, in which it cools for two or three days. The liquor and precipitate is then run into the montejus V, from which it is forced through the filter-press U. The liquor is collected in the reservoir W, and can be employed for boiling up the crude magenta in the "fine boiler" X. The rosaniline base is washed in the press till free from alkali, and is dried upon trays at 50°—60°. The yield is about 37 kilos. from 44 kilos. of magenta crystals.

Preparation of Cerise.—The mother-liquor arising from one magenta crystallisation is forced from the montejus C into the "cerise boiler" A, and made up with water to 2,500 litres. The liquor is boiled and kept agitated whilst the crude cerise from three melts is added. After the addition of 40 kilos. of hydrochloric acid the boiler is closed and heated for an hour at 1 atmosp. pressure. The liquor is then forced through the filter-press *b* into the tank *c*, where it is treated with 10 kilos. of hydrochloric acid and 20 kilos. of salt. On partially cooling crude magenta crystallises out. When test dyeings of the liquor show that sufficient magenta has separated, the solution, still warm, is run out into the tank D, heated to 40°, and precipitated completely with 20 kilos. of dry sodium carbonate. The precipitate which comes to the surface is skimmed off, and when the liquor is cold, the remaining precipitate is separated by the filter-press *f*. The precipitated cerise is treated with sufficient hydrochloric acid to make it soluble, and dried down in the steam-pan *g*. To obtain a still yellower shade of cerise, the above operations are repeated, by which means a further separation of magenta is effected.

Working up the Crystallisation Residues.—The residues which remain insoluble in the alkaline treatment of the crude magenta still contain considerable quantities of rosaniline and phosphine. 2,500 litres of magenta mother-liquor from C are boiled up in the boiler A, and the residues from two magenta crystallisations are added. After acidifying with 10 kilos. of arsenic acid, the boiler is heated for an hour at 1 atmosp. pressure, and the liquor then forced through the filter-press *b* into the tank *d*. The hot filtrate is treated with 25 kilos. of hydrochloric acid and 40 kilos. of salt, and left for three days to cool. Crude magenta crystallises out, and the mother-liquor, on precipitation with soda, gives a very yellow crude cerise.

Preparation of Maroon.—The residue remaining undissolved in the previous operation consists of violaniline, mauvaniline, brown colouring-matters, and a little rosaniline and phosphine. 200 kilos. of the mixed and powdered residues are treated with 120 kilos. of hydrochloric acid in the vat *h*, stirred up with 600 litres of water, and heated to boiling, allowing water to run in till the volume becomes 2,400 litres. After boiling for three hours the liquor is partially precipitated by the addition of 10—12 kilos. of dry sodium carbonate, and after one or two hours' standing is filtered through *i* into the vat *k*. Here it is completely precipitated with sodium carbonate and filtered through *l*. The precipitated maroon is made soluble by sufficient hydrochloric acid, and dried down in the pan *g*.

Treatment of Residues.—In many works the melt residues and liquors are worked up for the recovery of the arsenic. For this purpose many methods have been proposed, which in general consist in burning the residues with carbon and volatilisation of the metallic arsenic. The insoluble residues resulting from the purification of cerise and maroon are submitted to dry distillation, by which means a distillate is obtained containing water, ammonia, aniline, toluidine, xylidine, diphenylamine, and small quantities of acridine and naphthylamine. The bases are separated by fractional extraction with HCl and distillation.—A. G. G.

Manufacture of Colouring-Matters by the Action of Nitroso-Derivatives of Secondary Aromatic Amines upon Phenols and Oxycarbonic Acids. Oliver Imray, 28, Southampton Buildings, Chancery Lane. From the "Farbwerke vorm. Meister, Lucius, and Brüning," of Hoechst-on-the-Maine, Germany. Eng. Pat. 737, January 17, 1887. 6*d.*

The nitroso-derivatives claimed in this specification are prepared by the method of Fischer and Hepp (Ber. **1886**, p. 2991), these chemists having discovered that when a nitrosamine is allowed to stand in contact with an alcoholic solution of hydrogen chloride, a molecular transformation takes place, the nitroso-group being transferred to the aromatic nucleus with the formation of a nitroso-derivative, as shown by the following examples:—

$$C_6H_5.N(NO).CH_3 = NO.C_6H_4.NH.CH_3$$
$$C_6H_5.N(NO).C_6H_5 = NO.C_6H_4.NH.C_6H_5$$

The paranitroso-derivatives thus formed when heated in alcoholic solution with phenols, &c. give rise to the formation of blue or violet colouring-matters. The process is illustrated by two examples: (1.) 19 parts of the hydrochloride of the nitrosomonethylaniline are dissolved in 80 parts alcohol with 19 parts of β-naphthol, and the solution kept at 60° C. for some time. The colouring-matter, when formed, is precipitated by the addition of zinc chloride. (2.) Five parts of the hydrochloride of nitrosodiphenylamine are dissolved in 50 parts of 20 per cent. acetic acid, and heated on a water-bath with eight parts of gallic acid till the mixture acquires a blue colour. The colouring-matter is then precipitated by water.—R. M.

Improvements in the Manufacture of Colouring-Matters. H. H. Lake, Southampton Buildings. From K. Oehler, Offenbach-on-the-Maine, Germany. Eng. Pat. 4492, March 25, 1887. 6*d.*

These are azo-colours produced by the action of the tetrazo-salts of benzidine and its homologues and their sulphonic acids on metadioxy-, metadiamido-, and metamidodioxy-compounds and their sulphonic acids. The secondary azo-colours thus produced from resorcinol, orcinol, or metoxydiphenylamine are soluble in alkalis, and dye cotton directly, even from a cold alkaline bath. The colours are fast to soaping and milling, and vary in shade from yellow to bluish red. The corresponding compounds obtained from the metadiamines and their alkyl-derivatives are insoluble in alkalies, but their sulphonic acids, obtained by direct sulphonation, or by the use of the diazotised sulphonic acids of benzidine and tolidine, are soluble, and have similar properties to the metadioxy-compounds. The manufacture of the following secondary azo-compounds is given by way of illustrating the process:—(1.) From diazotised tolidine (one molecule) and resorcinol (two mols.), brown-red crystalline flakes. (2.) From diazotised benzidine (one mol.) and metaphenylene-diamine (two mols.), brown-black flakes insoluble in alkalies, but rendered soluble by sulphonation with three parts of fuming sulphuric acid containing 20 per cent. anhydride. (3.) From benzidinesulphonic acid (one mol.) and metaphenylene-diamine (two mols.), brown-red flakes. (4.) From benzidine and metaphenylenediaminesulphonic acid. (5.) From benzidine and the sulphonic acid of metatoluylene-diamine.

In addition to these, examples are given, showing the production of mixed tetrazo-colours, from diazotised tolidine (one mol.), metatoluylenediamine-sulphonic acid (one mol.) and salicylic acid (one mol.).—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improved Process and Apparatus for the Preparation of Rhea or other Vegetable Fibres for Textile Purposes. Robert Hanham Collyer, Louisiana, U.S.A. Eng. Pat. 5097, April 6, 1887. 11*d.*

The green stems of the rhea or other fibre-yielding plant are subjected to the action of oscillating rollers in contact with water. They then pass between a pair of rollers, which squeeze out the gummy matters loosened by the action of the water. The stems thus treated are carried forward to a pair of toothed rollers, where the outer bark and woody matter are completely removed.

The isolated fibres are then treated with a hot solution of soap in a specially-constructed apparatus, after which it is only necessary to squeeze and dry.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Bleaching Wood with Hydrogen Peroxide. Dr. P. Ebell. Chem. Zeit. 1887, **11**, 1529.

The advantage of this method of bleaching is that the wood retains its original structure. A previous treatment is not advisable, except in the case of fresh wood, when steaming causes a saving in the peroxide. Small pieces of wood are bleached in a few days. The bleach-bath is best kept alkaline with ammonia. If it is heated to 34° the wood is bleached more rapidly, but this entails a loss of peroxide through evolution of oxygen. Moreover, the final effect of using a cold bath is more satisfactory. After slowly drying, the wood appears perfectly white, a plane surface remains unchanged, and the curls and streaks, though now colourless, are nevertheless more distinct than previous to bleaching.
—A. R.

Bleaching Wool with Hydrogen Peroxide. Chem. Zeit. **11**, 1499.

(From A. Delmart's work on "Wool Dyeing," Part IV.)

The hydrogen peroxide supplied for this purpose may contain a small quantity of admixed substances (*e.g.*, barium phosphate), which aid in the bleaching. This is carried on in a cold bath; the room must not be too warm, but must be kept above zero. The material (wool, either yarn or in the piece) must be perfectly clean. The hydrogen peroxide preparation can be used without dilution, but it is better to dilute it with 5—6 times its weight of cold water and to add about 20 gr. of ammonia of sp. gr. 0·910 to every 100 litres of the diluted liquid, so that it gives a faintly alkaline reaction with litmus paper. Sufficient wool is put into the bath to allow of its being freely handled, and in 6—10 hours, according to the degree of whiteness desired, the bleaching is finished. White wool treated in small portions at a time, and with a strong bath, is done in 1—2 hours. After washing, the wool is dried slowly in the sun; on hot days it is spread out in thicker layers, since slow drying produces a better result. When the drying has to be done by steam a high temperature must be avoided. The bleached wool has a pale yellow appearance, and is treated with Pensée lake, or better, with methyl violet, to get it quite white. This operation must be effected in a separate bath when concentrated peroxide is used, but with dilute solutions the small quantity of the complementary colour can be added to the bleach-bath. With a further addition of peroxide, and the requisite quantity of ammonia, the bleach-bath is again ready for use; the methyl violet being added in fresh portions each time. The colouring-matter of the wool is actually destroyed by the peroxide, and therefore cannot reappear, an advantage over bleaching with sulphurous acid. The peroxide must be protected from light and air; the bleach-bath is exhausted when a drop of potassium permanganate produces a permanent coloration with the liquid.—C. A. K.

Meeting of the Société Industrielle de Mulhouse.

O. Scheurer proposes, in fixing iron mordant, to replace arsenious acid by phosphorous acid. The latter does not act so energetically as arsenious acid, still its action is quite sufficient.—S. H.

Improved Method or Process of Colouring or Staining Wood. François Munier and Numa Salvaire, France. Eng. Pat. 11,664, August 27, 1887. 6*d.*

The trunk, freshly felled, is fitted at both ends with suitable conical caps, and at one end a boiling solution of the colouring-matter is injected by means of a force pump, the operation being expedited by exhausting at the other extremity of the trunk. During the operation the wood is heated, in order to expand the fibre and facilitate the treatment.—W. E. K.

Improvements in separating Solid Matter from Alizarin or other Colouring Matters, or Starch. R. Reid, Glasgow. Eng. Pat. 3304, March 4, 1887. 4*d.*

The alizarin, aniline colour, pigment, or starch is passed through a silk cloth of the kind known as silk bolting cloth, whereby the grit is entirely separated, and what is known as "doctor streaks" in calico printing are thereby prevented.—W. E. K.

Improvements in the Method of and Apparatus for Dyeing, or otherwise Treating Textile Fibres. Joseph Walker, Dewsbury. Eng. Pat. 818, January 19, 1887. 8*d.*

The apparatus consists of a cylindrical vessel furnished with a perforated false bottom. The fibre to be dyed is placed on the false bottom, and is kept in position by means of a perforated top, which can, if necessary, be screwed down so as to compress the fibre. The dye liquor is contained in an outer rectangular vessel surrounding the cylindrical vessel, the two being connected at the bottom by a pipe and centrifugal pump. The liquor, which may be heated if desired, is drawn by means of the pump from the outer rectangular vessel, and is forced through the bottom of the cylindrical vessel. After passing through the fibre it flows over the top into the outer vessel.

—E. J. B.

Improvements in the Means and Method of and for the Washing, Scouring, Boiling, and Bleaching of Fibres, Fibrous Materials, and Textile Fabrics, and the Stripping of Fibres from Hides or Skins. E. B. Petrie, Rochdale, and R. Wild, Littleborough. Eng. Pat. 7550, May 25, 1887. 6*d.*

This invention claims the following mixtures for scouring, bleaching, and souring purposes. For washing and scouring: sub-borate of soda and soda-ash or potash, with or without soap, chloride of soda, phosphate of soda, "soda hyposulphis," and caustic soda or potash. For bleaching: a mixture of soda, chloride of lime, and "sub-borate of soda." For souring: a mixture of hydrochloric, sulphuric, and nitric acids.—W. E. K.

Improvements in Dyeing and Printing Aniline Black. F. Towlson, and E. Weldon, New Basford. Eng. Pat. 3389, March 5, 1887. 6*d.*

For dyeing, the yarn or fabric is twice padded in a mixture of bichromate of potash (2 lbs.), aniline oil (6 lbs.), hydrochloric acid (6 lbs.), and water (20 gals.), and then aged for 12 hours in a drying chamber at a temperature of 100° F. The material is next steamed for half an hour at low pressure, or passed through a boiling solution of bichromate of potash (½ oz. per gal.). For printing purposes a similar mixture, thickened with starch, is used. It is claimed that a permanent ungreenable black, which does not rub off, is thus obtained.—W. E. K.

Process for the Treatment of Textile Materials dyed with Aniline Black. W. J. S. Grawitz, France. Eng. Pat. 11,182, February 5, 1887. 6*d.*

Textile fibres dyed aniline black have a brownish tinge, which is converted by the action of a hot soap bath into the desired bluish tone, but by this treatment the fibre is rendered greasy and acquires a disagreeable odour. To eliminate this brown tinge, without these disadvantages resulting, the cotton (100 lbs.) after dyeing and washing is immersed in a cold or tepid bath of—

Water, 200 to 250 gallons.
Sulphuric acid 65—66° B., 3·2 pints.
Concentrated sulphoricinate of soda, 8 pints.

The temperature is gradually raised until the cotton has absorbed all the fatty matter produced by the decomposition of the sulphoricinate by the sulphuric acid. The combination of the fatty matter with the black is rendered more stable by raising the temperature of the bath, by subsequent rinsing in hot, boiling, or superheated water, or by steaming the cotton, either moist or after drying. The cotton thus treated may then be subjected to a soaping or alkaline treatment as desired, can be readily sized or dressed, and is devoid of smell. Sulpholeates or sulphoricinates of potash, soda, or ammonia, or the free acids themselves, may be used in this process, and other acids may be employed in place of sulphuric acid for acidifying purposes. It is claimed that aniline black dyes thus treated present a different composition and different properties to those heretofore obtained, and that they are more able to resist the action of chlorine, and constitute a new industrial product.—W. E K.

VII.—ACIDS, ALKALIS, AND SALTS.

Preparation of Hydriodic Acid. Lothar Meyer. Ber. **20**, 3381.

In the preparation of hydriodic acid it is generally recommended to use an excess of phosphorus; this gives rise to the formation of phosphorous acid, phosphuretted hydrogen, and phosphonium iodide. In order to avoid this difficulty the author recommends the use of a small excess of iodine, when a reaction according to the following equation takes place, $P + 5 I + 4 H_2O = PO_4H_3 + 5 HI$.

The following method yields good results:—100 parts of iodine are placed in an inclined retort, and moistened with 10 parts of H_2O, then by means of a stoppered funnel placed in the tubulus of the retort, a mixture of 10 parts water and 5 parts phosphorus is gradually added. The hydriodic acid is given off without the application of heat, and after passing through a long tube to condense any iodine vapours, is led into water. Finally, the retort is gently heated, when a further quantity of the acid distils over. From 100 grms. of iodine, 5 grms. of phosphorus, and 20 grms. of H_2O the author obtained 74·4 grms. of the acid given off as gas, and a further 23·7 grms. on distillation.

—G. D.

A convenient Method for the Preparation of Sulphuretted Hydrogen free from Arsenic. Clemens Winkler. Zeits. Anal. Chem. **27**, 26.

Sulphuretted hydrogen, free from arsenic, is obtained most conveniently and cheaply by acting on barium sulphide with dilute hydrochloric acid.

The barium sulphide is prepared as follows:—100 parts of heavy-spar, 25 parts of powdered coal, and 20 parts of common salt are finely powdered together, slightly moistened, and the mixture roughly formed into balls; these are pressed into an earthenware crucible, dried, covered with coarsely powdered coal, the crucible closed, and kept for several hours at an almost white heat.

The product is cooled quickly, and broken into suitable lumps.—F. S. K.

Oxygen-carriers. Lothar Meyer. Ber. **20**, 3058.

Kessler and Vernon-Harcourt have shown that there are cases in which the oxidation of one substance, by a second, is considerably hastened in presence of a third. For instance, in the oxidation of oxalic acid by potassium permanganate, the colour of the latter disappears the more readily, the more permanganate has already been added, and Kessler has shown that the increased rapidity of the reaction is due to the sulphate of manganese which acts as an oxygen carrier; similarly, oxalic acid is only oxidised by chromic acid in presence of manganese sulphate, and this salt also increases the rapidity of the oxidation of sulphur dioxide by air. Rössler found that sulphur dioxide is so rapidly oxidised by air when the mixture is passed through a boiling solution of copper sulphate, that he has applied this reaction practically for the recovery of sulphur dioxide which is evolved in the solution of silver and other metals.

Experiments show that many salts have this property; when a mixture of oxygen and sulphur dioxide is passed through a hot solution of manganese sulphate containing 2·404 grms. $MnSO_4, 5H_2O$ in 200 cc., six times as much sulphuric acid is present at the end of four hours as was originally contained in the solution; manganese chloride acts similarly but not with quite such good results. When sulphur dioxide is passed into strong solutions of copper sulphate $Cu_3S_2O_6, 2H_2O$ is produced; in dilute solutions, however, a soluble green salt is formed, which yields sulphuric acid with separation of about $\frac{1}{8}$ of the copper in the metallic state; when a mixture of oxygen and sulphur dioxide is passed through copper sulphate solution, a considerable quantity of sulphuric acid is formed, but less than in the case of manganese salts. The action of copper sulphate varies with the concentration of the solution, and reaches its maximum when the solution contains 3·11 per cent. $CuSO_4, 5H_2O$, the acid then formed from a mixture of equal volumes of the gases is about $\frac{2}{10}$ of that contained in the salt: even then the action does not cease, for long continued experiments showed that a further quantity of sulphuric acid (0·23 pts. approx. for every 1 Cu in one hour) is formed. Varying quantities of sulphuric acid were added to solutions of copper sulphate, and the mixture of sulphur dioxide and oxygen passed; it was thus found that the action ceases first in a solution of 12·44 grms. $CuSO_4, 5H_2O$ in 1 litre, and containing ten times as much added sulphuric acid as is contained in the salt.

Cuprous and cupric chloride act similarly, but more energetically than the sulphate; the hydrate and oxide of copper and the metal itself act somewhat less powerfully. Next to copper salts those of iron and cobalt were found to be most efficient, and their chlorides more so than their sulphates, the sulphates of nickel, zinc, cadmium come next in activity, but dilute solutions of thallium and potassium sulphates, and sulphuric acid, have no more action than pure water.—F. S. K.

Improvements in the Manufacture of Caustic Soda or Caustic Potash, and of Carbonic Acid from Mono or other Carbonate of Soda or Potash. L. Mond and D. B. Hewitt, Northwich. Eng. Pat. 1974. February 8, 1887. 6*d*.

This invention is based upon Löwig's process for making caustic alkalis by heating their respective carbonates with iron sesquioxide (Eng. Pat. 1882, 4364). The inventors have found that this process can only be successfully carried out if a very pure sodium carbonate is used, as impurities have a tendency to prevent the intimate contact of the molecules of sodium carbonate and iron sesquioxide, and bring about fluxing of the mass, which hinders the carbonic acid from escaping. As the process requires a very intimate mixture of the ingredients a very finely powdered and pure sodium carbonate, made from bicarbonate, is used and mixed by a mixing machine with iron sesquioxide, free from silica or alumina. The mass is submitted to a high temperature, but as soon as the reaction has once commenced the mixture becomes surrounded by an atmosphere of nearly pure carbonic acid gas produced by the reaction itself, and the progress of the decomposition is then only very slow. It is absolutely necessary for the rapidity and completeness of the process to constantly remove the materials out of the atmosphere of carbonic acid into an atmosphere relatively poor in carbonic acid. The presence of steam also materially facilitates the reaction. These objects are best effected by using a barrel-shaped or cylindrical furnace, revolving on a horizontal axis and lined with fire-clay blocks, which are set in such a way as to form a number of projecting radial ribs parallel to the axis of the cylinder. The furnace is heated by water gas, which both produces steam on being burnt with air, and yields a gas of high temperature containing little carbonic acid. The material introduced into the furnace is lifted up by the projecting ribs to a certain height, and then falls through the gases passing through the furnace, whereby the carbonic acid formed in the interstices of the mass is replaced by the gases, and no longer hinders the process, which can now be completed in a few hours at a reasonable expenditure of fuel. The furnace may be modified in various ways.—S. H.

Improvements in the Manufacture of Hydrates of Barium and Strontium. H. L. Pattinson, jun., Felling-on-Tyne. Eng. Pat. 3144, March 1, 1887. 6*d*.

In carrying out a previously patented process (Eng. Pat. 1884, 16,989), a liquor was obtained containing hydrate and tersulphide of barium or strontium, from which the hydrate was crystallised. The crystals contained some tersulphide, which was removed by washing and recrystallisation. The object of this invention is the removal of the tersulphide by washing with cold water in either of the following ways. According to the first method, a series of tanks is arranged so that the bottom of the first communicates with the top of the second, the bottom of the second with the top of the third, and so on. The liquor from one tank, which has been almost exhausted of tersulphide, goes on to the next tank with a considerable quantity of tersulphide in it. The solvent power of the water for sulphide is thus fully utilised, while the cold water only dissolves comparatively little hydrate. The same object can be obtained in other ways, the principle always being, that the water travels in one direction during the process, while the crystals improve inversely.—S. H.

Improvements in the Production of the Fluorides of Magnesium of Strontium, and of Barium. A. Feldmann, Hanover, Germany. Eng. Pat. 15,295, November 9, 1887. 4*d*.

This invention consists in treating the chloride of magnesium, of strontium, and of barium, or the double chloride of magnesium and potassium with calcium fluoride. The action of the latter on the chlorides may be carried out in the dry way or in the wet way. In the first case the calcium fluoride is mixed with the anhydrous chlorides in excess and the mixture is melted at a red heat. A double decomposition takes place, calcium chloride being formed, and on the other hand the fluoride of magnesium or of strontium or of barium. After cooling, the mass is lixiviated, the fluorides remaining behind. If working by the wet process, powdered calcium fluoride is suspended in a concentrated solution of the respective chlorides, and heated until the double decomposition has taken place, water being added at intervals to make up for loss by evaporation. The resulting mass is allowed to cool, whereby it solidifies and is then lixiviated with water in the same manner as above. If any undecomposed calcium fluoride remains in the precipitate, it may be removed by elutriation from magnesium fluoride, which is much lighter than the former.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

New Lustres and Colours on Glass. R. Zsigmondy. Dingl. Polyt. Journ. **266**, 364—370.

Experiments were made with the object of determining the method by which the metallic gold (or silver) lustre is given to certain French objects in glass, which appear of a transparent yellow colour by transmitted light, and which, though having all the appearance of true gilding, yet cannot be overlaid with gold leaf. The material imparting the lustre is unaffected by hydrochloric or nitric acids, or even by *aqua regia*; but is instantly altered by dilute hydrofluoric acid, so that it then resembles a lead paper which has been exposed in an atmosphere of hydrogen sulphide; it may then be rinsed off, leaving the natural colour of the glass. An analysis of such a solution showed the presence of silver, lead, arsenic, potassium, sodium, and traces of calcium; but with the exception of the first, all of these probably were due to the glass itself. The silver originated with the lustre-yielding material, and this metal would impart an intense yellow colour to the glass, which in this case was almost colourless. Trials were made with porcelain lustres, and among others it was found that a combination of bismuth-lustre and gold leaf gave, as on porcelain, a magnificent copper-like appearance by reflected light, being red and blue by the transmitted rays.

The author's lustres, like those of Schwarz for porcelain (*Dingl. Polyt. Journ.* **197**, 243), are compounds of resin acids with metallic oxides. That of lead being made by melting 1 part of the acetate with 3 parts of colophony; of bismuth by fusing 1 part of the sub-nitrate with 6 of resin; and of iron and silver by precipitating solutions of the perchloride and nitrate respectively with resin soap. The silver salt must be shielded from light and dried below 100°, otherwise it becomes insoluble in the oil of lavender or turpentine, in which each of these lustres is finally to be dissolved. A mixture of these lead and silver salts so prepared was brushed over a glass tube, which was then dried and heated over a flame until the organic bodies had been completely destroyed; the lustre was thus increased, but no colour was visible until the tube had been momentarily held in the reducing flame, when it became yellow and showed a fine gold lustre. But different glasses behaved differently; some, although yellow by transmitted light, had only a silver lustre, and required the addition of an iron or copper mixture to produce the appearance of gold. On a larger scale muffles were tried with equal success, the necessary reducing atmosphere being obtained by thrusting straw into the closed chamber; the better effects are dependent on the time occupied by the heating and cooling; a non-luminous reducing flame was therefore caused to play across the muffle at the right moment, the whole chamber being then cooled as rapidly as possible. The results always vary with the nature of the glass, the lustre mixture used, and the furnace arrangements; and the best conditions for a given glass can at present be only determined by experiment. A firing which produces a silver lustre may, if longer continued, yield a gold reflection; many glasses will not take the silver mixture alone, but require the addition of lead lustre; bismuth mixtures aid the formation of a good lustre, but the colour frequently plays into brown. Copper lustre may be made by precipitating copper sulphate solution with resin soap and dissolving the precipitate in oil of lavender. Applied to glass and treated as above, it gives in the oxidising flame a fine yellow with coppery lustre, and this appears even more rapidly in the reducing flame, but vanishes immediately upon withdrawal. The lustre may be fixed by plunging in alcohol, but this causes fracture; such a lustre is dissolved by nitric acid, whilst one produced by heating a similar tube in hydrogen is unaffected, showing that in this latter case the copper is actually dissolved in the glass. *Solution of Metals and Metallic Sulphides unaltered by Glass.* Paul Ebell has shown (*Dingl. Polyt. Journ.* **213**, 53, &c.) that glass may dissolve metals as such. The author found that, by treating a gold-lustred glass dish with hydrofluoric acid so dilute that it scarcely acted on silver, a residue of lead and silver was obtained in the form of a black metallic powder. Nitric acid and ammonium sulphide were without effect on the original lustred glass, hence it is argued that the glass held the silver in solution, the golden lustre being due to the passage of the rays to a certain depth through the yellow surfaced glass before reflection. Again, a glass, painted with the resin salt of silver and held above a flame, gives first a transient red or violet colour, and then yields a silver mirror, soluble in nitric acid and transmitting violet light; on now applying the oxydising flame the mirror vanishes and the glass becomes colourless, only to reappear with yellow colouring of glass by the action of the reducing flame; but this time it is not affected by nitric acid. The explanation is that the silver, at first superficially reduced, oxidises and passes into the glass as silicate, to be afterwards reduced again within the glass. Glass has also the property of dissolving metallic sulphides unchanged, and hence the coloration produced by sulphur. There is in the market a fine yellow glass—mostly a flashing on cryolite glass—containing 0·36 to 0·45 per cent. of cadmium sulphide; this colour cannot be due to silicate, for cadmium oxide itself imparts no colour, moreover, such glass passes through all the colour changes which the pure sulphide undergoes on heating. But this cadmium glass is peculiarly liable to devitrification, which occurs at a comparatively low temperature and which causes it to break up into small scales, occasioning great difficulty in its manipulation. A glass containing lead sulphide was produced which was almost black, but transparent, and not more prone than cadmium glass to devitrification.—W. G. M.

Improvements in the Method of and Apparatus for Printing in Colours. A. J. Béjot, Paris. Eng. Pat. 3248, March 3, 1887. 8*d.*

For the purpose of printing, by a single impression, chromo-lithographs in two or more colours, a block is cut so as to form any suitable design, the part or parts of the block which are to be of a different colour or colours from the remaining portion being cut separately, inked with the desired colour, and then replaced in grooves or apertures made to receive them in the remaining portion, which has been previously inked with its respective colour. The various parts thus form a single block, from which an impression of the whole design in the desired colours may be directly obtained. The process may be used for chromo-lithography on porcelain, under enamel.—W. E. K.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

On Corrosion of Lead Pipes by Mortar. G. v. Knorre. Dingl. Polyt. Journ. **266**, 220.

Leaden gas or water pipes frequently suffer corrosion at the point where they issue from the ground into the brickwork of buildings. The author has examined how far this corrosion is due to the influence of air, water, lime-water, mortar, and cement. The following table shows the result of some experiments: solutions of different salts (0·2 grms. per litre) were allowed to act on lead plates of equal size in the presence and absence of air:—

Solution of	Mgrms. of Lead dissolved in 14 to 21 Days.		
	The Solution was contained		
	In a Stoppered Bottle.	In a Beaker covered with Filter Paper.	In a China Basin covered with Filter Paper.
Ammonium nitrate .	1·8 to 1·8	2·0 to 4·0	8·0 to 16·0
Potassium nitrate...	1·2 to 1·6	0·5 to 0·5	2·8 to 6·0
Calcium chloride....	1·9 to 3·0	1·6 to 2·8	3·2 to 5·5
Ammonium sulphate	0·7 to 0·7	1·1 to 1·3	9·2 to 16·0
Potassium carbonate	0·3 to 0·3	0·3 to 0·3	0·7 to 0·7

Where the air had the easiest access, most lead went into solution and gradually separated out as basic carbonate. Lime-water does not attack lead, if the air be carefully excluded, whereas in the presence of air it acts on lead most energetically. The corrosion is strongest if the lead lies on the top of lime water, mortar, or cement, because the absorption of oxygen can take place under the most favourable circumstances. A yellow anhydrous oxide is quickly deposited on the lead, wherever oxygen, water, and calcium hydrate (mortar or cement) have free access. A lead pipe, which had been embedded in sandstone was found quite sound after many years, while where it entered the brickwork above ground and was there surrounded by mortar, it was completely eaten away and changed into yellow oxide, containing 99·69 per cent. PbO. This mortar consisted of: sand, 78·41 per cent.; calcium carbonate, 7·45 per cent.; calcium oxide, 4·15 per cent.; water, 9·99 per cent. Wherever lead oxidises in nature and calcium hydrate is absent, the crust formed is white. Lead hydrate is formed in the first instance, which is converted into basic carbonate by the absorption of carbonic acid. If calcium hydrate be present, the latter attracts the carbonic acid and the lead hydrate ultimately changes into yellow or red oxide. A yellow or red crust on lead pipes may in most cases be safely ascribed to the action of lime. (*See also* J. Soc. Chem. Ind. **1887**, 832.—S. H.

X.—METALLURGY, MINING, Etc.

The Formation of Wart-like Elevations ("Wanzen") in Pig Iron, and the Formation of Globules in Pig and Cast Iron. B. Platz, Stahl u. Eisen, **7**, 639.

The porous and coarse nature of the surface of many varieties of iron is due to the oxidising action of the wart-like elevations ("*Wanzen*") on the iron immediately underlying, whereby carbon monoxide is formed, and this gives rise to the pitting. A connexion exists between the formation of these elevations and of the globules, and from analyses by Muck and by the author, a complementary relation exists between the composition of the elevations ("Wanzen") and that of the adjacent iron. The crust first formed on the surface of the white hot metal had a different composition to the elevations formed on cooling, and each time after the removal of the elevations the iron assumed a dark appearance as long as it remained liquid. This is opposed to the idea that the elevated spheroids consist of metallic compounds of silicon, phosphorus, and sulphur, which, owing to their being specifically lighter and more volatile, were supposed to rise to the surface and it seems to show that they are combustion products of the uppermost layer of the melted iron where the more readily oxidisable substances silicon and manganese are readily burned away by contact with the air. When the first crust is sufficiently thick, the combustion process is continued below and a slag results, rich in oxides and capable both of oxidising and taking up large quantities of phosphorus as in the Thomas process, and also of oxidising the carbon of the iron to carbon monoxide whence the hollows above referred to arise. These hollows are absent in iron so rich in silicon that the carbon is not burnt off. By covering the surface of the molten iron with sand, and thus protecting it from the air, the formation of elevations ("Wanzen") is avoided. The globules in pig iron contain less silicon, but more manganese and phosphorus than the mother-iron. They occur only in grey and mottled cast iron, poor in silicon, in which the formation of elevations is especially marked. They are formed during the solidification of the molten iron in that portion of the mass richest in phosphorus, which either in the liquid or plastic condition forms drops in the hollows produced by the disengaged carbon monoxide. The author does not deny that globules may be produced having the same composition as the mother-iron and formed by spirting, but he has not met with any.—C. A. K.

A new Process of Utilising the Waste Liquors from Copper-extracting Works. By K. W. Jurisch. Chem. Ind. 1888, **3**.

These waste liquors contain chiefly sulphate of soda and ferrous chloride, sometimes also chloride of sodium in excess and free acid. But besides these constituents they contain according to the amount of zinc present in the pyrites and burnt ores used a varying quantity of chloride of zinc. In order to recover the latter, the iron must be eliminated first, and this is done in the following way. (Ger. Pat. No. 41,737, 1887.)

The liquor is first treated with limestone-dust in a vessel similar to the neutralising well of the Weldon plant, and then pumped into high-level settling tanks, from where it runs into the oxidising cylinder. This apparatus is of the type of a Weldon-oxidiser.

Here the liquor is heated by steam and oxidised by air, while at the same time milk of lime is cautiously added in small quantities and well distributed. By this treatment the ferrous chloride gets oxidised and precipitated in the shape of basic ferric sulphate. According to the progress of oxidation, acid is set free, which must be removed by lime. But in adding the milk of lime, care must be taken never to reach or surpass the point of neutralisation, lest the zinc should be precipitated. Samples of the filtered liquor must at all times be faintly acid. A temporary excess of acid does no harm, since the basic ferric sulphate is insoluble in weak acid.

The light-brown mud then flows into settlers. The clear liquor, containing the zinc, is siphoned off and precipitated by an excess of milk of lime, yielding oxide and carbonate of zinc. The iron-mud, however, containing gypsum and carbonate of lime, is used in the next operation instead of limestone-dust, whereby it becomes richer in iron. The gypsum contained in it may be used for the manufacture of sulphate of ammonia by treatment in the cold with carbonate of ammonia, leaving a mixture of oxide of iron with carbonate of lime.

From 50 cubic meters of such waste liquor containing about 40 grms. chloride of zinc in the liter, and coming from pyrites containing only 1·5 to 3 per cent. of zinc, the following quantities may be obtained by this process:

806 kilos. oxide of iron, mixed with carbonate of lime.

3600 kilos. sulphate of ammonia of 24 per cent. NH_3.

1444 kilos. oxide of zinc with 50 per cent. metallic zinc.

3245 kilos. salt of 95 per cent. NaCl; and a varying quantity of chloride of potassium.—K. W. J.

The Reduction of Alumina. G. A. Faurie. Compt. Rend, **105**, 494.

Two parts of pure and finely powdered alumina are intimately mixed with one part of sulphuric acid, and one part of petroleum or any other hydrocarbon. The mixture gradually assumes a yellow colour, and gives off sulphurous acid. It is then wrapped up in paper and put into a crucible, heated to bright redness. After the decomposition of the petroleum the mass is allowed to cool, finely powdered, and mixed with an equal weight of a powdered metal. The mixture is then introduced into a plumbago crucible, which is well covered and exposed to a white heat. After cooling, the crucible contains black grains of the aluminium-alloy. The same process may be employed for the reduction of silica, lime, and magnesia.—S. H.

Ingot-iron for Steam-boilers. P. Kreuzpointer. Stahl u Eisen, 1887, **7**, 611.

Ingot-iron is used extensively in America in the manufacture of steam-boilers, as it has the highest possible uniformity of structure; a soft, but sufficiently strong material is most suitable, and careful treatment is required in rolling; but the difficulties caused by its hardness and other peculiarities are small and easily overcome, compared with those met with in working weld-iron. The author made 162 comparative tests between old fire-box material made from ingot-iron and duplicates which were put aside when the boiler was built, and found that only in one case the thickness of the plate had decreased by use, whilst in almost every other case it had increased by 0·025—0·50 mm.: he attributes this phenomenon partly to the original homogeneity of the material. A sample of ingot-iron containing

0·11—0·17 per cent. C, 0·38—0·55 per cent. Mn, 0·01—0·05 per cent. Si, 0·03—0·06 per cent. P, and 0·02—0·03 per cent. S, may be taken as normal, but whether analysis throws any light on its value and durability remains undecided.—F. S. K.

On the Influence of Phosphorus in Iron. L. Schneider. Dingl. Polyt. Journ. **266**, 378–382.

In the Transactions of the American Institute of Mining Engineers (1887, 252), B. W. Cheevers explains the fact that the injurious effect of phosphorus is not proportional to its amount in different irons and steels by asserting that this element may exist in the metal in two forms—as phosphide and as phosphate. This assumption is based on the fact observed by him that the residue left on treating the metal with ammoniacal cupric chloride solution, yielded soluble phosphates when subsequently digested with an ammoniacal ammonium oxalate solution, or when shaken for five minutes with a 1 per cent. HCl solution. Estimated by this method, the phosphorus present as phosphates, in a large number of steels and irons, shows considerable divergence among the different grades, the percentage of the total phosphorus occurring as phosphate ranging from 2 to 5 per cent. in pig irons, to 71 to 76 per cent. in bar iron, and 71 to 80 per cent. in Clapp-Griffiths steel. From this it would seem that in the analytical examination of a given metal, the determination of the condition of the phosphorus is as necessary as that of the total percentage. But the author questions the correctness both of Cheever's method and of his deductions from it. A small percentage of the phosphorus in puddled bar is doubtless due to the phosphates contained in the admixed slag; but as the puddling furnace slag rarely contains more than 1 to 2 per cent. of phosphorus, it is clear that the percentage thus introduced cannot exceed a few hundredths of a per cent.; but a puddled steel may show 0·3 per cent. of phosphorus on analysis, and yet not be cold short. Again, Cheever, in his method of examination, assumes, on the one hand, that the small quantity of iron phosphide present is unacted on by cupric chloride, and on the other that a five minutes treatment with a 1 per cent. HCl solution, or digestion with alkaline ammonium oxalate, effects the complete solution of all phosphates formed from phosphides at a red heat. But experiments by Schneider show that the iron phosphide in iron is slightly attacked by ammoniacal cupric chloride solutions in the cold; if the solution is neutral, basic salts are formed, the phosphates produced being retained in the residue, from which they are afterwards readily extracted by a 1 per cent. HCl solution. If an alcoholic cupric chloride solution be used, the basic salts are not formed, and the phosphates pass into solution. The soluble phosphates, upon the existence of which the whole theory is based, were for the most part produced by the action of the cupric chloride upon the phosphide pre-existing in the metal.—W. G. M.

Improved Apparatus for the Detection of Explosive Gases in Mines or other Places. J. W. Swan, Bromley. Eng. Pat. 3362, March 4, 1887. 8*d.*

A platinum wire is enclosed in a box provided with openings to the atmosphere, which are protected by wire gauze. These openings can be covered over when desired to exclude the atmosphere, and the wire can be viewed through a hole protected by glass. The wire is made to glow by a current of electricity and the brightness observed when the atmosphere is excluded and then admitted. If the atmosphere is dangerous, the wire glows more brightly when it is admitted.—E. T.

A Special Method of Manufacturing Metal from Iron Ores and Apparatus for the Purpose. H. Gardner, London. From R. J. Henderson, Oswego, U.S.A. Eng. Pat. 2834, February 23, 1887. 8*d.*

A metal with small percentage of carbon is obtained direct from the ore by the use of gaseous fuel alone. A cupola is provided with two tiers of tuyères, through the upper of which highly heated carbonic oxide is introduced, through the lower a mixture of that gas with air, oxygen, or air enriched with oxygen. To ensure thorough reduction of oxides in the furnace, sufficient carbonic oxide must be introduced to yield a mixture of $CO_2:CO = 0·7:1$; the waste gases may be used for firing boilers.—W. G. M.

Improvements in Apparatus for the Extraction of Gold from Crushed or other Finely Divided Auriferous Material. C. T. J. Vautin, London. Eng. Pat. 15,574, November 14, 1887. 8*d.*

The ore is treated in a lead-lined iron cylinder by contact with chlorine or bromine under a pressure of about five atmospheres, supplied by an air force pump. Thorough admixture is ensured by rotation of the cylinder. After blowing off the excess chlorine through lime-water, the contents of the vessel are run off into filtering tanks, where they are separated by a canvas or asbestos filter in connexion with the pump specified in Eng. Pat. 15,575 of 1887 (*see* this Journal, page 109). The gold solution is passed to a tank in which excess of chlorine is expelled by blowing air through it; thence the liquid is allowed to flow over a filter of charcoal, or other suitable body, in large and small pieces alternately, in which the precious metal is deposited, and from which it may be subsequently extracted. The first portion of the process is described under Eng. Pat. 4609 of 1887.—W. G. M.

A Process of Reducing Slag and Recovering Metal therefrom. K. W. E. Maruhn, Ruhrort, Germany. Eng. Pat. 17,049. December 29, 1886. 4*d.*

The slag is preferably collected in a suitable reservoir, from which it is run out in a thin stream, and granulated by passing through it a current of air or steam as in making slag wool, but at a lower pressure. Metal admixed with the slag will also be granulated, but the particles, being heavier, will be deposited nearer the apparatus. In this way, by means of a partition, a separation may be effected, and the slag may then be crushed under common millstones. —W. G. M.

The Treatment of Spent Copper Liquors and the Application of the Product for the Purification of Sewage and like Matters. C. Wigg, Liverpool. Eng. Pat. 2403, February 16, 1887. 4*d.*

Spent copper liquors containing chloride of iron and sodium sulphate are mixed, under agitation by beaters, with milk of lime. The co-precipitated iron oxide and calcium sulphate are removed by filter presses or after subsidence, and may then be added to sewage in the proportion necessary for purification. During these operations the temperature should not exceed 38° C., so that peroxidation shall not be hastened.—W. G. M.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Improvements in Secondary Batteries or Electrical Accumulators. J. S. Sellon, London. Eng. Pat. 11,448, August 22, 1887. 8*d.*

The inventor causes a positive plate of one cell and the negative plate of the next which lies in the same plane, to be cast or otherwise formed in one piece with a bridge piece connecting them, and which when the plates are in use goes across the top of the two adjoining cells. By this means all the troublesome connexions at the top of the cells are avoided, and a faulty plate with its fellow in the next cell can be at any time removed and replaced without stopping the working of the battery. Moreover, should a short circuit occur between two plates the other plates will scarcely be affected.—E. T.

An Improved Means of Separating the Plates in Secondary Batteries. D. L. Salomons, Tunbridge Wells, and T. Parker and P. B. Elwell, both of Wolverhampton. Eng. Pat. 3197, March 2, 1887. 6*d*.

Upon the edges of the plates are cast, or otherwise formed, lugs or projections provided with insulating pieces or plugs. The lugs of one plate correspond with those of the one next to it, but are prevented from touching them by the insulating pieces or plugs. Where advisable a rod of insulating material may be suspended between the centres of the plates, to prevent any possibility of a short circuit there. —E. T.

Improvements in Galvanic Batteries. J. Vaughan-Sherrin, Ramsgate. Eng. Pat. 15,730, November 16, 1887. 6*d*.

This battery has the form of a cylinder capable of revolving, and divided into two portions by a plane parallel to the axis. One forms a receiver and the other is divided into as many compartments as there are to be cells in the battery. When the receiver is uppermost, the exciting liquid flows from it by pipes to the compartments, and so charges the battery. When revolved so as to bring the receiver to the bottom, the liquid flows into it from the compartments, and so the battery is discharged of its exciting fluid.—E. T.

Secondary Batteries. C. D. Abel, London. From A. Dun and F. Hasslacher, Frankfurt-on-the-Main, Germany. Eng. Pat. 1862, February 5, 1887. 6*d*.

The plates of this battery are made of carbon, or a metal not soluble in the exciting liquid, the latter consisting of a solution of zinc or lead oxide in caustic alkaline lye, with excess of potash or soda. The negative plate is coated with an oxide or combination of oxides capable of assuming a higher state of oxidation, such as the oxide of silver, &c. The battery requires no forming, and the supporting plates do not deteriorate with use.—E. T.

Improvements in Galvanic Batteries. C. D. Abel. From A. Dun and F. Hasslacher, Frankfurt-on-the-Main, Germany. Eng. Pat. 1929, 1887. 4*d*.

To batteries which employ alkaline liquids, such as potash, the inventors add 3 to 5 per cent. of starch flour. A gelatinous mass is thus produced, such that the battery cell may safely be turned upside down; the potash or other liquid is prevented from evaporating or absorbing carbonic acid from the air by coating it with solid paraffin or gypsum.—E. T.

Apparatus for Electrolysing Bleaching Solution. E. Hermite, E. J. Paterson, and C. F. Cooper, London. Eng. Pat. 1993, Feb. 8, 1887, 1*d*.

This invention is an improvement on their Eng. Pat. No. 13,929, of 1884, and consists of special methods of circulating the liquids and cleansing the cathodes. Circulation is produced by a suitably arranged rotary pump. The anodes are made of platinum, or are platinised, but glass, vulcanite, &c., faced with specially pure plumbago, may be used. The cathodes are of zinc, arranged in various specified ways, and are kept clean by scrapers, either these or the zincs being kept in continual circular or reciprocatory motion.—E. T.

New or Improved Means and Apparatus for the Separation of Gold and other Metals from their Ores. G. J. Atkins, Tottenham. Eng. Pat. 12,295, September 28, 1886. 8*d*.

This process combines electrolysis and amalgamation; the ore being first passed through an electrolytic cell and thence to an amalgamator. The first portion of the apparatus consists of a double chamber, the sides of which are separated by a porous partition. The ore is fed into the top of the anode compartment, and its descent is checked by a long vertical screw, nearly equal in diameter to the chamber itself, and rotating in such a direction that it tends to raise the ore through the liquid. A series of shelves may be substituted for the spiral, or if the ore is very rapidly attacked by the liquid all such arrangements may be dispensed with. The spiral is preferably connected with the positive pole of an electric generator, and is provided with special frictional safety driving gear. Any suitable electrolyte may be used, and the cathions, passing through the porous partitions, are deposited on a perforated copper cylinder rotating within the cathode chamber; thence the deposited metal is constantly removed by scrapers, finally collecting in a free space provided for it at the bottom of the vessel. The spent ore and gangue arriving at the bottom of the first compartment passes through a tube to a cylindrical chamber, in which it is carried beneath the surface of mercury by a grooved drum, and is finally discharged as tailings. The bottom of the amalgamator has a sump as a reservoir of mercury; and the level of the mercury in the vessel may be regulated at will. The tailings are kept free and prevented from carrying over mercury by a stirrer placed at the outlet. The base metals should thus be removed by electrolysis; the gold, and any silver not previously dissolved, are extracted by the mercury. If an electrolyte be used which evolves chlorine, gold will be dissolved, but will usually be redeposited by contact with more electro-positive metal. —W. G. M.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Improvements in Apparatus for Separating Mineral or other Oils from Oils or Substances of different Specific Gravities. A. F. Craig, A. Neilson, and J. Snodgrass. Eng. Pat. 3617, March 10, 1887. 8*d*.

The apparatus is of the centrifugal class, and an improvement upon that described in Patent No. 3749, of 1886. The details are unintelligible without the drawings.—W. L. C.

Improvements in Apparatus for Extracting Oils by Volatile Solvents. A. W. MacIlwaine. Eng. Pat. 16,979, Dec. 28, 1886. 6*d*.

Instead of the usual iron vessels, which in some cases discolour the oil, vessels lined with enamel, lead, tin, marble, slate, stoneware, porcelain, glass, and even wood are employed.—W. L. C.

Process of Refining Hydrocarbon Oils. S. Pitt, Chicago, Ill., U.S.A. Eng. Pat. 15,256, Nov. 8, 1887. 4*d*.

The vapour of the oil and steam are simultaneously passed through a "converter" full of fragments of granite or other material capable of increasing the surface exposed, and kept at from 420° to 460° Fahr. The sp. gr. of the oil is diminished by the process.—W. L. C.

Improvements in Treating Cotton Seed to obtain Oil, Feeding-cake, and Resin-like Matter. E. S. Wilson. Eng. Pat. 1057, Jan. 24, 1887. 6*d*.

Cotton seed is exposed to air heated to between 200° to 300° Fahr., and then decorticated and reduced to meal. The solid resin-like particles, which, in ordinary processes, discolour the crude oil, are then separated by sieving or by grading with a current of air, taking advantage of differences in specific gravity. The meal is then pressed, and the resulting oil is of superior quality. The resin may be utilised separately as a dye.—W. L. C.

Improvements in the Treatment of Fatty and Oily Matters for the Production of Glycerin, Lead Compounds, and Soap. S. S. Sugden. Eng. Pat. 1033. Jan. 22 1887. 6*d*.

A lead soap is prepared by boiling oxide of lead, water, and the oil together; the clear glycerin water is removed; the lead soap is thus converted into a potash or soda soap by being boiled with alkaline ley. The resulting lead oxide may be used over again, or may be dried and ground for a pigment.—W. L. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

The Utilisation of a Natural Product in the Manufacture of Blacking, Japan, Black Paint, and Varnish, and other similar Coloured Materials. R. E. Donovan, Rathmines, and James McKenny, Dublin. Eng. Pat. 2201. February 12, 1887. *4d.*

The patentees propose the use of ground or pulverised coal as a substitute for lamp black, ivory black, bone black, and other similar materials.—A. R. D.

Hard Drying Anti-corrosive Compound. O. Jeyes, Birmingham. Eng. Pat. 2457. February 17, 1887. *4d.*

One cwt. pitch mixed with 15 to 20 gals. crude naphtha or creosote oil and 15 to 30 per cent. slaked lime, with or without colouring pigments. A quick-drying paint, especially adaptable for resisting heat, is obtained in this way.—J. W. L.

A new Composition capable of being formed into Threads, Films, Sheets, Slabs, or Moulded Articles, or used as a Varnish. A. M. Clark, from M. P. E. Gérard, Paris. Eng. Pat. 2694. February 21, 1887. *6d.*

Ten parts guncotton and five parts gelatin are separately dissolved in acetic acid, then mixed together. A small quantity of glycerin and castor oil, or in other cases a little gluten, glucose, or honey, is added to improve the composition. The addition of a trace of calcium chloride renders it uninflammable. The product can be used as a varnish for wood, &c., and especially for plaster, and can also be moulded into articles of great delicacy of structure.
—J. W. L.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

An improved Process of Manufacturing Textile Threads from Viscous or Pasty Matters. A. M. Clarke, from M. P. E. Gérard, Paris. Eng. Pat. 2695. February 21, 1887. *6d.*

The object of the patent is to prevent agglomeration of the matter round the orifice, through which it is expelled when being made into threads. This is effected in the following way:—Superheated steam at 200° C. is brought to bear on the substance as it leaves the orifice, which extracts the solvent of the viscous matter, and carries it away, leaving the thread quite dry, and the latter may then be spun. In other cases ammonia gas at 100° C. is used for the same purpose.—J. W. L.

XV.—AGRICULTURE, MANURES, Etc.

The Relation between the Bloom and the Tubers of the Potato. E. Wollny, Forschungen auf. d. Geb. d. Agricultur-Physik, 1887. **10**, 214.

The author finds that the development of the bloom of the potato diminishes that of the tubers, and that wet and dull weather favour the growth of the latter, while the flowers flourish best when favoured by drought and sunshine.
—C. A. K.

Means of Preserving Stable Manure. Gesekus, Der Landwirth. **22**, 512.

Stable manure mixed with gypsum keeps well if covered with six inches of soil. With a covering of this thickness the manure never loses as much as one-fifth of its volume, and it shows no signs of decay or burning. The author recommends this thickness of soil, and the use of superphosphate for preserving manure.—C. A. K.

The Value of Residues from the Manufacture of Oil in Farming. C. Kornauth, Org. d. Centr. Ver. f. Ruben Zucker. Ind. Oesterr-Ungar. **25.**

The author discusses the value of these residues, and the best means of employing them as fodder. He insists upon the necessity of a microscopic examination, details of which are quoted.—B.

The Use of Fresh, of Decomposed, and of Disinfected Excrements as Dung. O. Kellner, Landw., Presse. **14**, 507.

In Japan and China the excrements employed as dung are always allowed to decompose completely before use. When fresh, their action is less certain, and the plants are likely to wither. The author finds that urea, the most important constituent of the dung, is not absorbed by the soil itself, but remains dissolved in the moisture contained in the soil. The nitrogen may, therefore, be readily washed away by rain; also the urea and other soluble constituents of the urine may saturate the liquid in the soil to such an extent that the plants can derive no moisture from it, whereupon they wither. In the putrefaction of urine, the urea is readily transformed into ammonium carbonate, which is very freely absorbed by most soils. For this reason the advantage of employing decomposed urine as manure is evident. The decomposition is effected by diluting it largely, and then allowing it to stand for 8—14 days. Disinfected manures possess no advantage over fresh excrements, and the disinfectants used are likely to injure the plants.—C. A. K.

Some Relations between Nitrogenous Salts and Plants. H. Molisch, Monatsh. Chem. 1887. 237—259.

The diphenylamine reaction shows that nitrates are present in most plants, especially in the pulp and parenchyma of the stalks, but, in general, herbaceous contain considerably more than woody growths; this reagent serves very conveniently for the detection of nitrates under the microscope, but in woody growths the reaction is often more or less prevented, owing to the rapid formation of humin substances by the sulphuric acid in which the diphenylamine is dissolved; a piece of wood when dipped in dilute nitric acid gives a brownish-black and not a blue colouration.

Nitrates remain for weeks or even months in the vegetable cells before they are destroyed; the assimilation of nitrates is favoured by light. Nitrites do not occur in the vegetable kingdom; not a trace even could be found in plants which were grown in a nutritious medium containing nitrites, and although nitrates were present, their formation was due to the action of bacteria and not to that of the plant, because when nitrites are assimilated they are rapidly reduced and destroyed; dilute solutions of nitrites (0·1—0·01 per cent.) act injuriously on many plants.

Substances which turn guaiacum emulsion and starch paper and potassium iodide blue are distinctly localised in various vegetable tissues.

Plants to which nitrogen is accessible, not in the form of nitrates, but as nitrites or ammonia, never contain nitrates; it follows, therefore, that neither nitrous acid nor ammonia undergoes oxidation in vegetable cells. Contrary to the views of Berthelot and André, plants, with, perhaps, the exception of bacteria, have not the power of producing nitrates from salts containing nitrogen; Schulze's experiments on lupines (this Journal, 1887, 601) also confirm this statement.

All nitrates originate from without, and if a larger quantity is contained in a plant than in the soil in which it grows, the excess is simply due to accumulation.—F. S. K.

XVI.—SUGAR, STARCH, GUM, Etc.

A reducing Substance in Raw Beet-Sugar. E. O. C. Lippmann. Ber., 20, 3298—3301.

It has been often pointed out that substances, other than inverted sugar, though possessing analogous reducing properties, must be present in commercial raw sugars, but they have not hitherto been isolated. By shaking out ordinary raw sugar with ether an aromatic extract was obtained, which, on evaporation, yielded, besides a few sugar crystals and a fatty mass faintly smelling of vanilla, a compound in the form of broad leaf-like efflorescent crystals; this substance melts at 102—103°, and shows all the properties of catechol (pyrocatechin), reduces silver solutions in the cold and Fehling's solution on warming. Catechol has powerful reducing properties; 100 mg. precipitate from 50 cc. Fehling's solution after three minutes boiling a quantity of cuprous oxide equivalent to 64 mg. copper (or 32·8 mg. grape sugar) and 200 mg. catechol precipitate a quantity of cuprous oxide equivalent to 187 mg. copper (or 95·7 mg. grape sugar); the reduction seems to vary according to the conditions of the experiment and before the separation of cuprous oxide, clouds, fluctuating in colour between green and red, are observed as is often the case in the estimation of sugar in beet-juices. Soldaini's solution, on the other hand, is not reduced under the above conditions even by five minutes continued boiling, but a green colour only is produced; this solution ought therefore to be exclusively used for the estimation of inverted sugar in presence of cane sugar.

Catechol may either be formed from the sugar in the process of manufacture, or it may originate in the beet itself; both views are tenable, nearly all carbohydrates yield a small quantity of catechol when heated with water to 180°—280°, and the author obtained from beet leaves a small quantity of a substance which was undoubtedly catechol; a trace of an organic acid was obtained at the same time, and this compound, probably $C_9H_{10}O_4$, yielded, on heating, a substance which was probably catechol. It seems likely, that as catechol is readily oxidised in alkaline solution by the air, it would be easily destroyed by using strongly alkaline juices in the process of manufacture, and only in the present very general method of working with juices of the least possible alkalinity, would it be retained to any great extent.—F. S. K.

Carbohydrates. A. G. Ekstrand and C. J. Johanson. Ber. 20, 3310—3317.

A white starch-like powder can be obtained from the tubers of *phleum pratense*, which, when air-dried, contain about 10 per cent. of this carbohydrate. Like inulin and irisin, this substance, after drying at 100°, has the formula $6\ C_6H_{10}O_5 + H_2O$; when heated in a capillary tube it remains unchanged up to 215° and then swells up and melts, it dissolves in potash, but is precipitated from its aqueous solution by baryta, the precipitate redissolving in an excess of the carbohydrate. 100 pts. water, at the ordinary temperature, dissolve 3·26 pts. of this substance, 3·29 pts. irisin and 0·96 pts. inulin; in lukewarm water irisin is, however, far more soluble. The carbohydrate from *phleum* does not give a blue colour with iodine, it dissolves very readily in concentrated hydrochloric acid, and the solution blackens on heating. The specific rotatory power is $[\alpha]_D = -48·12°$, that of inulin $[\alpha]_D = -34·53°$, and that of irisin $[\alpha]_D = -52·34°$, a 5 per cent. solution being used in all three cases, and the temperature being 17°. The new carbohydrate does not reduce Fehling's solution even on continued boiling, but an ammoniacal silver solution is blackened on heating; it is converted into levulose by dilute acids, a 5 per cent. solution, on heating with dilute sulphuric acid for five hours, turned brown and smelt distinctly of caramel; after removing the free acid it was found that 100 cc. contained 3·1 g. inverted sugar, the specific rotatory power of which is $[\alpha]_D = -84·83$ ($t° = 13°$); this solution gives phenylglucosazone with sodium acetate and phenylhydrazine hydrochloride. This carbohydrate from *phleum* resembles inulin in its tendency to form double refracting sphero-crystals, and is similar to irisin in rotatory power and solubility in cold water; it differs from the latter, however, in being considerably less soluble in warm water, and in having a higher and sharply defined melting point.

The rhizomes of *Baldingera arundinacea* contain about 5 per cent. of their weight of a mixture of two carbohydrates which can be partially separated by the difference in their solubilities in water. The more soluble compound, 2·96 pts. of which dissolve in 100 pts. water at the ordinary temperature, was found to have the formula $6\ C_6H_{10}O_5 + H_2O$ after drying at 100°; in its behaviour towards potash, baryta, iodine, and hydrochloric acid it resembles the compound obtained from *phleum*, it swells up and melts at 205° with decomposition when heated in a capillary tube. In a 5 per cent. solution its specific rotatory power $[\alpha]_D = -48·91°$, it reduces ammoniacal silver solution, but not Fehling's solution even on continued boiling. Dilute acids convert it into levulose, by a similar treatment to that described in the case of the preceding carbohydrate, a solution is obtained containing 3·36 g. inverted sugar in 100 cc., the specific rotatory power of which is $[\alpha]_D = -82·53°$; this solution gives phenylglucosazone with sodium acetate and phenylhydrazine hydrochloride.

The less soluble carbohydrate from *baldingera*, 1·79 pts. of which dissolve in 100 pts. of water at the ordinary temperature, swells up and melts at 208° with decomposition; its specific rotatory power in a 5 per cent. solution is $[\alpha]_D = -49·27°$.

From these results it seems that two carbohydrates of almost identical optical activity are present in *baldingera*, and there is no material difference, either in chemical or in optical properties, between the carbohydrate contained in *phleum* from that contained in *baldingera*. The name *graminin* is proposed for both these substances. The rhizomes of other *gramineæ* appear to contain the same carbohydrate.

Dracaena australis contains a carbohydrate which was obtained in the form of a white powder, the composition of which is $6\ C_6H_{10}O_5 + H_2O$ when dried at 100°; it begins to melt at 120°, and at 200° swells up and is decomposed; it reduces ammoniacal silver solutions, but not Fehling's solution even on boiling; in its aqueous solution baryta gives a precipitate soluble in an excess of the carbohydrate. This substance is similar to *triticin*, which Müller and Reidemeister obtained from *triticum repens*, and, according to analysis, they have both the same composition.

In a 5 per cent. solution the rotatory power of the carbohydrate from *dracaena* is $[\alpha]_D = -36·61°$, that of triticin $[\alpha]_D = -41·07°$; the former is converted into levulose by dilute acids, under the conditions already described, a solution is obtained containing 2·98 g. inverted sugar in 100 cc., the specific rotatory power of which is $[\alpha]_D = -82·78°$, this solution gives phenylglucosazone with sodium acetate and phenylhydrazine hydrochloride Triticin also yields levulose by a similar treatment.

Neither carbohydrate is coloured blue by iodine, and both, on heating with concentrated hydrochloric acid, give brown solutions, from which a black precipitate separates on addition of water.—F. S. K.

Synthetical Experiments in the Sugar Group. Emil Fischer and Julius Tafel. Ber. 20, 2566—2575.

By acting on acraldehyde with cold baryta-water a compound is formed, which combines with phenylhydrazine and gives two isomeric phenylhydrazine derivatives having the formula $C_{18}H_{22}N_4O_4$. The one is named *α-phenylacrose*, it melts at 205°, and is very similar to phenylglucosazone, (the phenylhydrazine derivative of dextrose and levulose), from which it differs, however, in being optically inactive; the second compound melts at 148°, and is termed *β-phenylacrose*.

When phenylglucosazone is reduced, a base, *isoglucosamine* $C_6H_{13}NO_5$ is produced, which, on treating with nitrous acid is converted into levulose, and, therefore, by this method dextrose can be readily transformed into levulose.

A base isomeric with isoglucosamine is obtained by reducing α-phenylacrose, and this base when treated with nitrous acid yields a syrupy compound, which has the formula $C_6H_{12}O_6$, and differs from a natural sugar only in being inactive; β-phenylacrose is also doubtless a derivative of a second synthetical sugar.—F. S. K.

On Lichenin. M. Hönig and St. Schubert, Monatsh. Chem. **8**, 452.

Lichenin occurs in considerable quantities in Cetraria islandica. The hot aqueous extract of Cetraria contains two carbohydrates, one of which, the lichenin, in much larger quantity than the other, the lichenin-starch. Lichenin forms a jelly, slightly soluble in cold water, and not blued by iodine. It does not turn the plane of polarisation, and dissolves in hot water to an opalescent liquid. Boiled with diluted acids it yields non-rotating dextrine, and easily crystallisable grape sugar. This property of lichenin deserves consideration, since it may lead to the application of Cetraria islandica as a raw material for the manufacture of grape sugar. The lichenin-starch possesses the usual properties of a soluble modification of starch.—S. H.

The Chemical Position of Inosite. Lorin. Bull. Soc. Chem. **48**, 235.

More than 10 years ago the author published the reaction discovered by him, that alcohols with more than one hydroxyl group decompose oxalic acid below 100° C. into water, carbonic and formic acid. For this reason inosite may be classed as an alcohol.—S. H.

Purification of Beet-root Juice. Niessen. Zeits. f. Zuckerind. **37**, 823.

The following statements are made by the author:—(1.) The deterioration of diffusion juice in comparison with beet juice may be due to the employment of too high a temperature and insufficient agitation. (2.) The saturation removes 42·1 per cent. of non-saccharine substance (54·14 per cent. allowing for the lime present). (3.) The filtering off of the scum injures the quality of the juice in proportion to the time the filter presses are allowed to work, 13·52 per cent. of the precipitated impurities being again taken up. (4.) A second saturation without a fresh addition of lime has no purifying action; nor is any good effected by a second filtration. (5.) 12 per cent. of bone charcoal removes 10·96 per cent. of non-saccharine matter, but the action slackens after two hours, so that much charcoal, prolonged contact, and careful separation of the drainings are necessary for good results. The filtration of the thin juice after the thick juice may cause decolorisation, but it deteriorates the value of the juice because, even after a few hours, 5·41 per cent. of the non-saccharine substances are again washed out. The author considers that bone charcoal when properly employed yields better products than are obtained by those methods of purification in which it is dispensed with.—C. A. K.

Improvements relating to Diffusing Apparatus for use in the Treatment of Beet-root, Sugar Cane, and other Substances. H. H. Lake. From La Compagnie de Fives-Lille, Paris, France. Eng. Pat. 2905, February 24, 1887. 8*d*.

This patent relates entirely to improvements in the apparatus used for the above purposes, and is unintelligible without the drawings.—G. H. M.

XVII.—BREWING, WINES, SPIRITS, Etc.

Germination of Malt. F. Schütt. Wochenschr. f. Br. **4**, 673.

The author allowed 100 gr. of malt to germinate in a suitable apparatus at 17°·5 C. for nine days, and found that the evolution of carbon dioxide increased rapidly for the first three days, reached its maximum between the third and fifth days, and then gradually decreased up to the ninth day. At a higher temperature the evolution of gas was increased, but light did not appear to affect the germinating malt. The carbon dioxide accumulating in the apparatus hindered the further evolution of gas in proportion to the quantity present By means of these experiments on the small scale it is calculated that in the malting-room 100 kg. of barley will yield 77 kg. of kiln-dried malt containing 2 per cent. of moisture; this agrees with the results obtained in practice.—C. A. K.

Formation of Normal Amyl Alcohol in the Fermentation of Glycerol by Bacillus butylicus. E. C. Morin. Compt. Rend. **105**, 816.

According to Fitz "*Bacillus butylicus*" converts glycerol into alcohols (ethyl, propyl, and butyl), glycol, and acids. The author finds that normal amyl alcohol is also produced, the quantity amounting to 4 per cent. of the mixture of alcohols obtained (equal to about 1 per cent. on the glycerol taken); it may be separated by fractionation. It is worthy of note that only normal alcohols are produced in this fermentation.—C. A. K.

The Effect of Heat on Cider. G. Lechartier. Compt. Rend. **105**, 653.

By heating cider either in bottles or casks to 60° to 65° the fermentation is stopped, and the tendency to turn sour from acetic fermentation, is prevented. The liquid, however, acquires a peculiar taste, resembling that of dried fruit; this may be removed by the addition of a bottle of the cider which has not been heated, when a normal alcoholic fermentation sets in.—C. A. K.

The Refrigeration of Cider. G. Lechartier. Compt. Rend. **105**, 723.

When cider is cooled to −18° to −20° a portion of the liquid soon solidifies and the temperature rises to −3° to −4°. The portion still liquid has a higher specific gravity than the original cider. The solidified portion melts to an almost colourless liquid, having a sp. gr. of 1·0 and containing only 0·3 per cent. of alcohol. Cider containing 4–5 per cent. of alcohol yields on freezing a concentrated cider containing 7—8 per cent. of alcohol and 60—80 gr. dry extract per litre; this composition corresponds to that of the richest Normandy cider. Both the taste and aroma of the cider are obtained in a concentrated form by freezing it. The fermentation is slowed but not stopped even after 212 hours.—C. A. K.

Process for removing Fusel Oil from Crude Spirits or from the Mash containing Crude Spirits. Herman Grote, Guatemala, Central America. Eng. Pat. 2109, February 10, 1887. 6*d*.

This patent consists in the preparation of a compound by fusing together either sodium or potassium nitrate and magnesium carbonate, or a carbonate of the alkalis or alkaline earths. The fused compound is then mixed, either before or during distillation, with the crude spirits or the mash. The inventor claims that it removes the fusel oil and other impurities.—G. H. M.

An Improved Process and Apparatus for Purifying Alcohols by means of Hydrocarbons. T. G. Bowick, Harpenden. Eng. Pat. 14,737, October 29, 1887. 8*d.*

In this process the alcohol and hydrocarbons are forced in opposite directions through a series of cylinders provided with diaphragms in the centre. An emulsion is formed which afterwards separates, and the alcohol passes out at the bottom of each cylinder and the hydrocarbons at the top, so that the purest alcohol meets the purest hydrocarbon in its passage through the cylinders. A full illustrated description of the plant employed is given.—G. H. M.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

New Peptone Preparations. E. Schumacher-Kopp. Chem. Zeit. **11,** 1395.

The well-koown Swiss firm of Maggi lately brorght out some new preparations, which are of especial value as food for invalids.

I.—Concentrated broth-extract.
II.—Solid peptone-food.

Their analyses showed the following results :—

—	I.	II.
	Per Cent.	Per Cent.
Water	37·40	8·03
Nitrogenous matter	20·46 (of which 11·6 per cent. is peptone.)	41·37 (of which 31·11 per cent. is peptone.)
Soluble carbohydrates.	20·20	37·80
Sodium chloride	9·77	3·33
Other salts	2·03	2·87
Organic matter	10·14	6·60

The same firm is also known for their legumin preparations, which give the following results on analysis :—

—	Per Cent.					
	A	B	C	AA	BB	CC
Albumen	23·21	17·21	19·42	30·50	27·19	19·25
Carbohydrates	39·27	67·33	63·69	49·50	50·92	63·17
Fatty matter	1·76	1·63	1·51	6·44	6·20	4·21
Salts	2·89	1·43	2·60	3·60	3·45	2·45
(Percentage of P_2O_5 therein)	(1·40)	(2·42)	(1·32)	(1·40)	(1·45)	(1·39)
Moisture	12·87	12·40	12·76	9·27	12·24	10·92
Proportion of albumen to carbohydrates	1 : 2·69	1 : 4	1 : 3·4	1 : 2	1 : 2·2	1 : 3·66

—S.H.

The Application of Molasses as a Food-stuff. S. Klix. D. Landw. Presse. **14,** 573.

The molasses from distilleries are given as food to cows and sheep; their value is thus not fully realised, while if given in excess they are liable to produce malanders and other illnesses. In order to employ molasses as food to the fullest advantage, this material should be kept at a temperature not below 56 C. for a long time, so as to prevent the development of bacteria, and should then be diluted and cooled to 25°—38° immediately before being given as food. Too great dilution is to be avoided, not more than 25—30 litres of water being given per 500 kilog. weight of the animal, daily. Fine-cut coarse fodder mixed with the molasses should be given by itself and not more than twice a day. Special strengtheniog food and calcium phosphate should only be given from time to time when necessary; dry fodder may always be given in sufficient quantity. It is very necessary that the vessels employed for the molasses food be kept perfectly clean, which may be effected by washing them with freshly-prepared lime water. According to the author these precautions, if properly carried out, ensure excellent results in the use of molasses, and there is no reason to fear the development of malanders.—C. A. K.

Saffron Surrogate and "Permitted" Colouring-Matters. Th. Weyl. Ber. **20,** 2835—2836.

Dinitrocresol ("saffron surrogat"), the employment of which for colouring butter, confectionery, &c. is permitted in Germany, is a deadly poison. When the commercial article is administered in doses of 0·25 grm. for every kilo. of rabbit, death follows in from 20—30 minutes, and since the commercial article contains ammonia the fatal dose of the pure compound will be considerably less. Martius-yellow, in doses of 1 gr. of the calcium or ammonia salt, is not poisonous, nor is the so-called "butter-yellow"; the yellow vegetable colouring-matters, such as Orleans, saffron, yellow-berries, calendula, curcuma, and yellow-wood, are also, as far as is known, non-poisonous.—F. S. K.

Improvements in the Manufacture of Vinegar, J. F. Peasgood. Eng. Pat. 10,346, July 25, 1887. 4*d.*

The fruit of the tomato plant, preferably when ripe or nearly so, is reduced to a pulp and steeped in water for 24 hours. The liquor is then drawn off, sugar added, and the whole allowed to ferment. The liquid, tomato vinegar, is then decanted. The claims are for the application and use of the tomato fruit for making vinegar, and the process of manufacture as described.—E. E. B.

New Treatment of Milk to prevent its turning Sour. J. France, Marsden, near Huddersfield, Yorks. Eng. Pat. 1772, February 4, 1887. 4*d.*

The treatment consists in charging with carbonic acid gas or otherwise aërating the milk which is subsequently preserved in air-tight bottles or barrels.—E. E. B.

(*B*)—SANITARY CHEMISTRY.

Alpha-oxynaphthoic Acid, a new Antiseptic. Ellenberger and von Hofmeister. *Arch. f. Exp. Path. u. Pharm. XVIII.* A. Lübbert, Mitth. Bacteriolog. Lab. Dresdener Albertstadt.

α-Oxynaphthoic acid $(HO)C_{10}H_6(COOH)$ is prepared by means of the action of carbon dioxide under strong pressure and at an elevated temperature on α-naphthol sodium. The compound is almost insoluble in water, 100 cc. only taking up in the cold 0·0535 grm. It sublimes unchanged between 90° and 100° C., and melts at 186°, evolving CO_2. It dissolves in solutions of the alkalis and their carbonates, forming colourless salts with neutral reaction, and more soluble both in hot and cold water than the acid itself (100 cc. at 18° C. dissolve 6·37 grms. of the salts). The acid is precipitated from solutions of its salts by hydrochloric, sulphuric, nitric, and acetic acids, but not by carbonic acid. Solutions of its salts gradually decompose when kept even at normal temperatures. The following reaction serves to distinguish the α- from the β-acid. A little of the respective salts is treated with *red* fuming nitric acid. In the case of the α-acid, a beautiful violet or blue colour results, passing into red; in that of the β-acid, only a greenish yellow colouration.

With regard to the antiseptic properties. (1.) Fresh meat juice began to decompose in about 12 hours when kept at from 37° to 40° C. (2.) The addition of 1 part to 20,000 of α-oxynaphthoic acid was found to retard this decomposition, so that it only commenced after 48 hours, whilst (3), with a proportion of 1 to 2,500, no bacteria could be detected in unboiled liquids after seven days. (4.) When the liquid had been boiled an admixture of 1 to 1,200 was found to be amply sufficient for preventing putrefactive change. (5.) In the proportion of 1 to 600 decomposition was stopped in liquids undergoing rapid change. (6.) The sodium salt, however, was required in the proportion of 1 to 300 to prevent decomposition, and when the latter was in vigorous progress this salt was powerless to check it. (7.) The effect of the β-acid and its salts was very similar to that of the α-acid and its salts.

With regard to the physiological experiments, the conclusions were that these acids, the α-isomeride especially, are more powerful than either salicylic or carbolic acids as antiseptics. Probably also they and their sodium salts will be valuable as antipyretics. The acid is not decomposed in passing through the system, and so would probably be valuable in case of diseases arising from some forms of putrefactive or fermentative change in the internal organs, and in treating affections supposed to be due to the action of micro-organisms in the blood. Toxic influence is not greater than with other bodies of the same class. Dr. Lübbert inoculated the bodies of dead animals, and in all cases the bacteria of putrid urine and meat, &c. were killed. The micro-organism of anthrax was sterilised with aqueous solutions of the α-acid. Salkowski, of Berlin, and Kobert, of Dresden, give similar evidence as the result of their experiments.—W. S.

The Stability of Antiseptic Sublimate Solutions. Victor Meyer. Ber. **20**, 2970—2974.

Solutions of Göttingen town's water, containing $\frac{1}{10}$ per cent. sublimate, when placed in airtight vessels, and kept *in the dark*, underwent no decomposition, even after the lapse of two months. Similar solutions, prepared with filtered pond water and water containing considerable quantities of organic matter, were kept under the same conditions, and after two months only the very slightest decomposition had taken place. The addition of common salt (*see* this Journal, 1887, p. 674) is, therefore, unnecessary.
—F. S. K.

A Chemical Test for Cholera-bacteria. J. Judassohn and F. Cahen. Zeits. Anal. Chem. **27**, 106.

The cholera-red reaction is due to a substance which is formed from the peptone or albumen contained in the nutritive medium, and which, according to Brieger, is an indol derivative.

Cahen has shown, however, that if the cholera-bacteria be placed in an alkaline nutritious fluid, coloured by litmus, and cultivated at 37°, the solution is decolorised. *Spirillum Finkler* and *spirillum tyrogenes* do not reduce litmus solution at this temperature.—F. S. K.

On the Preparation of Carbolic and Iodoform Gauze. G. Daux. Journ. Pharm. Chim., 1887, 5th Ser. **16**, 201.

For the preparation of carbolic gauze, a solution is made containing 100 grms. of crystallised carbolic acid, 0·5 grm. of resin, and 1 grm. of glycerol in 1,250 grms. of alcohol (90°), and 0·5 grm. of Venice turpentine. This solution is sufficient for 25 metres of white, washed, unfinished gauze. The gauze is cut into strips, and left in the solution for 2—3 hours, then wrung out lightly, and hung upon a line for about 20 minutes in a room through which there is a good draught. The slightly damp strips are then made up into a bundle, dried in the open air, and finally wrapped in parchment-paper, or kept in paper boxes, as in metallic boxes it undergoes change and turns yellow. As long as the carbolic gauze is moist, the smell of phenol is scarcely perceptible, as carbolic acid is given off only when the gauze is dry. 150 metres, which the author prepared by this method in 1881, have not as yet undergone any change, and smells now exactly as it did directly after its preparation.

To prepare iodoform gauze, 50 grms. of iodoform and 0·2 grms. of resin are dissolved in 500 grms. of alcohol (90°), 500 grms. of rectified ether, and 0·5 grm. of castor oil. This solution suffices for 10 metres of white, washed, unfinished gauze, which is cut into strips of 1 metre. 100 grms. of the solution are placed in a glazed vessel of 5—6 litres capacity, and one strip is dipped into the liquid, well soaked, wrung out, and the operation repeated until all the liquid is absorbed and no more can be wrung out of the strip. It is then immediately hung on a line in a dark room heated to 25°—30°. In 20 minutes it is quite dry, and is wrapped in yellow parchment-paper, as it must not be kept in metallic boxes.

The hands are freed completely from the smell of iodoform by washing them first with soap and then with tincture of iris, according to the suggestion made by Bélinguard.
—F. S. K.

Improvements in Treating Sewage and other Impure or Waste Liquids for the Recovery and Manufacture therefrom of Manurial and other Products, and in Means or Apparatus therefor. W. H. Hartland, Glasgow. Eng. Pat. 16,039, December 8, 1886. 11*d*.

The treatment is carried out in an apparatus explained by drawings, in which provision is made for subsidence of the heavier particles of solid matter, and the clarification of the liquid is completed by the use of various precipitants such as lime, sulphate of alumina, basic slag, chalk, &c. adapted to the nature of the liquid, the defecation being further assisted by means of aëration. The sludge may be dried and incinerated, or simply dried, for utilisation as manure.—G. H. B.

New or Improved Compounds to be used for Deodorising, Filtering, and Manuring Purposes. T. McMurray, Glasgow. Eng. Pat. 3292, March 4, 1887. 6*d*.

Slag from the blast furnace is run direct into dilute sulphuric or other acid, and the granular product is mixed with charcoal or coke, and ground to powder in a mill. The compound is used as a deodoriser in stables, &c. (the free acid present being useful in absorbing ammoniacal odours), and can also be used for treating waste liquors.—G. H. B.

A Process and Apparatus for Purifying Water. Gustav Bischof, Bloomsbury. Eng. Pat. 3461, March 7, 1887. 4*d*.

The water is purified by agitation with spongy iron, which is then removed by subsidence. The separation of the iron is assisted by means of aëration.—G. H. B.

Improved Means to be Employed in the Purification of Water and other Liquids, and the Preparation and Treatment of Materials therefor. C. J. Bühring, Hamburg. Eng. Pat. 7619, May 25, 1887. 6*d*.

A filtering medium is prepared by incorporating asbestos fabric with vegetable or animal charcoal freed from mineral impurities by treatment with acid. The mass is cemented together by mixing with pitch or a solution of glue, and the whole is carbonised by heat in closed vessels. The mass may be made to take any desired shape for use in filters.—G. H. B.

Improvements in preventing the second or further Fermentation of Yeast or of any other Ferment or Raiser when combined with Wheat or any other Cereal or Admixture of Cereals to be Consumed or Used as Food. C. R. W. Offen and A. F. More, both of Kingsland, London. Eng. Pat. 16, 592, December 2, 1887. 4*d*.

The antiseptic mixture claimed consists of salicylate of soda, boric acid, and biborate of soda, which is dissolved in water and mixed with the grain, either whilst it is still whole or after it has been ground into flour. Yeast is then added, and the dough baked in the ordinary manner. The proportions in the mixture are about 10 parts by weight of salicylate of soda, 3 of boric acid, and 4 of borax. —E. E. B.

Novel Composition for Preserving Organic Substances and Method of Using the Same. P. Grosfils, Verviers, Belgium. Eng. Pat. 2235, February 12, 1887. 6*d.*

The antiseptic mixture to which is given the name "Lactacidine" is composed of lactic acid and salicylic acid, to which various other materials, such as sugar, glycerine, &c., may be added. For the preservation of butter an aqueous solution containing 2·65 per cent. lactic acid and 0·35 per cent. salicylic acid is preferred, and the antiseptic may be removed from the butter before use by washing it with water.—E. E. B.

The Manufacture of an Improved Carbon for Filtering and Decolorising Purposes. G. F. Marshall, London. Eng. Pat. 2983, February 25, 1887. 4*d.*

Carded asbestos is steeped for about 48 hours in lime-water, well washed, and dried in a muffle furnace. It is next mixed with about one-fourth of its weight of powdered coal pitch and packed in crucibles in a muffle kiln, where it is raised to a white heat. When cold it is withdrawn, sieved, and sorted into the various grades, and is then ready for use. Instead of the preliminary soaking in lime to remove the dress, the asbestos may be simply boiled in water, and a roasting in an open kiln may be substituted for the muffle drying. Moreover, instead of placing the pitch in the crucibles with the asbestos, this last may be packed in crucibles with perforated bottoms, fumes of pitch being allowed to pass through these and act upon the contents.—A. R. D.

XIX.—PAPER, PASTEBOARD, Etc.

Sizing Paper with Rosin. James William Wyatt. Proc. Inst. Civil Eng., 1887. (Paper No. 2285.)

This paper contains a very full account of the preparation of the different kinds of rosin-size; also an explanation of the reactions which take place when rosin is dissolved in soda and when it is precipitated from its solution by means of alum or sulphate of alumina. The author gives the quantities of material necessary for preparing the rosin soap and the quantities of alum required for precipitation. He also gives useful hints for the prevention of "frothing" on the machine.—E. J. B.

Process for the Manufacture of Cellulose. Charles Kellner Podgora, Austria. Eng Pat. 15,942. 8*d.*

This process consists in heating wood or other fibrous material in an apparatus consisting of two separate cylindrical vessels connected together by pipes. The vessels are provided with steam coils, whereby they may be heated to a temperature of 126° C. They are filled with a solution of common salt, or other chloride, and a current of electricity is passed into separate parts of the connecting pipe, which is so arranged that the products of the electrolysis, chlorine and caustic soda, pass alone into the two vessels. After acting upon the material for some time the solutions are conducted into a small mixing vessel, where the chloride is reformed. The direction of the current is then changed, so that that vessel into which chlorine formerly passed is now treated with caustic soda solution, and *vice versâ*. By continuing this alternate action for some time the wood is completely reduced to pure cellulose.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Active Principle of the Quebracho Bark. Huchard. Arch. de Pharm. **10**, 453.

Quebracho bark contains, beyond quebrachol, the alkaloids aspidospermin, quebrachin, hypoquebrachin, aspidospermatin, and aspidosamin. These alkaloids all act as febrifuges, especially quebrachin, which reduces the temperature of the body 5°—7° in 15 minutes. Aspidospermin in doses of 0·05 to 0·15 gr. acts well in cases of asthma. All are poisonous, especially quebrachin and hypoquebrachin.— C. A. K.

Examination of the Extract of Buck-Bean. A. Kremel. Pharm. Post. **20**, 721.

The bitter principle of the buck-bean, "menyanthin," is obtained by digesting the aqueous extract with animal charcoal and extracting it from the latter with alcohol after washing with water, or by shaking the aqueous extract with chloroform. The extract is characterised by the considerable amount of manganese contained in the ash, which often appears of a blue-green colour; by adding dilute acetic acid cautiously to a solution of the ash it becomes red, owing to the formation of permanganic acid.—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Improvements in Printing Artificial Skies by Photography on to Photographs. G. J. Sershall, Birmingham. Eng. Pat. 2012, February 9, 1887. 4*d.*

A drawing of a sky is made on a transparent substance. A photographic negative of a landscape being taken, the part representing the sky is rendered opaque. A print of this is taken on sensitised paper, and the blank portion corresponding with the sky in the negative is carefully cut off. The part containing the landscape is now exposed to daylight and allowed to become black, and may thus be used as a mask to a photographic print of the same negative when printing the artificial sky by means of the above-mentioned transparency.—J. W. L.

Improvements relating to Photo-chemical Printing. W. Willis, Bromley. Eng. Pat. 16,003, November 21, 1887. 6*d.*

In this improved method of using the platinum bath, salts of lead or mercury are used instead of phosphates for rendering the ferrous image insoluble. The sensitised paper is coated in some cases with a solution containing 60 grains ferric oxalate with 1 grain plumbic chloride and 1 grain mercuric chloride in 1 fluid ounce of water; or if the lead salt be omitted two or more grains mercuric chloride are employed. The developing solution in this case is an aqueous solution containing 90 grains potassium oxalate and 9 grains "potassic-chloroplatinite" per fluid ounce, or 60 grains ammonium tartrate and 8 grains "ammonic-chloroplatinite." Or the salts of lead or mercury may be used in the developing bath instead of on the paper. In this case the paper is coated with a solution containing 60 grains ferric oxalate per fluid ounce, and the developing bath contains, in addition to the first named, lead acetate, added until a precipitate begins to form, or mercuric chloride, 5 grains to each fluid ounce.—J. W. L.

XXIII.—ANALYTICAL CHEMISTRY.

Testing Sodium Bicarbonate. Pharm. Centr. H. N. F. **8**, 569.

The author considers the phenolphthaleïn test for the presence of normal sodium carbonate in the bicarbonate to be unsatisfactory, for in 15 samples examined not one failed to give a red coloration. According to the experience of a manufacturer, the least exposure to the air, especially if it be damp or warm, suffices to cause the loss of traces of carbon dioxide, and in such cases the sample will give a distinct red coloration with phenolphthaleïn.—C. A. K.

Analysis of the Mineral Waters on the Peninsula of Methana. A. K. Dambergis. Ber. **20**, 3328.

The springs are situated near the village of Wromolimni, about 3 miles from the island of Poros, and 27 from the town of Piræus. The water has temperature varying from 26·4 – 31°, and sp. gr. of from 1·02869—1·02882. Gases in variable quantities are evolved from the springs, consisting for the most part of carbon dioxide and sulphuretted hydrogen.

The following is an analysis of the water :—

	In 10,000 parts.
Sodium chloride	297·630
Potassium chloride	6·960
Magnesium chloride	36·948
Magnesium bromide	0·584
Calcium sulphate	21·357
Magnesium sulphate	18·486
Calcium carbonate	4·600
Magnesium carbonate	2·250
Oxide of iron	0·038
Alumina	0·019
Silica	0·485
Organic matter	0·042
Total solid residue	389·399
Carbonic acid (as bicarbonate)	3·200
Carbonic acid (free)	7·218
Sulphuretted hydrogen	0·109
Total	399·926

There were also traces of ammonia, nitric acid, phosphoric acid, iodine, and fluorine.—G. D.

The Analysis of Antimony-Sodium Fluoride. G. Stein. Chem. Zeit. **11**, 1298.

Antimony-Sodium fluoride with 66 per cent. of antimony oxide, which threatens to displace cream of tartar in dyeing and calico-printing, is tested as follows :—1. Qualitatively. Ferrocyanide of potassium must show the absence of iron by producing no blue colouration. Barium chloride, acidified with hydrochloric acid, must give no precipitate, thus showing the salt free from sulphuric acid. 2. Quantitatively. 0·5 gramme of the fluoride is dissolved in hot water. A drop of phenolphthaleïn solution is added and ammonia until the reaction is alkaline. A precipitate of antimony oxide is formed, which is washed by decantation and filtered through a dried filter of known weight. The latter is redried at 110° C., and weighed. Since the product of commerce is nearly chemically pure, it should contain about 66 per cent. Sb_2O_3.—S. H.

The Examination of Bone-Powder. E. Heiden. Chem. Zeit. **11**, 1328.

The bone-powders of commerce are not always products of manufacture solely derived from the grinding of bones, but they not unfrequently contain several other substances. This is due to the fact that genuine powders contain from 3 to 3½ per cent. of nitrogen and 20 to 22 per cent. of phosphoric acid, whereas powders derived from bones, deprived of their gelatin, contain 1½ to 2 per cent. of nitrogen and 28 to 30 per cent. of phosphoric acid. It therefore becomes necessary to increase the nitrogen and to diminish the phosphoric acid, and the former object is attained by the addition of horn, blood, leather, and so forth, while the latter object is effected by adding gypsum or sand. The nitrogen in these substances is of less manurial value than that contained in genuine bone-powder, and Kroeker has found a method of determining the amount of the less valuable nitrogen. He discovered that these spurious additions are specifically lighter than bone-powder, they float on chloroform, whereas bone-powder sinks to the bottom. The latter contains at the very most 5 per cent. of matter light enough to float on chloroform, and this figure may be taken as the extreme limit for a genuine powder. If the floating matter be separated, weighed, and tested for nitrogen, the amount of the addition can be calculated.—S. H.

The Absorption of Carbon Monoxide by Cuprous Chloride. H. Drebschmidt. Ber. **20**, 2752—2755.

Hempel has recently stated that when cuprous chloride is employed for the absorption of carbon monoxide, an increase of volume often occurs, and this he attributes to the expulsion of ethylene from the solution by carbon monoxide. The author finds that this explanation is incorrect, and that the phenomenon is due to the liberation of carbon monoxide which has been absorbed in a previous operation. Carbon monoxide, as a rule, is not completely taken up by a cuprous chloride solution, the amount which remains unabsorbed depending on the quantity of that gas already contained in the solution and on the volume of the non-absorbable gases. Complete absorption can be attained only by using a solution which has not been previously employed.—F. S. K.

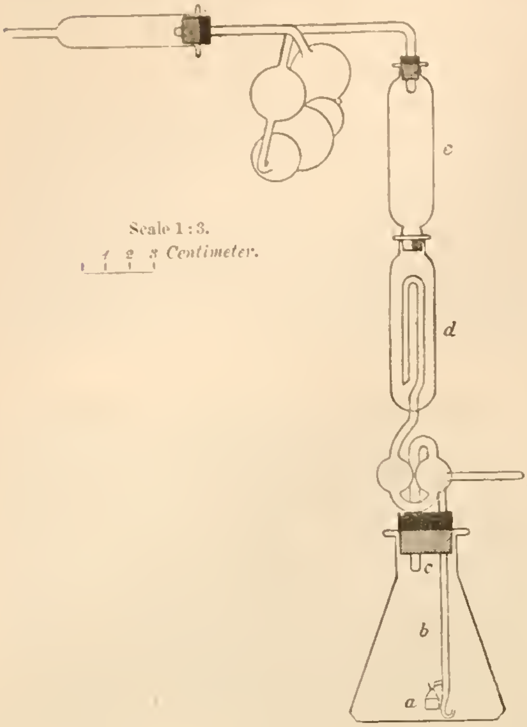
The Analysis of German Silver. Felix Oettel. Zeits. Anal. Chem. **27**, 15.

The chief difficulties in the analysis of this alloy are: the separation of the zinc from copper and nickel, and the separation of nickel from manganese. It was found that zinc and copper cannot be separated by one precipitation by sulphuretted hydrogen in a nitric acid solution, but that in a sulphuric acid solution the separation is complete; the alloy is dissolved in nitric acid and the tin weighed as dioxide, the filtrate is evaporated down with sulphuric acid (15—20 drops for every 0·5 grm. alloy), and the lead weighed as sulphate; 2 cc. hydrochloric acid are added to the solution and sulphuretted hydrogen passed, the copper being estimated as cuprous sulphide. The filtrate is neutralised, a few drops of sodium acetate added, and the zinc precipitated and weighed as sulphide; the filtrate from this contains Ni, Co, Fe, and generally traces of Mn. The iron is estimated as oxide after two precipitations with ammonia, the nickel and cobalt obtained together by electrolysis, and the manganese, which is precipitated at the same time in brown flocks, is weighed as Mn_3O_4. The copper may also be estimated by electrolysis, the lead being obtained at the same time in the form of dioxide; in this case a fresh sample is taken for the estimation of the remaining metals, which, after removing the copper by electrolysis in a sulphuric acid solution, using two platinum electrodes, are determined as above. Two analyses gave the following results:—

	Per Cent.	Per Cent.
Cu	61·22	57·53
Ni+Co	12·77	15·57
Zn	24·41	25·46
Pb	0·16	0·42
Sn	..	0·25
Fe	1·54	0·66
Mn	Trace	0·14
	100·10	100·03

—F. S. K.

A New Apparatus for the Direct Estimation of Carbonic Acid. Oscar Ostersetzer. Zeits. Anal. Chem. **27**, 27.



The flask A is of not more than 70 cc. capacity, containing very dilute hydrochloric acid, and fitted with a two-holed caoutchouc stopper; *g*, *c*, *b* is a glass tube, the diameter of which diminishes slightly from *c* to *b*, so that it can be moved up and down, on the inner side carrying a hook from which a small cup-shaped vessel *a*, containing the substance, is suspended; *d* is a Geissler's tube, and is $\frac{2}{3}$ filled with sulphuric acid; it is connected below with a Welter's safety tube, and above with *e*, which contains pumice, impregnated with copper sulphate, in order to absorb the hydrochloric acid fumes; the purified carbonic acid passes into a Liebig's potash bulb, which is connected with a tube filled with soda lime.

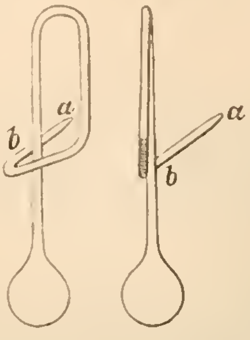
The substance is weighed in the vessel *a*, which is then hung on the hook, while the tube *g*, *c*, *b* is drawn up; the potash bulb and soda lime tube, after weighing, are placed in position; *f* is connected with an aspirator, and *g* with a wash-bottle containing potash; *g*, *c*, *b* is then pressed down to bring the substance in the acid, and a current of air drawn through the apparatus. Gentle heat is applied when the substance has all dissolved, and air is drawn through the apparatus for ten minutes after the reaction is at an end.

The carbonic acid is estimated by direct weighing. A series of experiments yielded very satisfactorily results.—F. S. K.

Kjeldahl's Method of Estimating Nitrogen. F. W. Dafert. Landw. Versuchsstation, 1887, **34**, 311.

The author has estimated the nitrogen in various organic compounds by Kreusler's modification of Kjeldahl's method. For the analysis of a volatile liquid it is weighed in a sealed bulb having the form shown in the figure; the point *a* is then broken off, and the bulb placed in the acid mixture so that *b* dips under the surface. When heat is applied gradually, the contents distil very slowly into the acid, and are acted upon as completely as possible.

From results obtained in a number of experiments, the author states that—(1) Kjeldahl's method in its original form is not suitable for the estimation of nitrogen in all compounds; (2) ammonia is formed by the action of concentrated sulphuric acid and potassium permanganate on



all nitrogenous substances at higher temperatures; (3) that the compounds experimented upon show an unexpected difference in the readiness with which they are converted into ammonium compounds by Kjeldahl's method, and by various reagents.—F. S. K.

Relations between the Composition of Organic Dye-stuffs and their Absorption Spectra. H. W. Vogel. Sitzungsber Kgl. Preuss Akad Wissensch. **1887**, 341.

The dye-stuffs examined by the author were: diazobenzene, *o*-diazotoluene, and *p*-diazotoluene, each combined with β-naphthol-sulphonic acid B, β-naphthol-sulphonic acid S, and β-naphthol-disulphonic acid R. The dye-stuffs are readily soluble in sulphuric acid, less readily in alcohol, and give, on sufficient dilution, similar spectra, consisting of two bands in the green. These are more distinct with the sulphuric acid than with the alcoholic solution. The examination of the former showed:—1. By the substitution of a methyl group in diazobenzene the bands are displaced towards the red, the change being more marked if the methyl stands in the ortho, than in the para position. 2. This displacement of the bands for the band β amounts to 10 mm. (MM. = $\frac{1}{1000000}$ mm.) and 14 mm. if the methyl has the ortho or para position respectively. 3. The substitution of β-naphthol-sulphonic acid S or β-naphthol-disulphonic acid R for β-naphthol-sulphonic acid B is also accompanied by a shifting of the bands, amounting to 4·5 mm. and 6 mm. 4. When the methyl group enters into diazobenzene the space between the bands becomes clearer, and the bands themselves more equal in intensity and width.—B.

Testing Natural Wines for Nitric Acid. E. Pollak. Chem. Zeit. **11**, 1465.

A number of samples of Rhenish wines grown and fermented by the author were examined by the diphenylamine test for nitric acid. If no blue colouration developed within 10 minutes, they were considered free from nitric acid, and this was found to be the case with 22 out of 25 wines, the remaining three showing faint traces. Pure wines are, therefore, practically free from nitric acid.—C. A. K.

Nylander's Test of Urine for Sugar. Centralbt. f. Medic. Wissensch. **25**, 678.

Nylander's solution consists of 2 grms. of bismuth subnitrate (magist. bismuthi), 4 grms. of potassium-sodium tartrate dissolved in 100 grms. of an 8 per cent. sodium hydrate solution. The mixture is allowed to stand for 24 hours, and then filtered through glass-wool. It does not change for many years. One part of the reagent is added to 10 parts of the urine to be tested, and boiled for a short time, when, in the presence of sugar, a small white precipitate is formed. A large amount of albumen (1 to 2 per cent.) present gives a black precipitate and conceals the sugar reactions.—S. H.

Remarks on the Examination of Chloroform. A. Jolles. Chem. Zeit. 11, 1394.

Loevy repeated Jolles' experiments, and confirms that a potassium manganate solution is very suitable for readily ascertaining the purity of chloroform. Alcohol, ethylene, aldehyde, and other oxidisable substances rapidly reduce the manganate to a lower oxide of manganese. But in Loevy's opinion, Jolles does not bring forward sufficient evidence to show that this lower oxide is an alkaline manganite. Jolles upholds his opinion in this article, and produces some further analytical and experimental proofs.
—S. H.

Detection of Cotton-seed Oil in Olive Oil. E. Bechi. Chem. Zeit. 11, 1328.

10 cc. of the oil to be examined are shaken with 1 cc. of the reagent I. and 10 cc. of the reagent II. The mixture is then heated at 100° C. for a quarter of an hour. If the liquid assumes a brown colour the oil in question contains at least 15 per cent. of cotton-seed oil. With a smaller addition of cotton-seed oil the reaction becomes uncertain.

Reagent I.

	Grms.
Silver nitrate	1
Alcohol	200
Ether	40
Nitric acid	0·1

Reagent II.

	Grms.
Amyl alcohol	100
Colza-oil	15

—S. H.

The Denaturation of Alcohol. G. Krämer and L. Loewenherz. Chem. Zeit. 11, 1395.

The liquid recently introduced by the German Government for the denaturation of alcohol, consists of two parts of wood spirit and one part of pyridine bases. The following are the official tests for these two substances.

I. Examination of wood spirit. 1. *Colour.* The colour must not be darker than that of a light hock. 2. *Specific gravity.* The specific gravity must be taken with a thermo-hydrometer, adjusted by Government. 3. *Boiling point.* 100 cc. of the spirit are distilled in a small metal flask, provided at the top with a small globe, which is connected with a Liebig condenser. A normal thermometer is fitted in the globe and the flask is then moderately heated, so that the distillation proceeds drop by drop. The distillate is caught in a graduated cylinder, and if the thermometer shows 75° C., at least 90 cc. must have distilled. 4. *Miscibility with water.* If 20 cc. of the spirit be mixed with 40 cc. of water, no oily drops must be separated, even after long standing. 5. *Test for acetone.* If 20 cc. of the spirit be shaken with 40 cc. of sodium hydrate solution (1·3 sp. gr.) at least 4 cc. of the spirit should be separated after some standing. 6. *Capacity for absorbing bromine.* 100 cc. of a solution of potassium bromide and bromate, prepared in the manner described below, are treated with 20 cc. of dilute sulphuric acid. This mixture represents a solution of 0·703 grm. Br. From a burette, divided in 0·1 cc., wood spirit is allowed to drop into the bromine solution, shaking all the time, until the colour of the bromine has disappeared. Not less than 7·5 cc. and not more than 10 cc. should be required. A glass-stoppered bottle is then filled with freshly-calcined pieces of charcoal of the size of a pea, and a mixture of equal parts of wood spirit and water is allowed to stand in contact with the charcoal for 12 hours. After this time at least 30 cc. of the filtrate should be sufficient for absorbing 0·703 gr. Br. The tests with bromine must be made in full daylight. To prepare the bromine solution, pure potassium bromide and bromate are dried at 100° C. for two hours, and allowed to cool in the desiccator: 2·447 grms. of the bromate and 8·719 grms. of the bromide are then dissolved in 1 litre of water. The dilute sulphuric acid is prepared by mixing one volume of strong acid with three volumes of water.

Examination of the pyridine bases. 1. *Colour.* The same as that of the wood spirit, but even a slightly darker colour is admissible. 2. *Behaviour towards cadmium chloride.* 20 cc. of a solution of 1 cc. of the pyridine bases in 250 cc. of water are treated with a 5 per cent. aqueous solution of cadmium chloride; a distinct turbidity should appear in a few moments. 3. *Boiling point.* The pyridine bases are distilled under the same conditions as the wood spirit, and 90 per cent. should have distilled when the thermometer stands at 140° c. 4. *Miscibility with water.* The same as wood spirit. 5. *Percentage of water.* If 20 cc. of the pyridine bases are shaken with 20 cc. of a sodium hydrate solution (1·4 sp. gr.) at least 18 cc. of the bases should separate out after standing some time. 6. *Volatility.* Four drops of the bases heated on a platinum foil in the flame of a Bunsen burner, should burn with a sooty flame and leave no residue.—S. H.

A Qualitative and Quantitative Estimation of Rosin-Oil in Mineral Lubricating Oils. L. Storch. Ber. d. österr. Ges. z. Förd d. chem. Ind. 9, 93.

A solution of rosin-oil in acetic anhydride assumes, according to Liebermann, a red colour on the addition of a little concentrated sulphuric acid. Even if rosin-oil has been repeatedly distilled and treated with alkali, Liebermann's reaction can be obtained, and this fact is made use of for detecting rosin-oil in mineral oils. 1 to 2 cc. of mineral oil is shaken with 1 cc. of acetic anhydride, and then allowed to settle. The acetic anhydride is pipetted off, and on adding one drop of sulphuric acid to it, a violet-red colour is produced, if the mineral oil contained any rosin-oil. This reaction must not be applied for the detection of rosin-oil in fat oils, as certain vegetable and animal oils give a similar colour reaction with the same reagents. For the quantitative determination of rosin-oil in mineral oils, which contain no fat oils, about 10 grms. of the mineral oil are extracted with 50 grms. of 96 per cent. alcohol. The solution, after cooling, is put into a tared Erlenmeyer beaker and gently evaporated on the water-bath. The residue is cooled and weighed (Residue A.). It is again dissolved in 96 per cent. alcohol, of which 10 times the weight of Residue A. is taken. The solution is poured into another tared beaker and gently evaporated on the water-bath, weighing the residue after cooling (Residue B.). This residue will now only contain traces of the mineral oil. Having regard to the different weights of the residues and the different quantities of alcohol used, the amount of rosin-oil present can be calculated. An example will best illustrate this. 11·1915 grms. of lubricating oil were treated with 50 grms. of 96 per cent. alcohol. Residue A. weighed 1·5136 grms. = 13·5 per cent. It was digested with 15 grms. of 96 per cent. alcohol. Residue B. weighed 1·1548 grms. = 10·32 per cent.

50 grms. of alcohol dissolved 1·5136 grms.
15·5 „ „ „ 1·1548 „

Consequently 34·5 grms. of alcohol dissolved 0·3588 grms. of mineral oil. Or 15·5 grms. of alcohol dissolved 0·1612 grms., which must be subtracted from B. Weight B. corr. = 0·9936 = 8·9 per cent. The percentage of rosin-oil in the mineral oil therefore lies between 8·9 per cent. and 10·32 per cent., whereas in fact it amounted to 10 per cent.—S. H.

On Hübl's Method for Testing Oils. E. Dieterich. Pharm. C. H. 8, 510.

In testing a large number of samples of olive oil for freedom from admixtures of other oils, the author took the opportunity of examining Hübl's iodine method as to its reliability and accuracy. He asks the following two questions:—1. Is the amount of iodine absorbed the same with a fresh or an old iodine solution, provided the same oil be taken? 2. Is the resulting "iodine-figure" independent of a smaller or greater excess of iodine used for the test? From an extensive table of results the following conclusions are drawn:—1. The change of Hübl's iodine solution is so easily controlled as to form no hindrance to the application of the method. 2. The "iodine-figure" obtained expresses only the amount of the iodine combined with the oil, regardless of the presence of a greater or smaller excess of iodine. Linseed oil forms an exception, as the "iodine-figure" is too high with concentrated solutions and too low with weak solutions. Hübl's method is, especially for olive oil, the most accurate test known at present.—S. H.

Notes on the Titration of the Pyridine Bases.

K. E. Schulze. Ber. **20**, 3391.

To an aqueous solution of the bases 1 cc. of a 5 per cent. solution of ferric chloride is added when ferric hydrate is precipitated. Normal sulphuric is now carefully added until the precipitate redissolves.

Five cc. pure pyridine were dissolved in 100 cc. of water, and to 25 cc. of this solution 1 cc. of the iron solution was added. Normal sulphuric was next run in until the precipitate disappeared. The first experiment required 15·5 cc. of acid, the second 15·4 cc., and the third 15·5 cc. The calculated amount was 15·5 cc.—G. D.

Modification of the Benedikt-Zsigmondy Method for the Determination of Glycerol in Fats and in Aqueous Solutions. A. Jolles. Zeits. Nahrungsmittel Untersuch u. Hygiène, 1887, **1**, 221.

The Benedikt-Zsigmondy method for the determination of glycerol (this Journal, 1885, 610) which consists in oxidising with an alkaline solution of potassium permanganate and determining the resulting oxalic acid is accurate in the case of aqueous solutions of glycerol, but is less so with the saponification products of oils; the ethyl alcohol contained in the methyl alcohol used in the saponification itself yields considerable quantities of oxalic acid. (*See* A. H. Allen, this Journal, 1886, p. 70.) The author's modification consists in substituting potassium manganate for the permanganate. The oxidation takes place quickly and regularly, while at the ordinary temperature potassium manganate cannot oxidise ethyl alcohol further than aldehyde.

To determine glycerol in aqueous solutions (which should not contain more than 0·3 gr. glycerol), 5 gr. caustic potash is added to the solution, which is then treated at the ordinary temperature with an alkaline solution of potassium manganate (3—4 gr. together with 5 gr. caustic potash in 1 litre of water). The solution remains of a greenish tint when the oxidation is ended; a trace of sulphurous acid serves to reduce any slight excess of the manganate. The oxalic acid is then determined as the calcium salt. In the case of fats about 3 gr. are saponified with alcoholic potash, diluted to 200 cc., the alcohol evaporated off, the fatty acids precipitated with dilute hydrochloric acid, filtered off, well washed, and the glycerol determined in the filtrate after the addition of an excess of alkali, as above. The soluble fatty acids contained in the filtrate do not affect the result.—C. A. K.

Analyses of Honey containing Dextrose. C. Amthor, Chem. Zeit. Rep. **11**, 289.

Three samples of pure honey examined by the author were found to contain from 5 per cent. to 7 per cent. of dextrines. These possessed a specific rotatory power two-and-a-half times that of grape-sugar. They were precipitated by strong alcohol in concentrated solutions, but not in dilute.
—C. A. K.

The Qualitative and Quantitative Determination of Rosin Oil in Mineral Lubricating Oil. L. Storch. Ber. de öst. Gesellsch. z. Förd. d. Chem. Ind., 1887, **9**, 93.

Led by the researches of Liebermann, Perrenoud, and Wallach, the author proposes to utilise a colour reaction of the rosin acids which are present in rosin oil as a test for the oil itself. 1 or 2 cc. of the sample to be tested are shaken with 1 cc. of anhydrous acetic acid and gently warmed; after cooling, the acetic acid solution is removed by a pipette, and a drop of concentrated sulphuric acid is added to it, whereupon a fine red colour is immediately produced if rosin oil is present. Owing to the fact that many oils contain cholesterin, which also gives a colour reaction by this method, it cannot be used to detect rosin oil in fatty oils or in fats. After criticising the methods at present in use, Storch proposes a modification of the alcohol extraction method as suitable for the assay of the mineral oil for rosin oil. Preliminary experiments showed that of the usual solvents, acetic ether, dry and free from alcohol, is practically the only other extracting material that may be employed, the remainder dissolving too large a quantity of mineral oil. Absolute alcohol mixes in all proportions with rosin oil, acetic ether in the ratio of oil : ether = 1:0·5. Next in regard to evaporation of the oil, it was found that an alcoholic solution evaporated in an open dish over a water-bath showed a loss of 14 per cent. of oil; but by substituting a beaker, the loss was very small, and by using an Erlenmeyer's flask it was imperceptible. Again it was found that the solubility of rosin oil in alcohol of 90 per cent. (by volume) varied from 2·6 to 4 per cent., while in 96 per cent. spirit it ranged from 11·3 to 16·2 per cent.; the latter was therefore used in the assay.

The analysis is conducted as follows: 10 to 15 grm. of the mineral oil, which has been found by the colour-test to contain rosin oil, but which must be free from fatty oils, is gently warmed in a flask with about five times its volume of 96 per cent. alcohol, shaken, and allowed to cool. These 5 vols. of alcohol suffice to dissolve out all rosin oil, even when it occurs to the extent of 50 per cent. The alcoholic solution is then transferred to a tared Erlenmeyer's flask, about 7 cm. in height; the mineral oil in the first flask is washed, without shaking, by a few cc. of fresh spirit, which are then added to the first quantity. The Erlenmeyer flask is now gently boiled on a water-bath, where it is surrounded by a beaker to prevent too rapid condensation, and evaporation is continued until the residue in the flask is free from bubbles; it is then cooled and weighed. The weight obtained will be that of the rosin oil *plus* that of the petroleum dissolved in the alcohol used. To make correction for this, the residue is next treated with just enough 96 per cent. spirit (10 times its weight) to dissolve it were it all resin oil; this solution is then treated as the first. The second residue will still retain a small quantity of petroleum (namely, the amount soluble in the smaller volumes of alcohol used), but will weigh less than the first, by the weight of mineral oil dissolved in the *difference between the two volumes of spirit employed.* Knowing the loss of weight in the second weighing, and the difference between the volumes of alcohol used, the solubility of the petroleum in the latter can be found, and hence the amount dissolved in the proportion of spirit required for the correcting experiment; the weight of the latter must then be deducted from that of the second residue, and should thus give the true weight of rosin oil. The actual quantity lies between the two weights of the second residue, viz., before and after the above final correction. If a rosin oil of lower solubility be present, which is highly improbable, a larger quantity of alcohol may be necessary.—W. G. M.

An Improvement on Goldenberg's Method of Analysis of Substances containing Tartaric Acid. N. v. Lorenz. Zeits. Anal. Chem. **27**, 8.

In the analysis of substances containing tartaric acid by this method, it was found (1), that neutral potassium tartrate, even in presence of a slight excess of acetic acid, is only incompletely converted into the acid salt and potassium acetate; (2), varying quantities of potassium acetate are without influence on the results; (3), the solution must be boiled with potassium carbonate over the free flame for 20 minutes (as Kaemmer has already shown); (4), when the acid potassium tartrate is allowed only a quarter of an hour to crystallise out, 0·30 per cent. higher results are obtained than when 24 hours are allowed; (5), when the acetic acid and alcoholic solution is stirred for two minutes, the results are 0·2 per cent. higher than when the solutions are simply mixed.

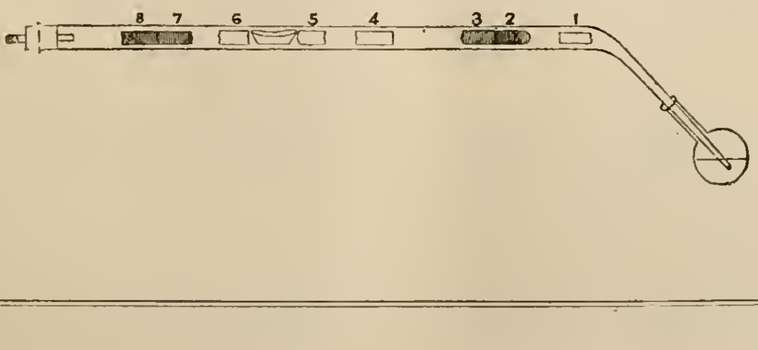
Goldenberg's method, modified as follows, is strongly recommended:—15 grms. of tartar as finely divided as possible are mixed with 250 cc. of water and 6 grms. of dry potassium carbonate, and boiled for 20 minutes over the free flame in a porcelain dish of at least 700 cc. capacity, the mixture being stirred and fresh water added to replace that which evaporates; when cold, the whole is poured into a 500 cc. flask and filled to the mark, well shaken and filtered through a folded filter into a dry glass; 100 cc. of the filtrate are evaporated in a porcelain dish of 700 cc. capacity as long as no salt separates from the warm solution; 5 cc. of acetic acid are then added, and the whole agitated until all the carbonic acid has escaped; after five minutes 100 cc. of absolute alcohol are added, and the mixture stirred for about two minutes, allowed to stand a quarter of an hour, and filtered through a 50 cc. funnel; the dish is washed quickly with absolute alcohol until the funnel is full (about 50 cc. of alcohol therefore being used), and then twice with 25 cc. of alcohol; the filter and contents are then replaced in the dish, about 200 cc. of water added and heated to boiling; the solution is titrated with caustic soda, which must not be more than 0·3 of the normal strength, until the litmus turns dark red, it is boiled for five minutes and the titration completed. The quality of the litmus employed is of the greatest importance. Since 0·0177 grms. of acid tartrate remain dissolved in the 200 cc. of alcohol employed, the actual percentage is obtained by adding 0·59 per cent. to the results obtained.—F. S. K.

The Estimation of Sulphur, Chlorine, Bromine, and Iodine in Organic Compounds. Peter Klason. Ber. 20, 3065—3066.

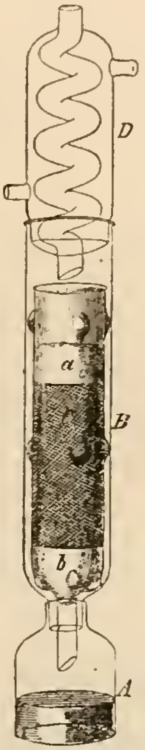
THE analysis is made in an ordinary combustion tube, about 15 mm. internal diameter and drawn out as shown in the figure. 2, 3, 7, 8, are little rolls of platinum gauze, 5 cm. long and 1 cm. in diameter, filled with beads which are saturated with fuming nitric acid. 1, 4, 5, 6, are rolls of platinum gauze; 5, 6, are not absolutely necessary, but serve to regulate the combustion. The flask contains a solution of silver nitrate when estimating the halogens, and water when analysing sulphur compounds.

When the substance and rolls are in position, 1, 4 are raised to a dull red heat, and then the parts of the tube between 1 and 2, 6 and 7, warmed so that nitrous fumes are evolved. Air is then slowly forced through the apparatus, and the substance gradually heated. The escaping fumes must be always red. Finally, the acid remaining in the rolls (and the sulphuric acid formed in sulphur estimations) is driven over into the receiver. After cooling, the rolls and tube are washed with water, the washings being added to the contents of the receiver.

In the estimation of chlorine and bromine, these elements are completely reduced by the nitrous acid, the hydrochloric or hydrobromic acid formed being absorbed by the silver nitrate. In iodine determinations the halogen is obtained in the free state deposited chiefly on the drawn-out end of the tube. It is brought into solution, and estimated as silver iodide.—F. S. K.



Apparatus for Extracting Fats. O. Foerster. Zeits. Anal. Chem. 27, 30.



A is a glass vessel of about 50—70 cc. capacity, in which the ether (or other solvent) is heated, and the fat afterwards weighed.

B is a glass tube, about 30 mm. in diameter and 190 mm. long, and fitted tightly into A.

C is a filter tube, about 150 mm. long and 22 mm. in diameter (reduced at c to 4—5 mm.); the walls of C are thickened in places to allow the ether or other vapour free play; it contains the substance to be extracted between two plugs of cotton wool (*a*, *b*).

D is a spiral condenser about 146 mm. long, and is fitted tightly into B.

The ether drops from the condenser on to the substance, which, being heated by the ether vapour, is completely freed from fat in a short time and with a small quantity of ether.—F. S. K.

New Books.

Sur la Constitution de la Naphtaline et de ses Dérivés, par F. Reverdin and E. Noelting. Extrait du Bulletin de la Société Industrielle de Mulhouse, Décembre, 1887. Mulhouse, Veuve Bader et Cie., Imprimeurs-Éditeurs. 1888.
London: H. Grevel & Co., 33, King Street, Covent Garden.

Paper covered 8vo Volume, price 6*s*., containing 76 pages of subject matter. A large portion of the volume, however, is composed of elaborately and most carefully arranged sheets of tabulated matter, giving altogether a complete history, with all the literature, of the naphthaline compounds and derivatives, classified in such a manner as to afford every kind of information as to properties and isomeric relationships that may be required by the research chemist or technologist, with the least possible expenditure of time for search, comparison, &c.

Modern Theories of Chemistry. By Lothar Meyer, Ph.D. Professor of Chemistry in the University of Tübingen. Translated from the German, of the 5th Edition, by Professor P. P. Bedson, D.Sc., and Professor W. Carleton Williams, B.Sc., &c. London: Longmans, Green, and Co. New York: 15, East 16th Street. 1888.

8vo volume bound in cloth, price 18*s*., containing Translators' preface, in which evidence is given of the high esteem in which the work is held in Germany and for the ground for the conviction that a reproduction in this translation, as close as possible of the original, should be given. The Author's preface to the fourth edition. Introduction to the first edition, Table of Contents, 586 pages of subject matter, two Addenda relating to Victor Meyer and J. Mensching's investigation of the Behaviour of Phosphorus, Arsenic, and Antimony at a white heat, and to Winkler's researches on Germanium, and a chart containing Interpolation Curves of Atomic Volumes, &c.

The work is divided into three parts, subdivided as follows:—

Part I. The Atoms.—1. The Atomic Hypothesis. 2. The Specific Gravity of Gases as an Aid to determine Atomic Weights. 3. Determination of Atomic Weights by the Aid of the Specific Heat in the Solid State. 4. Determination of Atomic Weights by Aid of Isomorphism. 5. Chemical Atoms.

Part II.—Statics of the Atoms.—6. Forms of Combinations of the Atoms; Types. 7. Law of Atomic Linking. 8. Molecular Weight and Atomic Linking of those Bodies to which Avogadro's Law cannot be applied. 9. The Chemical Value, Valency, or the Capacity of Saturation of the Atoms.

Part III. The Dynamics of the Atoms.—10. Chemical Change and its Causes. 11. Chemical Change produced by Mechanical Disturbance. 12. Heat as Cause and Effect of Chemical Change. 13. Influence of Mass in Chemical Action. 14. Chemical Action of Light. 15. Chemical Change as a Cause and Effect of Electricity; Electrolysis. 16. Stability of Chemical Compounds. 17. Conclusion.

The Mineral Resources of the United States. Calendar year 1886. By David T. Day, Chief of the Division of Mining Statistics and Technology, Washington. Government Printing Office, 1887. (Department of the Interior, United States Geological Survey.)

8vo volume, bound in cloth, commencing with a Notice, stating that this volume is the fourth of a series which began in 1882, and that its price is 50 cents. It contains Table of Contents, Introduction, and 790 pages of Subject-matter, and terminates with an Alphabetical Index. The matter treated of is as follows:—Iron: The American iron trade in 1886. The American iron trade from its beginning in 1619 to 1886. Southern resources for the manufacture of iron and steel. The iron ores east of the Mississippi river. Gold and Silver, Copper, Lead, Zinc, Quicksilver, Nickel, Cobalt, Chromium, Manganese, Tin, Tungsten, Aluminium, Platinum and Iridium, Coal, Coke, Petroleum, Natural Gas. Structural Materials: The building industry in general, Building stone, Slate, Cement, Lime, Brick. Abrasive Materials: Buhrstones, Grindstones, Corundum, Infusorial earth, Novaculite, Precious stones. Fertilizers: Phosphate rock, the fertilizer trade in North Carolina in 1886, Marls, Gypsum, Manufactured fertilizers, Salt, Bromine, Sulphur, Tellurium, Pyrites, Phosphorus, Borax, Alum, Bluestone, Copperas, Graphite, Lithographic stone, Fluorspar, Magnesium, Strontium, Felspar, Mineral paints, Mineral waters, Mining law.

The Pocket Book of Mensuration and Gauging, &c., for Revenue Officers, Brewers, Spirit Merchants, &c. By J. B. Mant, Inland Revenue. London: Crosby, Lockwood, and Son, 7, Stationer's Hall Court, Ludgate Hill. 1888.

Small pocket book form, measuring 5¼ by 3¾ ins., gilt, containing 12 blank ruled pages, title page, preface, and 219 pages of subject-matter. The matters principally treated of by description, formulæ, tables, &c., are as follows:—Beer. Casks. Centre of gravity. Circle. Circular areas. Cones. Conoids. Coppers. Cube root, rule for. Cylinders, area. Diagonal rod. Table of divisors. Ellipse, area of. &c. Equidistant ordinates. Factors, table of, Gallon, divisors for, &c. Gauge points, table of. Gauging vessels, areas, &c. Hydrometers. Hyperbola, area of, &c. Incumbrances, areas of, &c. Licences, notes on and table of, &c. Original gravity, &c. Parabola, area of, &c. Saccharometer, construction, formulæ for, &c. Short Methods for Calculation. Signs used explained. Slide Rule, examples, notation, principle. Spirits, Alcohol in terms of proof, &c. Stills, gauging, &c. Tables. Ullaging. Ungulas. Useful Numbers for rapid approximation, &c. Table of weights of spirits per gallon, &c. Wort, basis of calculations for, &c. Bushel of malt, equivalents for. Brewers' extract, &c. Mixing or "Blending." Standard Gallons, &c. Starch equivalent to Glucose. Sugar solutions, strength and gravity, equivalent invert, &c. The pocket-book concludes with 13 ruled and blank pages for notes.

Trade Report.

(From the Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Russia.

Increase of Import Duty on Mineral Burning Oils.

In a despatch, dated the 13th January last, Sir R. B. D. Morier, Her Majesty's Ambassador at St. Petersburg, states that the *Journal de St. Pétersbourg* of the same date notified that an excise duty having been imposed on mineral burning oils, the Customs duty on those oils has been raised from 70 copecks to one rouble gold per pond, that is, from 6*s*. 10*d*. to 9*s*. 9*d*. per cwt. The duty on machine oils is unchanged.

Switzerland.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lbs. avoirdupois; Franc = $9\frac{6}{10}d$.

The following decisions affecting the classification of articles in the Swiss Customs Tariff have been given by the Swiss Customs authorities during the month of December last:—

"Metallic cement and metallic water."—Category 9*a*. Duty, 7 francs per quintal.

Phenole is excluded from Category 16. (*See* Categories 17–18.)

The following are classified similarly to carbolic acid in Categories 17 and 18:—Phenic acid, phenole, phenic alcohol, creosote of coal tar, acidum carbolicum, acidum phenicum. Duties, from 1 franc to 2 francs per quintal.

Italy.

Classification of Articles in Customs Tariff.

The following decisions affecting the classification of articles in the Italian Customs Tariff have, according to the Italian *Bollettino di Legislazione e Statistica Doganale e Commerciale,* been recently given by the Italian Customs authorities:—

Mixture of acetic acid and sulphuric acid, artificially coloured, will pay a duty of 19 lire per 100 kilogrammes.

Elixir La Roche.—Elixir of quinine prepared with wine. Duty, 120 lire per 100 kilos.

Varnish composed of oxide of iron, spirits, an essential oil, and resin. Duty, 30 lire per 100 kilos.

Black to be used as a substitute for lamp-black. Duty, 5 lire per 100 kilos.

Ashes containing phosphate of lime, intended as manure. Duty free.

Residue of the distillation of fluid or half-fluid resin. Duty, 50 cs. per 100 kilos.

Unrefined paraffin. Duty, 8 lire per 100 kilos.

United States.

Customs Decisions.

The following decisions affecting the classification of articles in the Customs Tariff, and the application of the Customs law of the United States, were given by the United States Government during the months of December and January last:—

Yellow prussiate of soda, which bears a strong resemblance to yellow prussiate of potash, which is specially provided for in section 67, is, by virtue of section 2499 of the Revised Statutes, and the decision of the court in the case of Biddle against Hartranft, held to be dutiable at the rate of 5 cents per pound, under the provision for "yellow prussiate of potash"

So-called "distilled verdigris," which, upon investigation, is found to consist of an article known as an acetate of copper, is held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in section 92, for "all chemical compounds and salts, by whatever name known."

A substance styled by the importers "black salts," which, upon investigation, was found to be not the black salts specified in the free list (T. I., 605), viz., "aniline salts or black salts," but a species of crude potash, is held to be dutiable at the rate of 20 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 63), for "potash, crude."

It is held that articles such as blow-pipes, forceps, &c., when specially imported in good faith for the use of an institution established for scientific or educational purposes, are entitled to free entry under the provision in the free list (T. I., 759) for "philosophical and scientific apparatus, instruments, and preparations," specially imported for such institution.

A substance claimed by the importer to be iron ore, but which upon investigation was found to be unfit for use for smelting purposes, and to be commercially known as paint, is held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 87) for "colours and paints, whether dry or mixed."

CANADA.

Classification of Plant used in the Concentration of Sulphuric Acid.

The following is a copy of an order of the Governor-General of Canada, dated the 17th December last, respecting the classification of plant made of platinum, and used in the concentration of sulphuric acid, which was published in the *Canada Gazette* of the 24th December :—

"On the recommendation of the Minister of Customs and under the provisions of sub-section (*l.*) of section 245 of chapter 32 of the Revised Statutes of Canada, entitled, 'An Act respecting the Customs.'

"His Excellency in Council has been pleased to order, and it is hereby ordered, that retorts, pans, condensers, tubing and pipe, made of platinum, when imported by manufacturers of sulphuric acid for use in their works in the manufacture of concentration of sulphuric acid, be placed on the list of articles that may be admitted into Canada free of duty."

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

GIBRALTAR.

Soap.

There is, says the Belgian Consul at Gibraltar, a fair sized soap manufactory at Algeciras worked by steam. It has been established to compete with the English article known as "blue mottled soap," which is so very popular in this neighbourhood. It also produces toilet soaps, but these latter are only used by the poorer classes. At Linea de la Concepcion, on the Spanish frontier, there is also a small soap factory, but it is of little importance compared with that of Algeciras. A large quantity is imported from England, principally by way of Liverpool. Blue mottled soap, known by the Spaniards as "sabon republicano," made by the firm of Gossage, of Widnes, in Lancashire, is the most liked of any which have at present been imported, and it is specially to compete with them that the factory at Algeciras was established.

Candles.

Candles, the same Consul proceeds, are chiefly imported from England, the kind most in favour being that produced by Price's Patent Candle Company. Small quantities are also sent from Belgium and France, the firms which are most popular being the Compagnie Royal Belge, of Brussels and Antwerp, and Faulquier, Cadet, and Cie., Montpellier.

TONQUIN.

Opium Cultivation.

L'Economiste Français says that some attempts made in Tonquin to cultivate opium last year under the direction of M. Frederick have produced unexpectedly good results, considering that sowing took place three months too late, and that the ground set apart for the experiment was far from favourable. It is now certain that opium of a good quality, or rather the white poppy which produces opium, will succeed capitally at Tonquin. An effort will now be made to organise its culture on an extensive scale.

SICILY.

Sulphur.

The British Consul at Palermo reports that the very unsatisfactory state of this trade, and of the low prices this article finds in the market, are causing great anxiety to the owners of sulphur mines, and to those who trade in sulphur. For the last five years the prices have been steadily decreasing ; and, whereas at one time merchants insisted on a profit varying from 21 to 42 centimes, they are now only too glad to obtain a profit of 4 and sometimes 2 centimes. The reason for this is to be found in the fact that the production of the mineral during the last 30 years has been excessive, and at present the annual production has been from 600,000 to 700,000 quintals over and above the ordinary consumption. The consequence is that the sulphur accumulates at the mines and at the outports, thereby causing the owners to get rid of their produce at any price. Another circumstance that has tended to depreciate the value of sulphur is that Sicilians cannot be brought to bind themselves into companies or associations ; and so the opportunity of being able to close their mines for a few years until the stock is all disposed of at a fair profit is lost.

Chemical Products.

The same Consul says that chemical products as imported consists chiefly of sulphate of quinine (English and French) ; citrate of magnesia, chiefly from Milan ; sulphuric, nitric, citric, and other acids, chiefly from Newcastle. Soda in "iron drums," potash, salammoniac, sulphate of copper, chloride of lime, &c. In the matter of chemical products there is, however, now a strong competition on the part of Germany. The total value of chemical imports was 16,868*l.*, of which 6,097*l.* only came from England.

TURKEY.

Candles.

The annual import, according to the Belgian Consul at Salonica, is estimated at 396,000 pounds, chiefly in common qualities, and the trade is shared between France and Belgium. The Belgian quality "Lew" is preferred.

Petroleum.

The United States, declares the same Consul, are bringing to bear every effort to prevent the introduction of Russian petroleum in this market, and is offering very reduced prices to attract buyers, and although Russia is also making special efforts, the American article continues to be in favour with buyers. Consumers prefer it, not only for its superior quality, but also because it is more solidly packed.

COREA.

Aniline dyes are indispensable articles of import.

CHANGES IN THE CUSTOMS TARIFF OF SWITZERLAND.

The following is a statement of the changes effected in the General Customs Tariff of Switzerland by the law of the 17th December last. In all cases where Conventional rates of duty are stated these are still in force as regards imports from the United Kingdom.

NOTE.—*Quintal* = 220·4 *lbs. avoirdupois ; Franc* = $9\frac{5}{10}d$.

No. in Tariff.	Classification of Articles.	New Rates of Duty. (General Tariff.)	Conventional Rates of Duty.
	I.—WASTE MATERIAL AND MANURES.	Fr. Ct.	Fr. Ct.
2	Stable manure ; compost ; chalk-lime ; residue of animal black (dried waste of sugar refineries) ; ashes (of bone, coal, peat, wood, even lye washed) ; loam ; sweepings, &c. ; rags and other waste materials intended for the manufacture of manure	Free.	Free.
	Guano ; phosphorites, phosphates ; bone powder, &c. :		
3	Not chemically prepared ; as well as ammoniacal salts (crude), sulphate of ammonia, chloride of potassium, potash manure ; sulphuric acid once used	„	„
4	Chemically prepared ; as well as artificial manures	Quint. 0·20	*See* General Tariff.
	II.—CHEMICALS.		
	a. Apothecaries' and Druggists' Articles.		
11	Pharmaceutical preparations, such as powders, pastilles, salves, ointments, tinctures, essential oils and essences ; in wholesale packages, that is to say, susceptible of division for retail sale ; surgeons' bandages......	„ 40·00	„
	b. Chemicals for Industrial use.		
16	Alum ; white arsenic ; sulphate of barytes ; animal black ; chloride of barium ; chloride of calcium, crude ; chloride of lime ; chloride of magnesium ; chloride of manganese ; chrome-alum ; iron-mordant ; litharge ; pyrolignite of lime ; phenate of lime, crude ; chlorhydrate of lime ; extract of chestnut, liquid ; sulphate of magnesia (Epsom salts) ; liquid arseniate of soda ; bicarbonate of soda ; sulphate of soda (Glauber's salts) ; hyposulphite, sulphite, and bisulphite of soda ; muriatic soda ; flour of sulphur ; sulphuret of iron ; sulphuret of sodium ; sulphuric acid ; soda ; acetate and sulphate of alumina ; sulphate (vitriol) of iron, copper, and zinc ; soluble glass	„ 0·30	„

CHANGES IN THE CUSTOMS TARIFF OF SWITZERLAND—*cont.*

No. in Tariff.	Classification of Articles.	New Rates of Duty. (General Tariff.)	Conventional Rates of Duty.
		Fr. Ct.	Fr. Ct.
	II. CHEMICALS—*cont.*		
	b. Chemicals for Industrial use—cont.		
17	Caustic potash, caustic soda; starch, raw and roasted, dextrine; aniline; aniline compositions for manufacture of paints; anthracine; arsenious acid; benzoic acid; benzine; oil of bitter almonds, artificial; sugar of lead; nitrate of lead; bioxide of lead; borax; phenic acid, crude; cashew; chloride of aluminium; chloride of zinc; gallic acid; tannic acid; glycerine; verdigris; pyroligneous acid; acetic acid, crude, with an empyreumatical odour; wood spirit, raw; yellow prussiate of potash; chlorate of potash; red chromate of potash; hypermanganate of potash; bisulphate of lime; chestnut extract, solid; oxalic acid; naphthaline; salts of soda, not otherwise mentioned; oleic acid; paraffin; potash; salicylic acid, crude; chloride of ammonia; spirits of ammonia; saltpetre, refined; nitric acid; oxalate of potassium; sulphuric ether; sulphide of arsenic; stearine; aluminous cake; aluminate of soda; oil of Turkey red; zinc powder; salts of tin....................	Quint. 1·00	*
	c. Colours.		
	Ceruse and oxide of zinc:		
35	Not ground................	„ 3·00	3·00
35*a*	Ground....................	„ 5·00	*See* General Tariff.
36	Chrome, yellow and green; mountain blue; Prussian blue; smalt; ultramarine...........	„ 7·00	„
39	Varnishes and lac of all kinds, with the exception of oil varnishes....................	„ 25·00	7·00
39*a*	Oil varnish.....................	„ 10·00	7·00
	X.—MINERALS.		
168	Hydraulic lime................	„ 0·40	*See* General Tariff.
169	Roman cement.................	„ 0·40	„
170	Portland cement...............	„ 0·80	„
184	Oil of coal tar, not purified......	„ 0·30	„
	XIII.—PAPER.		
266	Fibre for paper-making.........	„ 1·50	„
268	Packing paper..................	„ 5·00	3·00
269	Printing and writing paper.....	„ 10·00	7·00
	XIV.—TEXTILE FABRICS.		
350	Caoutchouc and gutta-percha...	„ 50·00	16·00

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* Under the Conventional Tariff starch and nitric acid pay a duty of 60 centimes per quintal, all other articles in the category pay under the General Tariff.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

IMPORTS INTO THE UNITED KINGDOM FROM SPAIN.

PRINCIPAL ARTICLES.		December 1886.	December 1887.
Chemical products unenumerated	Value £	6,584	6,755
Copper ore and regulus.........	Tons	3,344	7,454
	Value £	53,270	192,679
Manganese ore....................	Tons	..	1,630
	Value £	..	1,549
Pyrites of iron or copper........	Tons	46,671	60,969
	Value £	90,037	118,877
Quicksilver......................	Lbs.	..	..
Rags, Esparto....................	Tons	4,721	5,924
	Value £	24,870	35,713
Total Value......................	£	867,183	1,160,441

In the month of January 1888 the value of the imports into the United Kingdom from Spain amounted to 993,680*l.*, as compared with 818,935*l.* in the corresponding month of 1887.

EXPORTS OF BRITISH AND IRISH PRODUCE FROM THE UNITED KINGDOM TO SPAIN.

PRINCIPAL ARTICLES.		December 1886.	December 1887.
Alkali............................	Cwts.	24,643	23,498
	Value £	9,456	7,389
Caoutchouc, manufactures of......	Value £	2,057	1,640
Cement...........................	Tons	250	285
	Value £	475	484
Chemical products and preparations (including dye stuffs)............	Value £	2,058	3,735
Coal, products of, including naphtha and petroleum..................	Value £	1,735	293
Glass manufactures...............	Value £	532	1,195
Manure...........................	Value £	1,325	3,390
Painters' colours and materials....	Value £	3,066	2,449
Paper of all sorts................	Cwts.	1,114	594
	Value £	2,331	1,134
Soap.............................	Cwts.	251	196
	Value £	221	180
Total Value......................	£	253,238	232,493

In the month of January 1888 the value of the exports of British and Irish produce from the United Kingdom to Spain amounted to 280,237*l.*, as compared with 235,826*l.* in the corresponding month of 1887.

MISCELLANEOUS TRADE NOTICES.

MUSEUM OF NATIONAL INDUSTRY IN WURTEMBURG.

In a despatch, dated the 26th January last, Sir H. Barron, H.M. Minister at Stuttgart, writes: "As an evidence of the encouragement accorded by the State to industry, I may mention that the Wurtemburg Parliament has voted 111,750*l.* for a new building to accommodate the Museum of National Industry."

IMPORTATION OF GERMAN SPIRIT INTO SPAIN.

See Board of Trade Journal for February, page 161.

PRODUCTION OF SULPHUR IN SICILY.

The French *Bulletin du Ministère des Travaux Publics* for November last, says that the total quantity of sulphur contained in the Sicilian mines before workings were commenced is estimated at 65,000,000 tons. The quantity produced from 1831 to 1885 is stated to be 8,353,091 tons, and previous to this period about two millions, making a total of 10,353,091. When it is considered that to obtain this quantity about 15 million tons were turned over (as generally a third is lost in the treatment), it results that the quantity still available is at least 50 million tons, and supposing that the average production for the future should be maintained at about the same proportion as in past years, the Sicilian mines may continue to be worked for another century.

Cultivation of Ramie in France.

The French *Journal Officiel* for the 22nd January last, states that the Commission appointed by the French Minister of Agriculture to inquire into the cultivation and employment of ramie has reported that the best way in which to procure the necessary quantity of this useful fibre will be to cultivate the plant close to Paris, and it has recommended the Government to utilise for this purpose the estates at Gennevilliers, the fertility of which is a guarantee of the success of such an experiment.

Gosalpur Manganese Ore.

The following information respecting Gosalpur (Jabalpur District of the Central Provinces, India) manganese ore is extracted from a memorandum recently issued by the Revenue and Agricultural Department of the Government of India:—

In March 1879, Mr. H. B. Medlicott, Director, Geological Survey of India, visited Gosalpur, in the Jabalpur District of the Central Provinces, with the object of examining the locality where manganese had been for some time extracted in small quantities by the natives. He described the deposit to be neither a vein or lode, nor properly a seam or bed, but as occurring irregularly through the laterite, which is an amorphous superficial deposit of variable thickness, and that a large supply of the ore might be counted upon. An examination of this mineral proved it to be pyrolusite, an ore of high quality. The local authorities arranged for an exploration with a view to ascertain the extent of the deposit, but owing to the person sent for this duty having sunk his pit below the laterite, he reported a failure of the ore.

In 1883 a fuller examination of the locality was made by Mr. F. R. Mallet, Superintendent, Geological Survey of India, who discovered a strong band of manganiferous sæmatite on the north-north-west front of the hills, the laterite being piled against it on the south-south-east. This is described as a definitely stratified ore occurring in the underlying rocks with an east-north-easterly strike. Besides being manganiferous, the rich band of iron ore contains a variable subordinate proportion of a manganese ore known as psilomelane, which is mentioned as a subsidiary source of manganese, the pyrolusite of the laterite being *the* manganese ore of Gosalpur.

In order to ascertain the commercial value and the quality of the manganese ore, arrangements were recently made for the testing of samples by experts in England. The results of the analysis show that the ore is rich in manganese and is considered well adapted for the manufacture of chlorine or ferro-manganese, but that for other purposes it would require to be mixed with purer ores in consequence of the excess of phosphorus.

The value of the ore in England is estimated at 61*s.* per ton, which should prove remunerative, as no plant is required, the mining being merely a matter of open-day excavation. The substance is fit for use as it comes out of the ground, and is not damaged by exposure.

Arrangements were being made last September for a further examination of the manganese field by an officer of the Geological Survey of India. Applications for permission to quarry the ore for export to Europe having been received, the Chief Commissioner of the Central Provinces has represented that, in order to deal with them, it is necessary to have a map prepared showing approximately the position and extent of the beds, and a rough estimate made of the quantity of ore available.

Law for the Encouragement of Native Industry in Roumania.

See Board of Trade Journal for February, p. 172.

Competition with English Foreign Trade.

By Mr. R. Giffen.

See Board of Trade Journal for February, pp. 175-191.

The Russian Sugar Industry in 1887.

See Board of Trade Journal for February, p. 208.

The Potassium Chloride Industry.

The potassium chloride industry in Stassfurt, which was originally called into existence by the Prussian Government, is mainly occupied with the production of carnallite salt. In its first state this is not a marketable article, but a simple treatment suffices to convert it into the ordinary potassium chloride of commerce. The Government works at Stassfurt formerly committed this process to private contractors, upon whom they were consequently dependent for the sale of the raw salts. In recognition of this circumstance, which isolated the mines entirely from the potassium chloride market, all the private potassium chloride mines which were subsequently established in competition with the Government works made arrangements for manipulating their raw salts on their own premises. By this means they obtained a preponderance over the fiscal works, which induced the latter to believe that unless they adopted similar measures their sales of raw salts would cease altogether. Shortly afterwards a convention was established between the Government and the private works, whereby a certain sale of raw salts was assured to the former. Considering, however, the numerous new private undertakings in which potassium chloride mining was combined with the manipulation of carnallite, and which had been established during the past few years, the Government works thought it on the whole more prudent not to involve themselves in conventions for any length of time, but to manipulate their raw salts for themselves. The Government therefore, demanded and received last session a sum of 350,000 m. from the Prussian Parliament for carrying out the scheme. That the State has invested its money well in establishing a dissolving station of its own is shown by the following facts. The sale and price of rock salt of all kinds remained last revenue year at nearly the same height as in the previous year. The sale of potassium chloride has declined by about 60,000,000 kg., while instead of the sale price of the former year (1 m. 39 pf. for 100 kg.) an average of only 1 m. 34 pf. was obtained. Nevertheless, the total receipts from the sale of the products of the fiscal mines show an increase of 805,350 m. as compared with those of the previous year. This rise is entirely due to the circumstance of the fiscal mines manipulating their own raw salts.—*Kuhlow's.*

Consumption of Nitrate of Soda.

The total consumption in the world for the past three years has been as follows:—

——	1885.	1886.	1887.
	Tons.	Tons.	Tons.
Continent of Europe	290,000	320,000	385,000
United Kingdom	95,000	106,000	98,000
United States	45,000	60,000	65,000
	430,000	486,000	548,000
Whilst the shipments for the same periods have been ...	420,000	438,000	680,000

BOARD OF TRADE RETURNS.

IMPORTS.

—		January 1885.	January 1886.	January 1887.
Drugs, unenumerated..	Value £	63,782	46,199	77,093
Chemical manufactures and products, unenumerated	„	88,785	91,123	103,754
Chemicals and dye-stuffs, unenumerated	„	130,166	698,328	1,012,436
Oils, not enumerated...	„	73,067	80,112	100,616
Alkali	Cwt.	2,633	4,152	2,418
	Value £	1,396	1,906	1,581
Brimstone	Cwt.	28,547	81,962	29,226
	Value £	7,031	19,130	7,238
Nitrate of soda	Cwt.	115,700	22,640	40,403
	Value £	62,972	10,761	18,178
„ of potash......	Cwt.	13,248	16,150	32,702
	Value £	12,376	14,835	28,861
Quicksilver	Lbs.	337,200	705,300	857,964
	Value £	26,976	67,799	114,804
Cinchona bark.........	Cwt.	11,203	16,551	12,944
	Value £	75,425	77,588	52,912
Gum Arabic	Cwt.	14,878	1,511	3,115
	Value £	57,732	7,358	14,910
Lac, seed, shell, stick, and dye	Cwt.	11,203	9,807	13,778
	Value £	33,847	26,318	40,430
Bark (for tanners' or dyers' use)..........	Cwt.	12,198	23,812	21,240
	Value £	4,675	7,464	7,709
Aniline	Value £	18,742	19,187	22,910
Alizarine	„	22,003	17,798	22,622
Other coal-tar dyes	„	..	480	1,035
Cochineal..............	Cwt.	2,279	805	1,002
	Value £	15,670	5,163	6,851
Cutch and gambier	Tons	2,085	2,333	3,633
	Value £	45,237	59,158	93,500
Indigo	Cwt.	16,164	13,367	20,366
	Value £	381,946	322,824	499,140
Madder, madder-root, &c.	Cwt.	1,779	2,751	1,202
	Value £	2,345	3,453	1,657
Cocoa-nut oil	Cwt.	17,448	24,264	6,457
	Value £	25,482	31,880	7,751
Olive oil	Tuns	1,248	2,023	1,956
	Value £	48,410	80,758	69,657
Palm oil	Cwt.	60,456	73,548	81,772
	Value £	73,579	77,439	80,633
Petroleum oil	Gals.	7,342,018	5,416,938	9,481,390
	Value £	216,234	151,194	248,457
Oil seed................	Tons	1,052	893	1,355
	Value £	27,621	22,251	33,194
Turpentine	Cwt.	26,712	39,540	23,150
	Value £	35,571	55,774	32,013
Paraffine...............	Cwt.	25,514	20,574	37,967
	Value £	43,497	29,311	50,569

EXPORTS.

—		January 1885.	January 1886.	January 1887.
British and Irish produce—				
Drugs and medicinal preparations, unenumerated	Value £	71,317	66,524	72,159
Sundry chemicals -	„	288,250	298,554	358,576
Painters' colours and materials	„	89,539	89,204	92,816
Alkali	Cwt.	528,157	404,417	448,542
	Value £	147,550	117,982	122,175
Bleaching materials .	Cwt.	114,300	101,576	111,379
	Value £	37,155	36,566	42,727
Seed oil.............	Tons	5,535	4,894	6,138
	Value £	117,940	101,245	125,282
Soap................	Cwt.	24,076	28,727	29,789
	Value £	28,329	32,086	27,911
Foreign and Colonial merchandise:				
Chemicals, unenumerated	Value £	15,314	21,786	33,746
Cinchona bark	Cwt.	6,627	4,905	9,538
	Value £	35,023	22,340	28,160
Cochineal...........	Cwt.	677	856	469
	Value £	4,861	5,373	2,624
Cutch and gambier .	Tons	351	775	674
	Value £	8,663	18,023	17,567
Gum Arabic	Cwt.	3,247	1,662	2,773
	Value £	15,270	6,857	12,644
Indigo..............	Cwt.	4,432	6,702	3,958
	Value £	14,633	18,592	12,347
Lac, seed, shell, stick, and dye	Cwt.	3,865	6,290	5,509
	Value £	88.542	154,584	136,207
Cocoa-nut oil	Cwt.	2,676	4,631	9,204
	Value £	3,698	6,793	13.771
Olive oil	Tuns	210	121	181
	Value £	10,173	5,090	6,803
Palm oil	Cwt.	27,867	41,449	46,234
	Value £	35,004	43,667	45,139
Petroleum oil	Gals.	42,502	35,103	67,591
	Value £	2,382	1,849	2,527
Quicksilver.........	Lbs.	284,437	448,051	163,592
	Value £	22,348	43,245	21,099
Nitrate of potash ...	Cwt.	6,746	2.516	6,474
	Value £	5,589	2,210	5,164

Shipments, Consumption, Stocks, and Prices, from 1880 to 1887.

——	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Shipments from South American ports to all parts for the six months ending 31st December	143,000	207,000	264,000	327,000	289,000	243,000	274,000	447,000
Do. do. for the 12 months ending 31st December........	214,000	319,000	476,000	567,000	535,000	420,000	438,000	680,000
Afloat for Europe on 31st December................	81,000	118,000	192,000	230,000	190,000	154,000	181,000	325,000
Stocks in United Kingdom ports:—								
Liverpool	5,400	2,000	11,000	11,000	13,500	18,000	10,700	2,000
London	1,850	1,200	450	1,500	2,900	6,200	5,300	3,250
Out ports	9,750	5,500	17,550	19,500	14,600	15,800	17,000	10,750
	17,000	8,700	29,000	32,000	31,000	40,000	33,000	16,000
Stocks in Continental ports on 31st December	30,000	27,000	35,000	73,000	130,000	116,000	66,000	50,000
Consumption in United Kingdom for the six months ending 31st December...........	28,000	24,500	23,000	31,000	27,000	22,000	24,000	30,000
Do. in Continent do. do. ..	56,000	72,500	99,000	124,000	118,000	70,000	112,000	145,000
Do. in United Kingdom for the 12 months ending 31st December...........	60,000	65,500	75,500	99,000	106,000	95,000	106,000	98,000
Do. in Continent do. do. ..	113,000	165,500	237,000	314,000	358,000	290,000	320,000	385,000
Visible supply on 31st December (including the quantity afloat for Europe and stocks in United Kingdom and Continent)........................	131,000	153,700	256,000	335,000	351,000	310,000	280,000	391,000
London spot price on 31st December...............	Per Cwt. 14*s.* 6*d.*	Per Cwt. 14*s.* 7½*d.*	Per Cwt. 12*s.* 3*d.*	Per Cwt. 10*s.*	Per Cwt. 9*s.*	Per Cwt. 11*s.* 3*d.*	Per Cwt. 9*s.*	Per Cwt. 9*s.*

Text of the New French Law for Preventing Fraud in the Manure Trade.

"L'Engrais," December 12, 1887.

Clause I.—Any person who, when selling or offering for sale manures or fertilizers, shall deceive or attempt to deceive the customer—(1.) As to the nature, composition, or useful constituents thereof; (2.) As to the method of the production thereof; or (3.) By the employment in describing or styling them of a name which, by right of user, has been given to other fertilizing substances, shall be liable to be imprisoned for a period of from six days to one month, and to a fine of from 50 to 2,000 francs, or to one or other of the above penalties alone.

In case of a second offence within three years after a conviction, the penalty may be increased to imprisonment for two months and a fine of 4,000 francs.

The powers given by this clause shall not be deemed to prejudice or affect the application of paragraph 3, Clause I., of the Act of March 27, 1881, dealing with frauds as to the quality of goods delivered, and of Clauses VII., VIII., and IX. of the Act of June 23, 1857, concerning trade and merchandise marks.

Clause II.—In the case provided for in the preceding clause the court may, besides the penalties above mentioned, order the sentence to be, as a whole or in part, published in such journals as it may think desirable, and order it to be posted on the doors of the house or warehouse of the offender, and the public buildings in the district where the parties are domiciled.

In case of a second offence within five years such publication and posting shall always be ordered.

Clause III.—Any person who, on delivery, shall fail to inform his customer, subject to the conditions laid down in Clause IV. of this enactment, as to the natural or industrial origin (provenance) of the manure or fertilizer which he sells, and its quantity of fertilizing constituents, shall be liable to a fine of from 1 to 15 francs, including costs (inclusivement).

In case of a second offence within three years he shall be liable to imprisonment not exceeding five days.

Clause IV.—The information referred to in Clause III. shall be furnished either in the sale note, or in the counterpart of the warrant (double de commission) handed to the customer at the moment of sale, or in the invoice which accompanies the delivery.

The quantity of fertilizing constituents shall be expressed in terms of the weight of nitrogen, phosphoric acid, and potash contained in each 100 kilogrammes of goods invoiced in condition as delivered, with a statement of the nature or state of combination of these bodies, according to the rules for the guidance of the public service referred to in Clause VI.

Whenever a sale shall have been effected with a stipulation that the price shall be based on an analysis made on a sample taken before delivery, the above-mentioned preliminary statement of the exact quantity of fertilizing constituents shall not be obligatory, but mention should be made of the price per unit and state of chemical combination of the nitrogen, of the phosphoric acid, and of the potash in such manure as delivered.

Evidence of the fulfilment of the above regulations shall be furnished, if occasion arise, failing a preliminary contract or the buyer's receipt, by the production of a copy of the purchaser's letters or by his book of invoices regularly filed, and containing the statement as prescribed by this clause.

Clause V.—The provisions of Clauses III. and IV. of this Act shall not apply to those who shall have sold for manure under their ordinary designation rubbish, dung, compost, nightsoil, road-scrapings, market waste, brewery refuse, sea-wrack or other seaweed, fresh slaughter-house sweepings, marl, calcareous marl, shelly-sand, chalk, plaster, cinders, or soot produced from burning oil and other combustibles.

Clause VI.—A departmental order shall prescribe what method of analysis for the determination of the fertilizing constituents of manure shall be followed, and shall determine the other measures to be taken to put this Act in force.

Clause VII.—The Act of July 27, 1867, is and remains hereby repealed.

New Belgian Law on the Adulteration of Manure.

"L'Engrais, January 14, 1888."

Clause I.—Every consignment of material, whether simple or compound, which contains one of the following fertilizing constituents, nitrogen, phosphoric acid, or potash, shall be accompanied by an invoice.

If the delivery of the invoice cannot be simultaneous with the consignment of the goods it shall be forwarded within a period which will be fixed by royal decree.

It should be certified to be accurate by the vendor or his agent (cédant), and should include the following provisions :—

1. The name or nature of the material consigned, whether it be simple or compound.
2. Its composition by analysis (dosage). This analysis will give the name and percentage of essential fertilizing constituents, as well as their state of chemical combination ; and the terms to be employed, as well as the methods of analysis to be adopted, shall be fixed by royal decree.

If the consignment is one of oilcake (tourteaux) the invoice shall state, in a manner to be determined by royal decree, the nature of the grain or grains from which it is produced.

Clause II.—The preceding clause shall not apply to consignments of fertilizing material either derived from the natural sources of the farm or produced spontaneously by the soil, such as nightsoil, cinders, soot, house waste, market waste, slaughter-house sweepings, farmyard manure, or such like simple fertilizers, if consigned under their exact name and in their natural state.

Clause III.—Each infraction of Clause I. shall be punishable by a fine of from 1 to 25 francs, and from 1 to 7 days imprisonment, or one of these penalties singly.

In case of a second offence within a year after a conviction for a similar offence the penalties shall be doubled.

Clause IV.—The seller or his agent shall be entitled to offer evidence, as a matter of right, that he has conformed to Clause I.

Clause V.—Any person who shall be guilty of deception, either as to the constitution of a fertilizing material or by the use of a trade designation which by custom belongs to another fertilizing material, shall be liable to a fine of from 100 to 2,000 francs, and from 15 days to 6 months imprisonment, or one of these penalties singly.

These penalties apply to those who falsify a sample taken for analysis pursuant to this Act as well as to those who in making delivery of oilcake are guilty of deception as to its composition.

In case of a second offence within two years after a conviction for a similar offence, the penalties may be doubled.

Clause VI.—In addition to the terms to be employed in connexion with the description and analysis of manures, a royal decree will determine the limits of application of and means by which effect will be given to this law.

Clause VII.—The Government is hereby authorised to take the necessary measures to ensure that no material within the provisions of this Act shall be imported without an invoice accompanying the same as prescribed in Clause I., or some other document of equal value.

MINERAL RESOURCES OF THE UNITED STATES.

From Geological Survey, U.S.A., 1886.

QUICKSILVER.

Years.	Imports.	Exports.	Price.		Years.	Imports.	Exports.	Price.	
			Highest.	Lowest.				Highest.	Lowest.
	Bottles.	Bottles.	£ s. d.	£ s. d.		Bottles.	Bottles.	£ s. d.	£ s. d.
1887	61,212	62,476	11 5 0	6 10 0	1883	54,520	48,997	5 17 6	5 2 0
1886	58,966	66,080	7 10 0	5 13 0	1882	45,921	40,424	6 5 0	5 11 0
1885	55,153	48,823	6 15 0	5 10 0	1881	56,261	24,842	7 0 0	6 2 6
1884	59,970	52,492	6 15 0	5 2 0	1880	49,541	16,070	7 15 0	6 7 6

Estimated consumption United Kingdom, 12,000 bottles per annum.

TOTAL COPPER PRODUCTION IN THE UNITED STATES, 1882 TO 1886.

Source.	1882.	1883.	1884.	1885.	1886.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Lake Superior	56,982,765	59,702,404	69,353,202	72,148,172	79,890,798
Arizona	17,984,415	23,874,963	26,734,345	22,706,366	15,657,035
Montana	9,058,284	24,664,346	43,093,054	67,797,864	57,611,621
New Mexico	869,498	823,511	59,450	79,839	558,385
California	826,695	1,600,862	876,166	469,028	430,210
Colorado	1,494,000	1,152,652	2,013,125	1,146,460	409,306
Utah	605,880	341,885	265,526	126,199	500,000
Wyoming	100,000	962,468	..	..	..
Nevada	350,000	288,077	100,000	8,871	50,000
Idaho	..	..	46,667	40,381	..
Missouri	294,695	260,306	230,000	..	..
Maine and New Hampshire	290,000	212,124	219,018	211,602	315,719
Vermont	1,265,000	400,000	655,405		
Southern States	400,000	395,175	317,711	40,199	29,811
Middle States	..	64,400	2,114	190,641	..
Lead desilverizers, &c.	125,000	782,880	950,870	910,144	1,282,496
Total domestic copper	90,646,232	115,526,053	144,946,653	165,875,766	156,735,381
From imported pyrites and ores	1,000,000	1,625,742	2,858,754	5,086,841	4,500,000
Total (including copper from imported pyrites)	91,646,232	117,151,795	147,805,407	170,962,607	161,235,381

THE PRINCIPAL FOREIGN PRODUCERS.

THE COPPER PRODUCTION OF THE WORLD, 1879 TO 1886 INCLUSIVE.

Countries.	1886.	1885.	1884.	1883.	1882.	1881.	1880.	1879.
EUROPE.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.
Great Britain	1,471*	2,773	3,350	2,620	3,464	3,875	3,662	3,462
Spain and Portugal: Rio Tinto	24,700	23,484	21,564	20,172	17,389	16,666	16,215	13,751
Tharsis	11,000	11,500*	10,800*	9,800	9,000	10,203	9,151	11,324
Mason and Barry	7,000	7,000*	7,500*	8,000	8,000	8,170	6,603	4,692
Sevilla	2,135	1,800	2,000	2,026	1,885	1,310	1,705	1,360
Portugueza	1,258	1,665	2,300*	2,357	1,700	1,410	1,000	770
Poderosa	3,560	2,424	2,251	1,000	800	800	800	800
Germany: Mansfield	12,595	12,450	12,582	12,634	11,536	10,999	9,800	8,400
Other German	1,870	2,800*	2,200*	3,568	3,552	1,743	1,600	600
Austria	550	585	670	572	474	474	500	255
Hungary	500	504	614	661	661	800	900	1,019
Sweden	600	775	662	732	798	995	1,074	800
Norway	2,220	2,560	2,706	2,630	2,590	2,640	2,426	2,412
Italy	900	835	1,325	1,600	1,400	1,480	1,380	1,140
Russia	4,875	5,100*	4,700	3,500	3,537	3,411	3,154	3,081
Total Europe	75,234	76,255	75,224	72,172	66,786	65,006	59,370	53,866
NORTH AMERICA.								
United States	69,971	74,053	03,555	51,574	40,467	32,000	27,000	23,000
Canada	1,410	2,500	236	1,055	500	500	50	50
Newfoundland: Bett's Cove	1,125	778	668	1,053	1,500	1,718	1,500	1,500
Mexico	850	375	291	489	401	333	400	400
Total North America	73,386	77,703	64,750	54,171	42,868	34,551	28,950	24,950
SOUTH AMERICA.								
Chili	35,025	38,500	41,648	41,099	42,909	37,989	42,916	49,318
Bolivia: Corocoro	1,100	1,500*	1,500*	1,680	3,259	2,655	2,000	2.000
Peru	75	229	362	395	440	015	600	600
Venezuela: New Quebrada	3,708	4,111	4,600	4,018	3,700	2,823	1,800	1,597
Argentine Republic	180	233	159	293	800	307	300	300
Total South America	40,088	44,573	48,269	47,485	51,108	44,389	47,616	53,815
AFRICA.								
Algiers	110	250	260	600	600	600	500	500
Cape of Good Hope	6,015	5,450	5,000	5,975	5,716	3,467	4,739	4,328
Total Africa	6,125	5,700	5,260	6,575	6,316	4,067	5,239	4.828
ASIA.								
Japan	10,000	10,000*	10,000*	7,600	4,800	3,900	3,900	3,900
Total Asia	10,000	10,000	10,000	7,600	4,800	3,900	3,900	3,900
AUSTRALIA.								
Australia	9,700	11,400	14,100	12,271	8,512	10,000	9,700	9,500

* Estimated.

COPPER AND COPPER ORE OF DOMESTIC PRODUCTION EXPORTED FROM THE UNITED STATES, 1864 TO 1886 INCLUSIVE.

[Cwts. are long hundredweights of 112 pounds.]

Fiscal years ending June 30.	Ore.		Pigs, Bars, Sheets, and Old.		Value of Manufactured.	Total Value.
	Quantity.	Value.	Quantity.	Value.		
	Cwts.	Dollars.	Lbs.	Dollars.	Dollars.	Dollars.
1864	109.581	181,298	102,831	43,229	208,043	432,570
1865	225,197	553,124	1,572,382	709,106	282,640	1,544,870
1866	215,980	792,450	123,444	33,553	110,208	936,211
1867	87,731	317,791	4,637,867*	303,048	171,062	791,901
1868	92,612	442,921	1,350,896	327,287	152,201	922,409
1869	121,418	237,424	1,134,360	233,932	121,342	592,698
1870	19,198*	537,505	2,214,658	385,815	118,926	1,042,246
1871	54.445*	727,213	581,650	133,020	55,198	915,431
1872	35,564	101,752	267,868	64,844	121,139	287,735
1873	45,252	170,365	38,958	10,423	78,288	259,076
1874	13,326	110,450	503,160	123,457	233,301	467,208
1875	51,305*	729,578	5,123,470	1,042,536	43,152	1,815,266
1876	15,304	84,471	14,304,160	3,098,395	343,544	3,526,410
1877	21,432	109,451	13,461,553	2,718,213	195,730	3,023,394
1878	32,947	169,020	11,297,876	2,102,455	217,446	2,488,921
1879	23,070	102,152	17,200,739	2,751,153	79,900	2,933,205
1880	21,623	55,763	4,206,258	667,242	126,213	849,218
1881	9,958	51,499	4,865,407	786,860	38,036	876,395
1882	25,936	89,515	3,340,531	565,295	93,646	748,456
1883	112,923	943,771	8,221,363	1,293,947	110,286	2,348,004
1884	386,140	2,930,895	17,044,760	2,527,829	137,135	5,595,859
1885	432,300	4,739,601	44,731,858	5,339,887	107,536	10,187,024
1886	544,020	3,068,879	24,292,393	2,493,898	108,971	5,671,748

* Evidently errors in quantities.

BRITISH IMPORTS AND EXPORTS OF COPPER.

Years.	Imports of		Total Imports.	Exports.
	Bars, Cakes, and Ingots.	Copper in Ores and Furnace Products.		
	Long Tons.	Long Tons.	Long Tons.	Long Tons.
1860	13,142	13,715	26,857	26,117
1865	23,137	23,922	47,059	41,398
1870	30,724	27,025	57,749	53,006
1871	33,228	23,671	56,899	56,633
1872	49,000	21,702	70,702	53,195
1873	35,840	26,756	62,596	55,716
1874	39,906	27,894	67,800	59,742
1875	41,931	29,483	71,414	51,870
1876	39,145	36,191	75,336	52,468
1877	39,743	53,582	93.325	54,088
1878	39,360	48,212	87,572	55,001
1879	46,670	50,421	97,091	62,412
1880	36,509	56,2*5	92,734	59,482
1881	32,170	54.057	86,227	61,689
1882	35,509	58,366	93,875	55,683
1883	35,653	63,493	99,146	59.350
1884	39,767	69,623	109,390	64,692
1885	41,993	81,616	123,609	62,050
1886	43,069	65,046	108,115	60,510

* Illegible.

PRODUCTION OF COPPER IN GREAT BRITAIN.

Years.	Ore.	Copper.	Years.	Ore.	Copper.
	Long Tons.	Long Tons.		Long Tons.	Long Tons.
1860	362,696	15,968	1878	56,094	3,952
1865	198,298	11,888	1879	51,035	3,462
1870	106,698	7,175	1880	52,118	3,662
1871	97,129	6,280	1881	52,556	3,875
1872	91,893	5,703	1882	52,810	3,464
1873	80,188	5,240	1883	46,820	2,620
1874	78,521	4,981	1884	42,149	3,350
1875	71,528	4,323	1885	36,379	2,773
1876	79,252	4,694	1886	18,617	1,471
1877	73,143	4,486			

IMPORTS OF COPPER INTO GREAT BRITAIN FROM 1878 TO 1886 INCLUSIVE.

Character.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.
	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.
Pure in pyrites	14,443	12,040	16,446	13,551	15,672	15,016	14,077	16,333	13,905
Pure in precipitate.....	13,173	18,159	18,205	18,619	17,935	23,645	19,688	21,398	19,323
Pure in ore	15,441	13,173	14,976	15,396	15,489	15,880	21,677	15,683	13,749
Pure in regulus	5,155	7,049	6,598	6,491	9,270	8,952	11,181	28,202	18,069
Bars, cakes, &c..........	39,360	46,670	36,509	32,170	35,509	35,653	39,767	41,993	43,069
Total	87,572	97,091	92,734	86,227	93,875	99,146	109,390	123,611	108,115

IMPORTS OF PYRITES INTO GREAT BRITAIN.

Years.	Norway.	Portugal.	Spain.	Germany.	Other Countries.	Total.
	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.
1873	67,462	199,559	246,692	..	6,634	520,347
1874	41,044	162,569	294,117	..	907	498,637
1875	21,820	165,433	344,019	..	6,283	537,555
1876	7,688	56,579	419,068	..	21,417	504,752
1877	8,564	149,562	498,977	..	22.209	679,312
1878	5,773	136,705	419,561	..	12,318	574,357
1879	8,485	82,529	374,505	..	15,783	481,302
1880	10,952	166,519	463,199	8,695	8,684	658,049
1881	6,009	140,079	379,216	8,412	8,662	542,378
1882	..	114,132	497,807	..	15,761	627,700
1883	1,271	121,137	473,343	..	5,537	601,288
1884	522	85,454	471,556	..	5,541	563,073
1885	2,608	28,899	619,523	..	3,491	654,521
1886	4,117	28,656	521,718	..	2,497	556,988

METALS EXTRACTED FROM BURNED CUPRIFEROUS PYRITES.

Years.	Ore.	Copper.	Gold.	Silver.	Years.	Ore.	Copper.	Gold.	Silver.
	Long Tons.	Long Tons.	Ozs.	Ozs.		Long Tons.	Long Tons.	Ozs.	Ozs.
1880	415,567	15,000	1,043	246,981	1884	416,412	15,200	1,900	335,000
1881	396,737	14,000	1,490	258,463	1885	407,700	14,880	1,840	328,000
1882	434,427	15,300	1,500	400,000	1886	393,699	14,370	1.780	316,000
1883	439,156	15,370	1,511	348,210					

Copper Production of Spain and Portugal.

Mines.	1886.	1885.	1884.	1883.	1882.	1881.	1880.
	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.
Rio Tinto (Spain)	24,700	23,484	21,564	20,472	17,389	16,666	16,215
Tharsis (Spain)....................	11,000	11,500	11,800	9,800	9,000	10,203	9,151
Mason and Barry (Portugal)......	7,000	7,000	7,500	8,000	8,000	8,170	6,603
Sevilla (Spain)	2,135	1,800	2,000	2,026	1,885	1,340	1,705
Portugueza (Portugal)............	1,258	1,665	2,300	2,357	1,760	1,410	1,000
Poderosa (Spain)..........	3,560	2,424	2,251	1,000	800	800	800
Total..................	49,653	47,873	47,415	43,655	38,774	38,589	35,174

Production of the Rio Tinto Mines.

Years.	Pyrites for Shipment.	For Extraction of Copper by Local Treatment.	Total.	Actual Consumption of Pyrites in England, Germany, &c.	Average Copper Contents of Ore Mined.
	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Per Cent.
1877	251,360	520,391	771,751	..	..
1878	218,818	652,289	871,107	..	..
1879	243,241	663,359	906,600	236,849	..
1880	277,590	637,567	915,157	274.201	2·619
1881	249,098	743,919	993,017	256,827	2·750
1882	259,924	688,307	948,231	292,826	2·805
1883	313,291	786,682	1,099,973	288,104	2·956
1884	312,028	1,057,890	1,369,918	314,751	3·234
1885	406,772	944,694	1,351,466	354,501	3·102
1886	336,548	1,041,833	1,378,381	347,024	3·016

Production of Metallic Copper at Rio Tinto.

Years.	Long Tons.	Years.	Long Tons.	Years.	Long Tons.
1876	946	1880	8,559	1884	12,668
1877	2,495	1881	9,466	1885	14,593
1878	4,184	1882	9,740		
1879	7,179	1883	12,295	1886	15,863

Operations of the Tharsis Company.

Years.	Ore Raised.	Pyrites Shipped.	Precipitate Shipped.	Net Profits.	Dividends.
	Long Tons.	Long Tons.	Long Tons.	£	£
1882	486,860	218,218	5,534	(?)	(?)
1883	490,033	202,318	6,717	334,401	323,032
1884	518,552	206,939	7,095	(?)	(?)
1885	587,303	311,151	6,110	104,211	117,466
1886	573,446	273,298	6,463	91,240	88,099

MERTON'S ESTIMATE OF THE WORLD'S PRODUCTION OF ZINC.

Countries.	1886.	1885.	1884.	1883.	1882.	1881.	1880.
	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.
Rhine District and Belgium	129,020	129,754	130,522	123,891	119,193	110,989	98,830
Silesia	81,630	79,623	76,116	70,405	68,811	66,497	64,459
Great Britain	20,730	23,099	29,259	28,681	25,581	24,419	22,000*
France and Spain	15,305	14,847	15,311	14,671	18,075	18,358*	15,000
Poland	4,145	5,019	4,164	3,733	4,400	4,400*	4,000*
Austria	3,760	3,890	4,470	4,672	5,094	4,270	2,520*
Total, Europe	254,590	256,232	259,872	246,033	241,154	228,533	206,809
Total, United States	38,072	36,339	34,414	32,921	30,148	30,000*	20,749
Grand Total	292,662	292,571	294,286	278,954	271,302	258,533	227,558

* Estimated.

PRODUCTION OF NICKEL IN THE UNITED STATES IN 1885 AND 1886.

—	1885.		1886.	
	Quantity.	Value.	Quantity.	Value.
	Lbs.	Dollars.	Lbs.	Dollars.
Metallic nickel	245,504	169,398	182,345	109,407
Nickel in nickel ammonium sulphate	..	..	7,047	9,000
Nickel in matte	14,400	4,577	20,000	7,000
Nickel in ore	18,000	6,000	5,600	1,750
Total	277,904	179,975	214,992	127,157

PRODUCTION OF METALLIC NICKEL IN THE UNITED STATES FROM 1876 TO 1886 INCLUSIVE.

Years.	Pure Grain Nickel.	Nickel contained in Copper Nickel Alloy.	Total.	Average Price per Pound.	Value.	Years.	Pure Grain Nickel.	Nickel contained in Copper Nickel Alloy.	Total.	Average. Price per Pound.	Value.
	Lbs.	Lbs.	Lbs.	Dollars.	Dollars.		Lbs.	Lbs.	Lbs.	Dollars.	Dollars.
1876	..	..	201,367	2·60	523,554	1882	277,034	4,582	281,616	1·10	309,777
1877	..	..	188,211	1·60	301,138	1883	6,500	52,300	58,800	·90	52,920
1878	..	..	150,890	1·10	165,979	1884	..	64,550	64,550	·75	48,412
1879	..	..	145,120	1·12	162,534	1885	..	..	245,504	·69	169,398*
1880	..	..	233,893	1·10	257,282	1886	..	..	182,345	·60	109,407*
1881	..	..	265,668	1·10	292,235						

* Not including value of nickel in ore and matte.

TOTAL PRODUCTION OF SUBSTANCES CONTAINING COBALT IN 1885 AND 1886.

—	1885.		1886.	
	Quantity.	Value.	Quantity.	Value.
	Lbs.	Dollars.	Lbs.	Dollars.
Cobalt oxide	8,423	19,373	8,680	17,378
Matte	180,000	14,500	243,875	20,000
Ore	201,000	31,500	70,000	3,500
Total	..	65,373	..	40,878

PRODUCTION OF COBALT OXIDE IN THE UNITED STATES.

Years.	Lbs.	Years.	Lbs.	Years.	Lbs.
1869	811	1875	3,441	1881	8,280
1870	3,854	1876	5,162	1882	11,653
1871	5,086	1877	7,328	1883	1,096
1872	5,749	1878	4,508	1884	2,000
1873	5,128	1879	4,376	1885	8,423
1874	4,145	1880	7,251	1886	8,689

PRODUCTION OF CHROME IRON ORE FROM 1882 TO 1886.

Years.	Quantity.	Value in California.	Years.	Quantity.	Value in California.
	Long Tons.	Dollars.		Long Tons.	Dollars.
1882	2,500	50,000	1885	2,700	40,000
1883	3,000	60,000	1886	2,000	30,000
1884	2,000	35,000			

PRODUCTION OF POTASSIUM AND SODIUM BICHROMATES.

Years.	Potassium Bichromate.	Sodium Bichromate.	Years.	Potassium Bichromate.	Sodium Bichromate.
	Short Tons.	Short Tons.		Short Tons.	Short Tons.
1882	1,000	..	1885	2,000	500
1883	1,000	..	1886	2,250	1,000
1884	1,250	..			

CHROMATE AND BICHROMATE OF POTASH AND CHROMIC ACID IMPORTED AND ENTERED FOR CONSUMPTION IN THE UNITED STATES, 1867 TO 1886 INCLUSIVE.

Fiscal Years ending June 30.	Chromate and Bichromate of Potash.		Chromic Acid.		Chrome Ore.		Total Value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Lbs.	Dollars.	Lbs.	Dollars.	Long Tons.	Dollars.	Dollars.
1867	875,205	88,787	..	..	..	..	88,787
1868	777,855	68,634	..	..	..	..	68,634
1869	877,432	78,288	..	3	..	..	78,291
1870	1,235,946	127,333	..	8	..	..	127,341
1871	2,170,173	223,529	..	5	..	..	223,534
1872	1,174,274	220,111	514	49	..	..	220,160
1873	1,121,357	178,472	922	276	..	..	178,748
1874	1,387,051	218,517	44	13	..	..	218,530
1875	1,417,812	183,424	45	22	..	..	183,446
1876	1,665,011	175,795	120	45	..	..	175,840
1877	2,471,669	264,392	13	10	..	..	264,402
1878	1,929,670	211,136	32	35	..	..	211,171
1879	2,624,403	221,151	..	..	..	..	221,151
1880	3,505,740	350,279	5	3	..	..	350,282
1881	4,401,237	402,088	124	89	..	..	402,177
1882	2,449,875	261,006	52	42	..	..	261,048
1883	1,960,140	208,681	290	338	..	..	209,019
1884	2,593,115	210,677	..	120	2,677	73,586	284,383
1885	1,448,539	92,556	..	39	12	239	92,834
1886	1,985,809	139,117	..	101	3,356	43,731	182,949

PRODUCTION OF LEADING TIN DISTRICTS FROM 1880 TO 1886.

——	1880.	1881.	1882.	1883.	1884.	1885.	1886.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Total exports from Singapore and Penang:— To Great Britain, Europe, and America	11,908	11,216	12,104	17,145	17,547	17,182	19,600
To India and China	2,855	3,519	5,870	4,161	4,920	3,887	4,025
	14,763	14,735	15,974	21,306	22,467	21,069	23,625
Total exports from Australia to Europe and America	9,100	10,200	10,300	10,500	8,800	8,500	7,375
Total production in the United Kingdom	8,918	8,615	9,158	9,307	9,574	9,000*	9,000
Totals	32,781	33,550	35,432	41,113	40,841	38,569	40,000
Total visible supply December 31	22,248	19,241	17,924	19,263	16,774	16,116	12,000

* Estimated.

PRODUCTION OF BROMINE IN THE UNITED STATES, 1883 TO 1886.

Sources.	1883.	1884.	1885.	1886.
	Lbs.	Lbs.	Lbs.	Lbs.
Pomeroy, Ohio	171,116	159,881	110,000	111,866
Tuscarawas Valley, Ohio	23,334	21,710	15,000	15,000
West Virginia	106,650	99,509	85,000	126,391
Pennsylvania	..	..	60,000	49,519
Michigan	..	..	40,000	125,528
Total	301,100	281,100	310,000	428,334

More than two-thirds of the bromine is used for the manufacture of potassium and sodium bromides for medicinal use and for photography. The remainder is used for aniline colours.

RAW MATERIALS, PRINCIPALLY OF MINERAL ORIGIN, USED IN THE PRODUCTION OF FERTILIZERS IN THE UNITED STATES DURING 1886.

Substances.	Amount.	Value.	Substances.	Amount.	Value.
			IMPORTS.		
PRODUCED IN THE UNITED STATES.	Long Tons.	Dollars.	Fertilizers:	Long Tons.	Dollars.
South Carolina phosphate rock	430,519	1,872,936	Bones, crude, not manufactured, burned, calcined, ground, or steamed, and bone dust and bone ash, for the manufacture of phosphates and fertilizers	19,784·31	325,581·00
North Carolina phosphate rock	1,400	12,600	Carbon, animal, fit for fertilizing only	1,450·70	25,800·00
Other phosphate rock	100	1,000	Guano	14,383·37	341,647·00
Bones	100,000	1,000,000	Kieserite, kyanite (or cyanite), and kainite	102,391·36	650,688·73
Marls	800,000	400,000	Phosphate, crude or native, for fertilizing purposes	37,980·50	432,591·04
Gypsum	102,000	405,960	All other substances used expressly for manure	21,364·66	358,170·00
Guano (natural)	500	5,000			
Total	..	3,297,496	Total fertilizers imported	..	2,134,486·77

ESTIMATED PRODUCTION OF MANUFACTURED FERTILIZERS, YEARS ENDED APRIL 30.

States.	1883.	1884.	1885.	1886.
	Short Tons.	Short Tons.	Short Tons.	Short Tons.
Alabama	3,000	4,000	4,000	5,000
Connecticut	15,000	15,000	15,000	15,000
Delaware	40,000	45,000	50,000	50,000
District of Columbia	7,000	7,000	7,000	5,000
Georgia	25,000	30,000	35,000	40,000
Illinois	30,000	35,000	35,000	30,000
Indiana	3,000	4,000	5,000	5,000
Iowa	1,000	1,000	1,000	..
Kentucky	2,500	3,500	4,000	7,000
Louisiana	2,000	2,500	3,000	15,000
Maine	0,500	7,000	7,500	7,500
Maryland	260,000	290,000	300,000	306,000
Massachusetts	75,000	80,000	85,000	80,000
Michigan	2,000	3,000	3,000	15,000
Missouri	6,000	6,000	6,000	6,000
New Jersey	85,000	90,000	95,000	90,000
New York	90,000	95,000	100,000	100,000
North Carolina	15,000	15,000	15,000	20,000
Ohio	15,000	15,000	18,000	20,000
Pennsylvania	60,000	65,000	70,000	80,000
Rhode Island	12,000	12,000	12,000	10,090
South Carolina	90,000	100,000	110,000	140,000
Virginia	30,000	40,000	40,000	50,000
West Virginia	2,000	2,000	3,000	3,000
Total	877,000	967,000	1,023,500	1,099,500
Value $	23,680,000	26,110,000	27,640,000	27,487,500

ESTIMATED CONSUMPTION OF MANUFACTURED FERTILIZERS IN THE FOLLOWING STATES, YEARS ENDING APRIL 30.

States.	1883.	1884.	1885.	1886.
	Short Tons.	Short Tons.	Short Tons.	Short Tons.
Alabama	45,000	45,000	45,000	40,000
Delaware	10,000	20,000	20,000	15,000
Florida	5,000	5,000	10,000	5,000
Georgia	125,000	170,000	180,000	160,704
Illinois	5,000	7,500	7,500	7,500
Indiania	8,000	8,000	10,000	7,500
Kentucky	6,000	6,000	10,000	8,000
Louisiana	5,000	5,000	5,000	10,000
Maryland	80,000	75,000	75,000	75,000
Michigan	5,000	5,000	5,000	10,000
Mississippi	20,000	10,000	10,000	5,000
Missouri	5,000	5,000	5,000	..
New York	30,000	30,000	35,000	30,000
New Jersey'	35,000	40,000	45,000	50,000
New England States	60,000	75,000	100,000	100,000
North Carolina	90,000	95,000	90,000	95,000
Ohio	20,000	20,000	20,000	30,000
Pennsylvania	80,100	100,000	100,000	115,000
South Carolina	90,000	110,000	100,000	107,927
Tennessee	10,000	10,000	15,000	10,000
Virginia and W. Virginia	80,000	100,000	100,000	100,000
Western States	26,000	25,000	30,000	25,000
Total	840,100	966,500	1,017,500	1,006,631

THE STATISTICS OF PYRITES PRODUCTION IN 1886.

Countries.	Consumed for Acid Making where Mined.	Imported for Acid Making.	Exported for Acid Making.	Copper Contents.	Silver Contents per Ton.	Gold Contents per Ton.
	Long Tons.	Long Tons.	Long Tons.	Per Cent.	Troy Ozs.	Pwts.
Spain and Portugal	..	..	711,419	3·05	1·50	2
United Kingdom	30,500	592,000	..	3·05	1·50	2
France	182,700	67,200	..	Variable	None	None
Germany	132,000	73,000	..	„	Uncertain	..
Belgium	28,000	..	22,000	„	..	..
Norway and Sweden	..	..	46,000	1·50	..	..
United States	55,000	57,000	..	3·00	Variable	..
Canada	..	..	37,000	3·50	7*	..

* The ores contain an average of 1 oz. of silver per unit of copper.

AVERAGE COMPOSITION OF THE WORLD'S PYRITES.

Localities.	Sulphur.	Iron.	Copper.	Arsenic.	Zinc.	Lead.	Carbonate of Lime.	Silica.	Total.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
Milan Mine, New Hampshire :—									
No. 1	46·00	40·00	3·75	Traces	4·00	None	..	6·25	100·00
No. 2	35·00	30·50	5·00	None	8·00	..	..	21·50	100·00
Davis Mine, Massachusetts	49·27	45·30	1·47	Traces	..	..	..	3·83	99·87
Elizabeth Mine, Vermont	33·00	50·00	3·50	„	..	..	..	13·50	100·00
Saint Lawrence county, New York	38·00	34·00	3·00	„	..	..	..	25·00	100·00
Ulster county, New York	39·12	34·16	Traces	„	..	..	..	26·69	99·97
Arminius Mine, Virginia	46·00	44·50	2·10	„	..	..	..	7·40	100·00
Gaston county, North Carolina	44·00	36·00	Traces	„	..	..	..	20·00	100·00
Paulding county, Georgia	41·00	37·00	4·00	„	..	..	..	18·00	100·00
Ducktown, Tennessee	35·00	40·00	5·00	None	..	..	8·00	12·00	100·00
Capleton, Canada*	40·21	35·20	5·10	Traces	..	..	..	19·43	99·94
Rio Tinto Mines, Spain*	48·50	40·92	4·21	0·33	0·22	1·52	0·90	3·46	100·06
Tharsis Mines, Spain*	49·90	42·55	3·10	0·47	0·35	0·93	†0·87	2·20	100·37
San Domingo, Portugal*	49·07	44·28	3·25	0·38	..	..	‡0·93	2·59	100·50
Swedish mines, average	38·05	42·80	1·50	None	..	..	5·09	12·56	100·00
Norwegian mines, average§	46·15	44·20	2·10	Traces	1·20	..	2·50	3·65	99·80
French mines, average	46·60	39·70	None	„	..	..	0·20	13·50	100·00
German mines, average	45·60	38·52	..	0·95	6·00	0·74	..	8·19	100·00
Belgium mines, average	42·80	35·70	..	0·20	0·40	0·92	‖5·45	12·47	99·94
English mines, average	34·34	32·29	0·89	0·91	1·32	0·40	..	30·03	100·00
Irish mines, average	47·41	41·78	1·93	2·11	2·00	..	..	4·77	100·00

* Gold and silver variable. † Includes sulphate of lime 0·50. ‡ Includes carbonate of magnesia 0·25.

§ No gold or silver. ‖ Includes carbonate of magnesia 1·65, and sulphate of lime 0·65.

SHIPMENTS OF BORAX FROM CALIFORNIA AND NEVADA IN 1883, 1884, 1885, AND 1886.

To	1883.	1884.	1885.	1886.
	Lbs.	Lbs.	Lbs.	Lbs.
East by rail	3,288.200	2,995,880	1,500,000	4,009,600
New York by sea	1,911,116	3,146,326	5,081,557	5,713,241
Liverpool	1,287,777	740 291	2,312,827	1,964,283
China	20,231	33,862	28,056	32,392
Japan	8,882	3,327	20,498	
Victoria	1,200	2,487	..	
Mexico	6,301	3,555	7,916	
Honolulu	4,200	475	120	
Australia	820	21,512	29,589	
Central America	..	200	600	
Antwerp	..	22,500	..	
British Columbia	..	..	807	
France	..	..	23,630	45,337
Total	6,528,727	7,270,445	9,006,200	11,764,85

PRODUCTION OF BORAX.

Years.	Lbs.	Years.	Lbs.	Years.	Lbs.
1876	5,180,810	1880	3,860,748	1884	7,000,000
1877	3,727,280	1881	4,015,405	1885	8,000,000
1878	2,802,800	1882	4,236,291		
1879	1,584,966	1883	6,500,000	1886	9,778,290

BORAX, BORACIC ACID, AND BORATE OF LIME, IMPORTED AND ENTERED FOR CONSUMPTION IN THE UNITED STATES, 1867 TO 1886 INCLUSIVE.

Fiscal Years ending June 30.	REFINED BORAX.		CRUDE BORAX.		BORACIC ACID.		BORATE OF LIME.		TOTAL.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Lbs.	Dollars.	Lbs.	Dollars.	Lbs.	Dollars.	Lbs.	Dollars.	Dollars.
1867	49,652	6,601	5,672	711	770,756	73,396	..	..	80,708
1868	73,183	10,127	22,293	2,985	243,993	22,845	..	..	35,957
1869	89,695	12,799	34,822	8,011	988,033	109,974	..	..	130,784
1870	97,078	14,511	2,616	322	1,163,145	173,806	33,529	1,666	190,305
1871	131,927	20,705	5	1	1,204,049	185,477	45,600	2,248	208,431
1872	35,512	6,288	..	..	1,103,974	191,575	22,500	800	198,663
1873	9,284	2,152	..	..	1,222,006	255,186	..	..	257,338
1874	3,869	1,253	588	78	233,955	52,752	..	..	54,083
1875	5,153	1,224	..	..	41,742	6,280	..	..	7,504
1876	3,145	691	..	..	137,518	15,711	..	..	16,402
1877	3,500	676	55	12	107,468	11,231	..	..	11,919
1878	3,492	514	286	61	178,798	14,925	..	..	15,500
1879	3,472	490	..	..	306,462	21,888	..	..	22,378
1880	15,278	2,011	..	..	243,733	18,473	22,122	742	21,226
1881	4,136	835	..	..	187,053	15,771	..	..	16,636
1882	15,710	3,774	..	..	536 334	71,343	..	..	75,117
1883	5,611	1,359	..	..	4,334,432	580,171	..	..	581,530
1884	7,332	1,691	142	34	44,512	4,494	..	..	6,219
1885	240	41	..	..	48,517	4,035	..	..	4,076
1886	4,625	770	4	1	430,655*	26,237	..	..	27,008

* 393,832 pounds were "commercial," the remainder pure.

PAINTS.

White-lead.—There are 35 white-lead corroders in the United States of America, most of whom belong to a combination, and manufacture by the so-called Dutch process. 60,000 tons are produced. One-third of this was manufactured on the Atlantic coast, and the remainder inland and west.

IMPORTS OF WHITE LEAD, OXIDES OF LEAD, AND ZINC OXIDE IN 1885 AND 1886.

WHITE LEAD.		OXIDES OF LEAD. 13,000 tons were produced.			ZINC OXIDE. Production 18,000 tons.		
Fiscal Year ending June 30.	Pounds.	Fiscal Year ending June 30.	1885.	1880.	Fiscal Year ending June 30.	Dry.	In Oil.
			Lbs.	Lbs.		Lbs.	Lbs.
1885	705,535	Red lead…………	216,449	466,855	1885	2,233,128	98,566
1886	755,193	Litharge…………	35,283	23,770	1886	2,670,019	106,042
		Orange mineral….	693,781	1,412,151			

Monthly Patent List.

The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

918. J. Bullen, Manchester. Fittings for the mouths or nozzles of carboys to enable their contents to be expelled by air or gas pressure, pumped or otherwise. January 21.

1038. J. Rankine and J. P. Hall, Jarrow. The cleaning and preservation of boiler furnaces. January 24.

1083. A. Don, London. Apparatus for prevention and consumption of smoke and more complete combustion of fuel in furnaces. Complete Specification. January 24.

1392. B. E. R. Newlands and J. B. Alliott, London. *See* Class XVI.

1419. W. P. Thompson.—From J. B. Craft, United States. Improvements in refrigerating processes and apparatus therefor. Complete Specification. January 31.

1519. J. P. Guy, Burslem. An improved refractory material for use in furnaces or kilns. February 2.

1589. H. E. Newton.—From E. Theisen, Germany. Apparatus for evaporating and cooling purposes. February 2.

1823. F. Vyrazil, London. Evaporating or condensing apparatus. February 7.

1921. L. Gismondi, London. Filter presses. February 8.

1923. J. A. Drake and R. Muirhead, London. Filter presses. February 8.

2200. T. Williamson, Rutherglen, N.B. Gas producers. February 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

66. M. Prior. Economising heat in boilers, and preventing corrosion. February 11.

1315. W. Bergh. Centrifugal apparatus for separating fluids of different specific gravities. January 28.

2127. J. Brock and T. Minton. Filter presses. February 11.

5117. F. Hocking. Apparatus for condensing steam, and for cooling and heating other fluids. February 18.

5469. A. Dickinson. Condensers. February 18.

5676. J. Platt. Apparatus for obtaining more perfect combustion of fuel in furnaces. February 4.

8396. A. J. Marquand. Electrical apparatus for preventing or removing incrustation in boilers. February 18.

17,276. E. Beauvalet and L. Beauvalet. Cocks or taps for use with liquids under pressure. February 11.

1883.

213. H. T. Yaryan. Vacuum evaporating and distilling apparatus. February 11.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

1018. C. Herzog, London. Improvements in apparatus for carburetting air and enriching gas. January 23.

1109. G. Prescott and J. Farrar, Dublin. Improvements in light-giving apparatus where a stream of oxygen is used. January 25.

1195. J. T. Williams, Bristol. Improvements in treating small anthracite coal and rendering the same conveniently available for use as fuel. January 26.

1232. C. H. Gosling, London. Improved artificial fuel. January 26.

1259. J. J. Royle, London. Improvements in the method of and apparatus for heating by steam. January 27.

1274. T. Settle, Westminster. Improvements in apparatus for relieving gas retorts from pressure. Complete Specification. January 27.

1282. J. Lyle, London. An improved automatic retort grate and apparatus connected therewith for burning coal or other fuel, whereby the fuel is retorted or raised to a high temperature before it enters the fire chamber, ensuring perfect smokeless combustion and causing a corresponding saving in fuel. January 27.

1315. C. Brotherhood, Bristol. Improved apparatus for automatically generating gas from liquid fuel. January 28.

1367. J. Morley, London. An improvement in the method of heating, dissolving, and mixing the ingredients for making fire-lighters. January 30.

1844. E. B. Ellice-Clark and L. Chapman, London. Improvements in and apparatus for or connected with the production of oxygen and nitrogen gases from atmospheric air. February 7.

2096. J. H. R. Dinsmore, London. Improvements in the manufacture of illuminating gas and in apparatus employed therein. February 11.

2183. W. Boggett, London. New or improved apparatus for obtaining heat and light by the combustion of petroleum or other analogous oils or spirits. February 13.

2322. J. B. Terrace, Glasgow. Improvements in fire-clay gas retorts. February 16.

2378. W. Brown, London. Improvements in apparatus for carburetting air or gas. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

1297. F. A. McMinn. The manufacture of inflammable gas from oil, and from oil and coal. February 4.

3834. A. E. Webb, H. J. R. Johnstone, and H. W. Paul. Incombustible wicks. January 28.

4881. W. Majert and G. Richter. Process and apparatus for the production of hydrogen gas by a dry method, chiefly for military purposes. February 18.

4886. J. Wybauw. Apparatus for lighting and heating by means of gas. January 28.

5012. G. F. Redfern.—From A. Robert. Apparatus for the manufacture of artificial fuel. February 4.

8679. A. G. Meeze. Manufacture of gas and apparatus therefor. February 11.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATIONS.

1158. F. Lennard and S. P. Eastick, Westminster. A new process for the purification of crude anthracene, and in relation to which the otherwise waste materials may be utilised. January 25.

1617. H. J. Fenner, F. Fenner, and G. H. Fenner, London. An improved process for treating or refining hydrocarbon products, such as are obtained from the distillation of coal tar. February 3.

2282. F. Rylance, W. Rylance, and J. Rylance, Manchester. Improvements in or relating to the obtaining or production of certain bye-products in the manufacture of gas from coal. February 15.

COMPLETE SPECIFICATION ACCEPTED.

1887.

5824. J. W. Knights and W. D. Gall. Manufacture of carbolic acid and other tar acids. February 18.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

1346. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Improvements in and relating to the manufacture of blue and blueish azo dyes. January 28.

1472. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, France. Manufacture of new colouring matters. January 31.

1571. J. C. Mewburn.—From La Société Jeannolle et Cie. The production of fast black colour by toluidine for dyeing and printing fibres and fabrics. February 2.

1593. H. H. Leigh.—From R. G. Williams, United States. Improvements in the manufacture of colouring matters. February 2.

2084. A. Studer and A. Liebmann, Manchester. The production of new yellow, red, and blue colouring matters. February 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4243. W. Majert. Manufacture of colouring matters. February 18.

15,265. G. Thomas.—From H. Schultz, Germany. The manufacture of certain dye matters. January 28.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATION.

603. C. R. Dames, London. Improvements in the method of preparing fuller's earth for use in manufactures. Complete Specification. January 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2423. G. I. J Wells and S. L. Howard. Treating rhea bark, China grass, and similar material, and apparatus therefor. February 18.

4799. C. Binns. Machine for polishing, brushing, or raising yarns or woven fabrics of wool, worsted, shoddy, or cotton. January 28.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

APPLICATIONS.

897. J. Marshall, Walsden. Dyeing and printing cotton cords and fustians and other cotton pile fabrics in two colours, and so producing a shot effect. January 20.

988. A. McNab, Glasgow. Improvements in boiling or bleaching and washing textile fabrics, and in apparatus therefor. January 23.

1357. T. Winter, Halifax. Immersion rollers used in printing, dyeing, bleaching, sizing, or other like purposes. January 30.

1804. W. J. Selous, London. Improved method and apparatus for printing wall paper and various other printing matter. February 7.

1951. S. Spencer, London. Improvements in machines for mordanting and dyeing hanks of yarn, also applicable for sizing and washing a certain kind of woollen hanks. February 9.

2093. F. Lee, J. Bradshaw, and F. Lee, Bradford. An improved method of and apparatus for dyeing wool, cotton, and other fibrous substances. February 11.

2341. W. Mycock, Manchester. Improved arrangement of vats and apparatus for dyeing. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4507. E. Sutcliffe and G. E. Sutcliffe. Method and apparatus for washing, bleaching, dyeing, and treating textile materials. January 28.

4547. R. Chadwick and J. W. Consterdine-Chadwick. Dyeing yarns and fabrics black, blue, and other colours. January 28.

4579. T. Hardcastle. Printing and finishing cotton fabrics. February 11.

4627. W. B. Silverlock. Apparatus for applying bronze or other powder to the surface of paper or other material. February 4.

13,415. W. J. S. Grawitz. Dyeing vegetable and animal textile materials before spinning. February 18.

13,896. A. J. Boult.—From W. T. Alexander. Dyeing wool tops and other fibrous materials, and apparatus therefor. January 28.

1888.

402. H. H. Lake.—From U. Weldon. Apparatus for dyeing textile and other materials. February 11.

VII.—ACIDS, ALKALIS, and SALTS.

APPLICATIONS.

896. H. Kenyon, Clayton. The recovery of sulphur, cyanogen, ammonia, utilising waste products, the production of ammonia, cyanogen, and other matters. January 20.

1082. H. P. Weidig and R. C. Remmey, London. Improvements in absorption towers for the manufacture of muriatic or nitric acid. Complete Specification. January 24.

1270. W. Donald, London. Improvements in the manufacture of nitric acid. January 27.

1371. J. Hargreaves, T. Robinson, and J. Hargreaves, Liverpool. Improvements in the treatment of alkali waste to obtain sulphuretted hydrogen and other products, and in apparatus employed to obtain these substances. January 30.

1495. A. M. Chance and J. F. Chance, Liverpool. Improvements in treating sulphides of sodium and potassium to obtain sulphuretted hydrogen, and in apparatus employed therein. February 1.

1546. J. Wilson, Leith. Improvements in making sulphide of zinc. February 2.

1560. C. N. Hake, London. Improvements in the manufacture of chlorate of potash. February 2.

1561. C. N. Hake, London. Improvements in the manufacture of chlorate of potash. February 2.

1665. J. Beveridge, Frodsham. Improvements in obtaining gaseous hydrochloric acid in suitable condition for conversion into chlorine, &c. February 4.

1693. A. Nicolle, Liverpool. Improvements in or appertaining to the manufacture of phosphorus. February 4.

1707. H. A. Fergusson, London. Process for recovering zinc and alkali from spent liquors of Lalande voltaic batteries. February 4.

2004. W. W. Staveley, Liverpool. Improvements in or appertaining to the manufacture of alkali carbonates, and also of phenol or phenoloid bodies. February 10.

2019. J. Perino. *See* Class X.

2070. J. Hauff, London. Producing poly-basic aluminium salts of hydrochloric acid and nitric acid. Complete Specification. February 10.

2104. H. W. Deacon and F. Hurter, London. Improvements in the manufacture of chlorine. February 11.

2236. A. J. Lawson, Bristol. Improvements in apparatus for the causticisation of sodium carbonate and potassium carbonate. February 14.

2311. H. W. Deacon and F. Hurter, London. Improvements connected with the manufacture of chlorine. February 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2963. A. Brin and L. Q. Brin. Production or manufacture of chlorine. February 11.

4201. J. Taylor. Manufacture of nitric acid. January 28.

4241. H. Baum. Manufacture of pyro-sulphates. January 28.

4430. J. Brock.—Partly communicated by G. Lunge. Apparatus for the manufacture of monohydrated sulphuric acid. January 28.

5393. E. Hermite. Manufacture of bleaching and disinfecting liquor. February 18.

8666. A. M. Chance and J. F. Chance. Treating alkali waste to obtain sulphuretted hydrogen, and apparatus therefor. February 4.

VIII.—GLASS, POTTERY, and EARTHENWARE.

APPLICATIONS.

935. S. Turner, Hull. An improved roof tile, which he calls "A crab-claw lock roof tile." January 21.

1093. J. Edwards, London. Improved method of and appliances for supporting articles of pottery during the baking or firing. January 24.

1385. G. F. Chance, London. Improvements in kilns and lears for flattening and annealing sheets of glass, and in the method of conducting the process of annealing sheets of glass. January 30.

1449. D. Gilles, London. A special disposition of furnace for annealing thick plate glass by letting it cool gradually and by annealing it with gas heat. January 31.

1515. C. A. Eissner, London. Improvements in machines for cutting clay in the manufacture of bricks and tiles, and for like purposes. February 1.

1517. H. Tooth, London. Improvements in the manufacture of articles in pottery, china, earthenware, terra-cotta, and the like. February 1.

1550. J. P. Guy, Burslem. A machine for making hollow earthenware. February 2.

1751. J. B. Germeuil-Bonnaud, London. Improvements in the production of pictures and designs on china, earthenware, and glass. February 6.

1764. R. Stanley, London. Improvements in ovens or kilns for burning bricks, tiles, and other articles. February 6.

1800. The Worcester Royal Porcelain Co., Limited, and W. M. Binns, London. Improvements in the application of designs or ornaments by transfer to potters' ware or other irregular surfaces. February 7.

1862. J. T. Welch, Bethesda, N. Wales. Improvements in the utilisation of slate and slate waste, and in the manufacture of glass and other articles therefrom. February 8.

2184. E. Story and R. Punshon, London. Improvements in the manufacture of glass. February 14.

2206. H. Aynsley and Co., Longport. Improvements in ovens for baking or firing pottery ware. February 14.

2241. W. H. Fitch, London. Improvements in the manufacture of glass bottles and similar articles. February 14.

2261. J. Tabrar, London. Improvements in the manufacture of bottles and other hollow ware in glass, and in machinery for the same. February 14.

2280. D. Rylands and B. Stoner, Barnsley. Improvements in machinery for the manufacture of bottles and other hollow articles in glass. February 15.

2318. J. B. Adams, London. A process for the manufacture of bottles and other glass ware, and an apparatus for performing the same. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5560. A. D. Brogan and A. M. Malloch. Producing rippled, chequered, or other patterns or designs upon rolled plate and sheet glass, and apparatus therefor. February 18.

17,066. M. Ehrlich and C. Storck. Printing gold, silver, or platinum decorations on ceramic articles. February 4.

17,763. E. Leak. Apparatus for supporting pottery ware in kilns or ovens. February 4.

17,857. R. Haddan.—From E. M. Burr and J. W. Stipes. Machines for cutting clay in the manufacture of bricks and tiles. February 4.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

1004. G. A. Wright, London. An improved brick block or slab for building or other purposes. January 23.

1135. A. Clery, London. Metallic cement. January 25.

1689. J. C. J. Smith, London. Improvements in apparatus for the manufacture of Portland cement. February 4.

1978. W. Joy, London. Improvements in and connected with the manufacture of cement, and apparatus for use therein. February 9.

1979. G. H. Sharp and F. W. Turner, London. Improved manufacture of cement suitable as plaster and for moulding purposes. February 9.

1980. M. H. Heys, Manchester. Improvements in and relating to the manufacture of lime and of natural and artificial cements. February 9.

2272. J. Bassett and F. N. Seydé, Birmingham. Improvements in the construction of fire-proof ceilings and partitions. February 15.

2366. G. J. Snelus, J. C. Swan, and H. Smith, London. Improvements in the manufacture of cement. February 16.

COMPLETE SPECIFICATION ACCEPTED.

1887.

4689. L. Preussner. Artificial stone. February 11.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

686. H. H. Lake.—From J. Illingworth, United States. Improvements relating to the casting of metal ingots and to apparatus therefor. Complete Specification. January 16.

692. A. M. Clark.—From La Société Anonyme de Produits Chimiques, Etablissements Malétra, France. Improvements in the extraction of cobalt and nickel from manganiferous ores of cobalt. January 16.

716. J. Noble, Middlesbrough. An improvement in regenerative furnaces for use in the manufacture of steel and other metals. January 17.

767. M. N. d'Andria, Liverpool. Improvements in recovering tin from tinned metal. January 18.

814. P. Jensen.—From F. W. Martin, France. A new or improved process and apparatus for the manufacture of plates, sheets, and other objects of copper, yellow metal, naval brass, and the like. January 18.

885. J. Otter, Brightside, Yorks. An improved crane for lifting and turning over large ingots during the process of being forged. January 20.

920. G. Baron de Overbeek.—From F. Horming and F. W. Kassnuyer, Germany. Improvements in the production of the alkaline metals. January 20.

1174. C. K. Farquharson and R. R. Gubbins, London. Removing the tin from tin scrap. January 25.

1380. J. Moss, Liverpool. Improvements in miners' lamps. January 30.

1500. J. Pearson, London. Improvements in miners' safety lamps. February 1.

1569. E. N. Barnard, London. Improvements in economically chlorinating ores, together with leaching tanks for the same. February 2.

1633. R. H. Edmundson and J. Smethurst, London. An improved flame-destroying cartridge for blasting or mining purposes. February 3.

1723. A. French and R. Munro, Glasgow. Improvements in separating or extracting gold, antimony, or tin from ores, alloys, sulphides, or oxidised compounds containing also lead, copper, or iron. February 6.

1788. W. S. Sutherland, Liverpool. Improvements in heating, principally for welding or uniting plates, tubes, or other forms of iron or steel or other metals, and in apparatus employed therein. February 7.

1886. W. H. Beck.—From A. Sentex, C. Marechal, and A. Saunier, France. Improvements in the manufacture of bronze. February 8.

1904. H. Moon, London. Improvements in apparatus for the extraction of metals from ores by amalgamation. February 8.

1914. J. Hornsby and G. E. Coupe, London. Improvements in apparatus suitable for separating gold from its ores. February 8.

1939. H. Morris.—From A. W. de Leuse Lenczewsky, Russia. A mode of treating manganese ore for convenience and economy in transportation and shipment. February 9.

1991. T. L. M. Hare and L. Boudreaux, London. The manufacture of nickel electrotypes. February 9.

2018. J. C. Bothams, Salisbury. Improvements in the construction and arrangement of armour for vessels of war. February 10.

2019. J. Perino, London. Improvements in disintegrating copper pyrites by means of nitric iron salts for extracting copper. Complete Specification. February 10.

2025. A. N. Mason, Birmingham. Improvements in amalgamating or separating metals from their ores, and in machinery to be employed therefor. February 10.

2071. H. H. Lake.—From E. S. Hayden, United States. Improvements relating to the separation and refining of metals, and to apparatus therefor. Complete Specification. February 11.

2182. J. Sinclair and J. P. Smith, London. Improvements relating to the production of metallic compounds or alloys. February 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

704. H. Hall. Process and apparatus for coating sheets, plates, and pieces of iron, steel, or other metal with tin, terne, and other metals. January 28.

3704. J. Hargreaves, T. Robinson, and J. Hargreaves. Treatment of cupreous pyrites to separate gold, silver, copper, and sulphur, and to obtain oxide of iron; and apparatus therefor. February 4.

4054. F. E. Elmore Means and apparatus for coating metal, and for cleaning metal. February 18.

4228. C. Netto. Extraction of aluminium from substances containing it. January 28.

4389. G. J. Snelus. Treatment of furnace slag, and apparatus therefor. February 4.

4512. T. Marshall. Miners' safety lamps. January 28.

4528. H. F. Taylor and W. P. Struvé. Method of finishing metal plates coated with tin, &c., and apparatus therefor. January 28.

5727. A. Wilson. Apparatus for manufacturing compound plates of iron and steel. February 18.

6035. C. Morris and G. Birkbeck. Manufacture of terne plates. February 18.

7657. J. Weirich. Treatment of auriferous materials. February 18.

8277. W. Jukes. Manufacture of steel, and apparatus therefor. February 4.

11,530. J. Cabry and W. H. Kinch. Improved iron and steel sleepers. February 18.

12,741. G. G. Mullins. Improvements in the process of puddling or treating iron for the purpose of purifying, hardening, and improving it. January 28.

16,027. C. E. Tripler. Method and apparatus for amalgamating and separating precious metals from powdered ore or earth. February 11.

16,495. W. R. Lake.—From A. Vogelmann. Apparatus for extracting metals from their ores by amalgamation. February 4.

17,356. A. E. Barthel and J. C. J. Möller. Process for providing metallic objects with a coating of tin. February 11.

1888.

401. H. A. Harvey. Treatment of low steel. February 18.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

549. J. Blackburn, London. Improvements in dynamo-electric generators and motors. January 13.

633. C. Coerper, London. Improvements in dynamo-electric machines. Complete Specification. January 14.

713. T. Coad, Forest Gate. Improvements in voltaic or galvanic batteries. January 17.

718. E. Guitton.—From M. Sappey, France. Improvements in self-acting electric batteries or generators in which the liquids are automatically renewed. January 17.

727. R. Kennedy, Glasgow. Improvements in thermo-dynamo-electric machines. January 17.

729. D. Urquhart, London. Improvements in electric batteries and elements therefor. January 17.

734. J. Noad, London. Improvements in galvanic batteries. Complete Specification. January 17.

980. W. Balch, London. An improvement in the construction of electric battery cells for lighting or other purposes. January 21.

1009. J. H. Davies, London. Improvements in dynamo-electric machines. January 23.

1100. G. Downing.—From E. Blass, Germany. Improvements in electrical brazing and soldering. January 24.

1128. A. A. Fortin, London. Improvements in galvanic batteries. January 25.

1177. E. E. Mandeville, London. Improvements in means for supporting or suspending elements in electric batteries. January 26.

1210. E. Andreoli.—From P. A. Fichet and A. L. C. Nodon, France. Reversible chlorine batteries. January 26.

1461. R. K. Boyle, London. Improvements in applying metals to metals by electric action or electric fusion, applicable more especially to obtaining a rough hard surface or a surface of a character other than that of the metal to which the surface is applied, but applicable in other cases where metals can be joined to metals by electric action or electric fusion. January 31.

1707. H. A. Fergusson, London. Process for recovering zinc and alkali from spent liquors of Lalande voltaic batteries. February 4.

1733. W. J. S. Barber-Starkey, Manchester. Improvements in the method of and apparatus for depolarising the negative elements of galvanic batteries. February 6.

1843. J. C. Mewburn.—From La Société Anonyme pour la Transmission de la Force par l'Electricité, France. Improvements in rheostats and rheotomes. February 7.

1875. G. Hookham, Birmingham, and R. H. Housman, Bromsgrove. Improvements in dynamo-electric machines and in electro-motors. February 8.

1876. G. Hookham, Birmingham. Improvements in the armatures of dynamo-electric machines, and of electro-motors February 8.

1968. W. Tilley, Brighton. An improved secondary battery or accumulator for the storage of electricity. February 9.

2178. R. N. Boyd, London. Improvements in plates for secondary batteries. February 13.

2246. H. H. Lake.—From R. Eickenmeyer, United States. Improvements relating to dynamo-electric machines. Complete Specification. February 14.

2308. C. Coerper, London. Improvements relating to dynamo-electric machines. Complete Specification. February 15.

2314. S. Z. de Ferranti, London. Improvements in electrical safety fuses. February 15.

2316. S. Z. de Ferranti, London. Improvements in dynamo-electrical machines and apparatus used in connexion therewith. February 15.

2368. M. Bailey and J. Warner, London. An improved method of manufacturing woven plates for secondary batteries. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2419. F. Bosshardt. — From A. L. Hillaire-Desbois, France. Dynamo-electric machines. January 28.

4322. J. Hopkinson and E. Hopkinson. Dynamo-electric machines. February 11.

4472. S. P. Thompson. The electro-deposition of cobalt. February 11.

4781. The Electrical Power Storage Co., Lim., and H. W. Butler. Improvements in electric batteries. February 4.

5009. J. T. Armstrong. Charging and re-charging, cleansing, changing and varying the chemicals and liquids used in secondary batteries. February 11.

5096. G. Kapp. Dynamo-electric machinery. February 18.

5583. H. Liepmann. Galvanic batteries. February 18.

10,057. E. de Pass.—From M. Bernard and E. Bernard. The extraction of aluminium from its fluorides by electrolysis. February 18.

17,837. P. M. Justice.—From E. G. Acheson. Means of generating electricity from heat. February 1.

1888.

100. H. H. Lake.—From W. Humans. Apparatus for generating electricity. February 18.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

517. R. Hunt, Liverpool. Improvements in the treatment of cotton seed oil foots. January 13.

550. R. Hunt, Liverpool. Improvements in the purification of cotton seed oil, and in apparatus therefor. January 13.

771. T. McDonald, Halifax. Improvements in apparatus employed in the manufacture of cake from oil seeds. January 18.

1846. A. Wilkinson, London. A novel process for treating palm and other coloured oils and fats to render them white and clear. February 7.

2306. O. H. von Wilke, London. A process for the manufacture of soap soluble in sea water. February 15.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

678. J. Nipper, London. Improvements in the manufacture of distemper colours. Complete Specification. January 16.

683. W. C. A. Holzapfel, Newcastle-on-Tyne. An anti-corrosive composition for the protection of the inside of iron and steel vessels, bridges, piers, and other structures which may be exposed to the action of the atmosphere or water. January 16.

870. A. Crossley, W. Prodham, P. P. Mosley, and W. H. Haynes, London. Improvements in the manufacture of oxide of iron pigment colour from copperas and other iron compounds containing sulphur and chlorine. January 19.

1101. J. O. Wallace and W. Ward, London. Improved anti-corrosive and anti-fouling compositions for coating of submerged surfaces. Complete Specification. January 24.

2344. W. S. Somers, Liverpool. The manufacture of an improvement in drying oils and varnishes. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4278. W. Corbould. Manufacture of whiting. February 11.

4578. J. Baird. Improvements in polish, and process of working the same. February 4.

4607. R. M. Collingham. Apparatus for forming black-lead or other material into blocks. January 28.

1888.

678. J. Nipper. Manufacture of distemper colours. February 18.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

742. L. A. Groth, London. Improved apparatus for tanning hides and skins by the aid of electricity. January 17.

1818. G. W. Rhodes, Finchley. Tanning by electricity, in a tanning pit or trough, the combination of motionless hides, skins, &c., with a circulating tanning liquor traversed by an electric stream. February 7.

1913. A. Herrmann, M. Herrmann, and E. Herrmann, London. An improved process for dyeing furs or skins. Complete Specification. February 8.

2154. M. Martin, V. Martin, E. Schloesser, W. Schloesser, and F. Schloesser, London. Improvements in apparatus for shaving or scraping, dressing, and polishing hides and skins. Complete Specification. February 13.

2353. W. Zahn, London. Improvements in process of tanning. Complete Specification. February 16.

XV.—AGRICULTURE, MANURES, ETC.

APPLICATION.

571. F. I. R. Seaver, London. Improvements in manures. January 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5532. E. Edwards. *See* Class XVIII.—C.

6848. F. Knauer. Enriching seed plants with alimentary substances. February 18.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

642. E. Easton and S. Hoyland, London. Improvements in apparatus for extracting juice from sugar canes. January 14.

967. A. M. Wood, London. New or improved rubber compositions. Complete Specification. January 21.

1222. H. H. Lake—From H. F. W. Vollner, Germany. An improved agglutinant. January 26.

1392. B. E. R. Newlands and J. B. Alliott, London. Apparatus for filtering saccharine or other liquids or solutions, and appliances for cleaning the said apparatus. January 30.

1528. C. D. Abel.—From E. Kiderlen, J. W. van Leenhoff, A. Wernicke, A. Wilhelmi, and A. Kohlmann, Germany. Process for the preparation of materials containing starch for direct treatment in brewing processes, the production of malt, and other saccharifying processes. February 1.

1529. C. D. Abel.—From E. Kiderlen, J. W. van Leenhoff, A. Wernicke, A. Wilhelmi, and A. Kohlmann, Germany. Process for the production of maltose powder free from water. February 1.

1752. A. Chapman, London. Improvements in apparatus for evaporating saccharine or other solutions or liquids. February 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4397. H. W. Walker and T. L. Patterson. Apparatus for moulding and refining sugar. January 28.

5459. A. Schuhmann. Manufacture of non-fermentable cementitious body soluble in water, from starch. February 18.

5460. A. Schuhmann. Manufacture of dextrine or soluble starch free from smell and taste. February 18.

5660. J. Thomson and J. Black. Improvements in sugar-cane mills. February 18.

17,793. W. P. Thompson.—From J. H. Man. Apparatus for extracting the juice from cane, sorghum, and other like substances. January 28.

1888.

894. F. Wilhöft. Manufacturing non-blooming vulcanised soft rubber. February 11.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

1353. J. A. Wilson, Dundee. Re-charging stale beer or other fermented liquors with carbonic acid gas. January 30.

1434. A. Velluet, London. Apparatus for making wine, and for other purposes. January 31.

1528 and 1529. C. D. Abel. *See* Class XVI.

1558. W. S. Squire, London. Improvements in the manufacture of yeast. February 2.

1622. R. P. Preston and R. W. Preston, Liverpool. Improvements in or relating to stills. February 3.

1833. E. R. Moritz, London. A new or improved method of clarifying beers and other liquids. February 7.

1946. E. McCann and C. Bean Edmonson, Bradford. An improved rouser for facilitating the fermentation of beers, wines, spirits, or any other fermentable substances or liquids. February 9.

2059. C. Hoffmann and L. Ebert, London. Improvements relating to the treatment of beer wort, and to apparatus therefor. February 10.

2099. H. de Soberon, Liverpool. Improved liquor resembling brandy, and process for manufacturing the same. February 11.

2372. C. D. Abel.—From E. K. J. W. van Leenhoff, Holland; A. Wernicke, A. Welhelmi, and A. Kohlmann, Germany. Improvements in the process for the production of beer, maltose, and other products of fermentation or saccharification by the aid of centrifugal action. February 16.

COMPLETE SPECIFICATION ACCEPTED.

1887.

4845. L. Rössler and H. Reinhard. Apparatus for removing roots, acrospires, and impurities from malted or other grain. January 28.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

668. G. Christopher, P. Cooper, and R. W. Leftwich, London. Improvements in or relating to preparations of extract of tea. January 16.

1653. H. H. Lake.—From F. Tiedemann, Denmark. An improved process of preserving eggs. February 3.

2327. E. M. Lévy, commonly called E. Samson, and G. E. Millaud, Liverpool. Improvements in preserving putrescible or fermentable substances. February 16.

B.—Sanitary Chemistry.

693. W. Blizzard, Tettenhall. An improved method for the treatment and final disposal of sewage. January 17.

1105. W. Webster, jun., London. Improvements in the means or appliances for treating sewage by electrolytic action, and for disposing of the deposits thereof. January 24.

1161. A. J. Capron, London. Improvements in the purification of sewage and impure waters. January 25.

1175. J. Arnold. London. Improved apparatus for deodorising and disinfecting sewer gases. January 25.

1245. J. B. Alliott and J. M. C. Paton, Manchester. Improvements in or connected with steam disinfecting apparatus. Complete Specification. January 27.

1326. W. C. Roberts, London. Improvements in the arrangement and construction of sanitary disinfecting and deodorising apparatus or appliances for sewage and other drain ventilation and the like purposes. January 28.

1393. J. Hanson, London. Improvements in means for effecting the evolution of sulphurous acid for disinfecting and deodorising. January 30.

1884. R. Muirhead, London. Improved construction and arrangement of apparatus for the separation of liquids and semi-liquids from solids, especially applicable for sewage sludge, slip surry, and other like body. February 8.

1970. T. de Courcy Meade, London. Improvements in automatic apparatii for discharging disinfectants into water vaos, flushing tanks and chambers, sewage reservoirs, and other receptacles. February 9.

2187. J. H. Barry, Hackney. Process for precipitating and purifying sewage, and the material therefor. February 14.

C.—Disinfectants.

1253. J. Royston, Sheffield. Producing gases for disinfection, to be called "The disinfecting gas-producer." January 27.

1696. W. Black and W. L. Rennoldson, London. Improved manufacture or preparation of antiseptics. February 4.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1887.

214. J. Storer. Method for the preservation of fresh fruit for storing or transport. February 11.

5708. J. F. O. Qvistgaard. Apparatus for heating milk prior to separating the cream therefrom, and for destroying germs therein. February 18.

16,935. C. Collin and L. Benoist. Method of preserving and preventing the putrefaction of animal and vegetable substances. January 28.

B.—Sanitary Chemistry.

1887.

177. B. D. Healey and B. H. Thwaite. The application of gaseous fuel for treating towns' refuse and the fumes therefrom, and apparatus therefor. February 11.

C.—Disinfectants.

1887.

5393. E. Hermite. *See* Class VII.

5532. E. Edwards. A material for use as a disinfectant, manure, preservative against decay, and as a filtering and decolorising material. February 18.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

745. A. Brab, London. Improvements in the manufacture of casks or barrels from paper, and in apparatus therefor. January 17.

1146. F. Hawke and C. J. Ford, London. Improvements in the method of and apparatus for producing water-mark-like designs on paper or other materials. January 25.

2208. J. Scott, Glasgow. Improvements in the construction of strainer plates used for straining pulp in the manufacture of paper or other industries. February 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4058. J. Thompson. Strainers or knotters used in the manufacture of paper and for other purposes. January 28.

4073. H. J. Rogers. Manufacture of strainers and strainer plates therefor used in the manufacture of paper. January 28.

5528. T. Goodall and T. Webster. Means for straining pulp. February 18.

6053. J. Ridgway and E. A. Ridgway. Transfer paper for applying lithographic impressions to pottery. January 28.

XXI.—PHOTOGRAPHIC MATERIALS and PROCESSES.

APPLICATIONS.

949. J. B. Thornton, Manchester. Flash lights and apparatus connected therewith for photographic and other purposes. January 21.

982. T. R. Dallmeyer, London. Improvements in photographic lenses. January 21.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

641. Baron Armstrong, London. Improvements in fuses for projectiles. January 14.

666. W. Bennetts, London. Improvements in safety fuses, and in the manufacture thereof. Complete Specification. January 16.

1031. J. Pain and A. A. Craig, London. Improvements in signal lights or other fireworks for use at sea or elsewhere. January 23.

1153. A. Greenwood, London. Improvements in machines for the compression of gunpowder, and for similar purposes. January 25.

1469. A. V. Newton.—From A. Nobel, France. Improvements in explosive compounds. January 31.

1470. A. V. Newton.—From A. Nobel, France. Improvements in the manufacture of safety fuses. January 31.

1471. A. V. Newton.—From A. Nobel, France. Improvements in the manufacture of explosives. January 31.

1591. C. D. Abel.—From H. Schoneweg, Germany. Improvements in explosive compounds. February 2.

1685. A. Brock, South Norwood. Improvements in ships' signal lights, rockets, Roman candles, and other fireworks. February 4.

1984. C. Libbrecht, London. Improved compounds and cartridges to be used as explosives in coal mines and other places. February 9.

2336. W. D. Scott-Moncrieff, London. Improvements in methods for the production and utilisation of explosive force. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4216. O. Rowe. Manufacture of cartridges. February 11.

16,783. C. F. Hengst. Smokeless gunpowder. February 11.

1888.

666. W. Bennetts. Safety fuses, and manufacture thereof. February 18.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATION.

2367. J. Marx, London. Improvements in the method of and means for separating matters in solution by osmose, dialysis, or diffusion, or by electrolysis, or by a combination of those processes. February 16.

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NOTICES.

Notice is hereby given that the next Annual General Meeting will be held in Glasgow in the month of July next, when members will have an opportunity of visiting the Glasgow Exhibition. Full particulars will appear in subsequent issues.

Notice is hereby given that the numbers for January, 1882, 1883, and 1886, and February, 1886, are exhausted, and no orders for those copies can be executed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January, 1882, and February, 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once with Mr. Cresswell.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

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SESSION 1887-88.

Prospective Arrangements.

The asterisk * indicates dates other than 1st Monday in the month.

*April 9th (2nd Monday).—B. Derham, M.D. "On the errors and defects of the present Revenue system of charging the duty on Spirits, and the means of remedying them."

*April 23rd (4th Monday).—Mr. C. T. Kingzett. "Notes on the manufacture of Chlorine by the Weldon-Pechiney process."
Messrs. Cross and Bevan. "Further notes on M. Hermite's method of Electrolytic Bleaching."

May 7th (1st Monday).—Mr. W. J. Dibdin. "Standards of Light."

*May 14th (2nd Monday).—Mr. Lewis T. Wright. "The present position and prospects of the Coal Gas Industry."

June 4th (1st Monday).—Messrs. B. E. R. and J. A. R. Newlands. "The mode of using Char in Sugar Refining."

Notice will be given in the Journal and other Scientific Papers of other Meetings and papers.

Communications to be addressed to the Local Secretary.

Meeting held March 5th, 1888.

PROF. JAS. DEWAR, F.R.S., IN THE CHAIR.

THE RECOVERY OF SULPHUR FROM ALKALI WASTE BY MEANS OF LIME-KILN GASES.

BY ALEXANDER M. CHANCE, F.C.S.

THE recovery of sulphur from alkali waste has occupied the attention of alkali makers for more than half a century.

So far back as 1837, the late Mr. Gossage commenced his long and careful investigations of this attractive but perplexing subject; but although, to quote his own words, "he devoted thirty years of his life and a fortune" to this object, he failed to establish a process by which the sulphur could be profitably recovered.

Since that time many other chemists have devoted much time, thought, and money to this object, but hitherto no process for the recovery of the sulphur lost in the alkali waste, produced in the manufacture of soda by the Leblanc process, has been sufficiently successful to be generally adopted.

One after another eminent technical chemists at home and abroad—notably, Schaffner in Germany, Mond in England, and Mactear in Scotland—have devised processes which have been partially adopted in certain localities on a limited scale, but hitherto no process has been discovered capable of economical and general adoption.

It will be in the recollection of many who are present to-night, that in the spring of 1882, I had the honour to read a paper in London before the Society of Arts,[*] entitled "The Recovery of Sulphur from Alkali Waste (Schaffner and Helbig's process): a record of recent results," in which, after giving some details of the history of this subject, I pointed out its importance, and then passed on to describe at considerable length the process invented by Messrs. Schaffner and Helbig, of which our firm at Oldbury were the pioneers in England, a process which seemed likely at that time to be universally adopted.

At a cost of over 10,000*l.*, and after two years' hard work, our firm conclusively proved that, by means of Messrs. Schaffner and Helbig's beautiful process, the sulphur lost in the vat waste might be recovered, as sulphuric acid, at a cost to the alkali maker equivalent to about 3*d.* per unit of sulphur per ton of Spanish pyrites, as compared with 6*d.* per unit then being charged to the alkali trade by the pyrites companies. In the last of the four papers[†] which I read on this important subject, I used the following words: "You have to-day (18th April 1883) fully set before you the present position of the Schaffner and Helbig process. What now may be regarded as its prospects?"

"A reduction of 3*d.* per unit in the price of pyrites would, as has been shown, deter alkali makers from embarking in it in its present form. The uncertainty in which alkali makers by the Leblanc process find themselves at the present moment is one of the greatest of the many difficulties with which they have to contend. This uncertainty is due largely to the doubts which exist as to the line of action likely to be pursued by the pyrites companies at the expiration, in 1884, of the combination by which they now maintain pyrites at the monopoly price of 6*d.* per unit."

The uncertainty was soon solved.

Notwithstanding certain inspired newspaper paragraphs, written evidently in the interests of the pyrites companies, which were freely published in the following June (1883), describing the Schaffner and Helbig process as "most completely a commercial failure," and as "having been wholly abandoned," and affirming that "the importance of this fact to the pyrites companies cannot be over estimated;" notwithstanding all such statements, the Tharsis Company, realising the real value of the process, broke away from its allies, and in the autumn of 1883, by a reduction from 6*d.* to 3*d.*, secured for some years to come the contracts of the leading alkali makers, and effectually stopped the adoption of this process of sulphur recovery.

With the price of the unit of sulphur in pyrites thus reduced to 3*d.*, and, in face of the proved value of the Schaffner and Helbig process, without any serious risk of any great rise being again established in the price of sulphur in pyrites, there seemed little encouragement to pursue further a question which, in the graphic words of my friend Mr. Carey,[*] "had long been a sort of will-o'-the-wisp in the alkali trade, and had lured many a good man to serious discomfiture, if not to ruin." We stopped our process at Oldbury; but the plant remained, a plant on which so much care had been lavished, so much money expended, and by which so many hopes had been inspired. Must it remain idle for ever, must all our hopes be abandoned, and must the problem still remain unsolved? With such feelings the question of sulphur recovery was ever present to my mind, and day by day I was constantly on the look out for any fresh discoveries relating to sulphur recovery. But in this as in so many other phases of human life, "when the night is darkest then the dawn is nigh."

A ray of light suddenly appeared from an unexpected quarter, the publication of a fresh departure in the treatment of sulphuretted hydrogen (H_2S) caught my eye, and once again this veritable "will-o'-the-wisp" beckoned me on, and to-night, after five more years of patient labour and of hope deferred, I am able to announce that the problem has at last been solved, and I am about to show you that every alkali maker has ready at hand, each on his own works, the cheapest possible means of recovering, by a simple method, the sulphur from the soda waste as it leaves his vats.

What Mr. Gossage, in 1837 and subsequent years, believed would be done and tried hard to do at his Stoke Works near Bromsgrove, we accomplished in 1887, just 50 years later, at our works at Oldbury, both in the county of Worcester; but I feel pretty confident that if Mr. Gossage, during the course of his prolonged investigations, had had at his disposal the modern machinery and appliances and the powerful carbonic acid gas pumps which the progress of science placed within our reach in 1887, he, and not we, would have hit upon the process which I am about to describe.

Alkali makers have much reason to thank Mr. Gossage, and his name is not likely to be forgotten by any who study the history of the rise and progress of the alkali trade.

In a paper read before the Chemical Section of the British Association at Manchester in 1861, Mr. Gossage used these words, "I am convinced that, whenever the utilisation of the sulphur in alkali waste may be effected, it will be by means of this action of carbonic acid."

That this conviction was shared by many is evident from the fact that, immediately after I had read my paper at Liverpool in the spring of 1883, I received from three distinguished chemists, the late Mr. Weldon, F.R.S., Mr. Mactear, and Mr. F. H. Gossage, suggestions relating to the recovery of sulphur from alkali waste, all based upon the action of carbonic acid gas upon sulphide of calcium; not one of these suggestions, however, led to any practical result.

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[*] *See* Jour. Soc. Arts, May 19th, 1882, pp. 724—738.

[†] 1st paper, London, Jour. Soc. Arts, May 19th, 1882, pp. 724—738.
2nd paper, Manchester, July 6th, 1882, J. Soc. Chem. Ind., Vol. I., pp. 264—273.
3rd paper, Birmingham, March 8th, 1883, Birm. Phil. Soc., Proceedings of, Vol. III., pp. 408—424.
4th paper, Liverpool, April 18th, 1883, J. Soc. Chem. Ind., Vol. II., pp. 202—213.

[*] Jour. Soc. Arts, May 19th, 1882, p. 733.

The irregular and ever varying strength of the sulphuretted hydrogen gases given off was fatal to the practical adoption of each suggestion. The suggestion made to me by Mr. F. H. Gossage, in a letter dated April 19th, 1883, was shortly afterwards tried by us, but without result; the dilution and irregular strength of the sulphuretted hydrogen gases thus obtained rendering them quite unfit for use by any process known to us. But I gladly and gratefully acknowledge the kind suggestions and friendly hints which then and on other occasions have been made to me by various friends.

The conviction which the late Mr. William Gossage expressed in 1861 has now become realised: by means of lime-kiln gases Mr. Gossage sought to effect the recovery of sulphur from alkali waste, and it is by means of lime-kiln gases alone that we have succeeded.

The difference between the results of his labours and of ours forms the subject of our consideration to-night.

Those who followed the course of our Schaffner and Helbig experiments, and all who care to refer to the published papers on the subject, will be conscious of the fact that Messrs. Schaffner and Helbig's proposal to recover sulphur from sulphuretted hydrogen, by precipitating the sulphur by the reaction $2\ H_2S + SO_2 = 3S + 2\ H_2O$, was never satisfactorily carried into practical effect,* otherwise the action of the pyrites companies, by lowering the price of the sulphur in their pyrites, would merely have restricted, but not have stopped, the adoption of the Schaffner and Helbig process.

That carbonic acid gas, as given off from a lime-kiln, would decompose the sulphide of calcium in vat waste and liberate sulphuretted hydrogen, was conclusively proved by Gossage, but the problem of economically utilising the sulphuretted hydrogen thus formed remained unsolved, and Messrs. Schaffner and Helbig's attempt to extract pure sulphur had to be abandoned.

Such was the position of affairs when the ray of light, of which I have spoken, suddenly appeared to me, and encouraged me to persevere, with the results now about to be described.

On the 18th of April 1883, in my paper at Liverpool, referring to sulphuretted hydrogen, I used these words, "eventually it will be treated for the obtainment of free sulphur . . . . . by one of several other methods which are now being investigated at Oldbury, or by some method which may be hereafter introduced."

On the 29th April 1883, there appeared in our Journal, under the patent literature, on page 177, a notice headed thus:—

> "Obtaining sulphur from sulphide of hydrogen. C. F. Claus, London. English patent 3608, July 29, 1882."

By this process Mr. Claus had mainly in view the purification of coal gas, and the recovery of sulphur from the sulphuretted hydrogen therein; but it at once occurred to me that it might perhaps be advantageously applied to the recovery of sulphur from the sulphuretted hydrogen liberated from vat waste by means of carbonic acid (CO_2).

I lost no time in entering into negotiations with the "Ammonia Gas Purifying and Alkali Company, Limited," who control Mr. Claus's patents, and by the 10th July 1883, our firm had concluded terms with them. Two days later, in connexion with the annual meeting in London of the Society of Chemical Industry, on July 12th, this process was inspected by several of the members in experimental operation at the works of the South Metropolitan Gas Company. (See *Journal*, Vol. II, page 318.)

In the previous April of the same year (1883) we ourselves had obtained at Oldbury a small quantity of sulphur by a method we were then trying, some specimens of which I then and there sealed up, and will now open and show to you.

In the following July I obtained a pound or so, which I will now show you, of the sulphur then being produced by Mr. Claus's method at the South Metropolitan Gas Works in London. Both of these samples were produced by methods working on the formula $H_2S + O = H_2O + S$.

Simple as the problem thus appears on paper, it took four years of labour and a further expenditure of several thousand pounds before we were able economically to produce from vat waste, by means of the Claus kiln, sulphur on a manufacturing scale such as the specimens which are before you to-night, as produced and sold by us; specimens both of brimstone and of flowers of sulphur, the quality and purity of which have satisfied the most critical consumers.

Let us now consider first the Claus kiln, and then the method and the apparatus by which we have obtained sulphuretted hydrogen from vat waste in such a condition as to render the sulphuretted hydrogen not only available for the recovery of solid sulphur, but also for the direct production of sulphuric acid.

Mr. Claus claims (No. 3608, 29th July 1882, page 4)—

(1.) The use of heated anhydrous oxide of iron for the absorption of sulphuretted hydrogen.

(2.) The admixture of cold or heated air in regulated quantities with the sulphuretted hydrogen before it is passed through the anhydrous oxide of iron, for the purpose of obtaining free sulphur in a continuous stream.

(3.) The maintenance of the necessary temperature for causing the anhydrous oxide of iron to absorb the sulphuretted hydrogen by the admixture of air with the gases and the consequent carrying forward of the sulphur.

(4.) The series of operations forming a continuous process or method of obtaining sulphur from sulphuretted hydrogen by means of anhydrous oxide of iron.

In this process the hydrogen only of the sulphuretted hydrogen is burnt by atmospheric oxygen, and its sulphur set free:

$$H_2S + O = H_2O + S.$$

The process is performed by mixing sulphuretted hydrogen with a *regulated quantity* of air, and sending the mixture of sulphuretted hydrogen and air through a layer of anhydrous oxide of iron, which, by the heat generated by the reaction itself, is maintained at a dull red heat, the oxide of iron itself undergoing no change. Free sulphur, accompanied by vapour of water, passes off, the free sulphur being obtained in the fused or sublimed form, according to the temperature of the kiln and of the depositing chambers.

As the result of various experiments at Oldbury, performed at the request of Mr. Claus, of Professor C. W. Heaton, and later in conjunction with the late Mr. Walter Weldon, F.R.S., all acting on behalf of the Ammonia Gas Purifying and Alkali Company,

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* See p. 207, J. Soc. Chem. Ind., May 29th, 1883, Vol. II. (*a*) (*b*) (*c*) (*d*).

Limited, several subsequent patents were taken out by Mr. Claus namely,

A.D. 1883, 25th October, No. 5070
,, 31st December, No. 5958
,, ,, No. 5959
,, ,, No. 5960

By these fresh patents the use of various other oxides and also of "contact substances" was claimed, and protection obtained for the use of a bed or layer of fragments of suitable solid material, such as broken fire-brick and other substances chemically inert; the maintenance of the bed of such suitable solid material at a suitable temperature either by the heat of the reaction itself or by extraneous heat, &c. &c.

It may be convenient, at this stage, to describe the Claus kiln, as finally used by us, which produced the specimens which you see before you this evening.

Through a pipe *A A* the regulated mixture of sulphuretted hydrogen and air ($H_2S + O$) passes under the perforated bottom *P P* of a circular kiln *K K* lined with fire-brick, first through a bed of broken fire-brick *F F F* and then through a layer of oxide of iron *O O O*.

By the reaction already described steam and sulphur vapour are produced, which pass along the outlet pipe *D D D*, first into the small brick chamber *C C C* and thence through *M M* into a large brick subliming chamber *S S S*.

The heat of the reaction itself soon becomes sufficiently great to cause part of the sulphur vapour to condense in the liquid form at the bottom of the chamber *C C C*, whence it is tapped and run into blocks, a specimen of which is shown to-night, through the tapping hole *H H*.

A considerable quantity, however, of the sulphur vapour passes into *S S S* where, in the first portion of this chamber, it gradually cools and is deposited as dry flowers of sulphur, specimens of which are exhibited this evening.

The steam condenses in the latter part of the subliming chamber, and the outlet gases are controlled by simple methods before passing into the atmosphere.

The Claus kiln, as its inventor claimed, depends for success upon the PERFECT REGULATION of the supply of atmospheric oxygen required to combine with the hydrogen and release the sulphur.

By an excessive supply of air some sulphurous acid would be formed; by a deficiency in the supply some sulphuretted hydrogen would pass off. *In the perfect, regular, and constant adjustment of the oxygen required by the hydrogen to form vapour of water, lay the main key to the success of the process.* Given a regular supply of gas containing a fixed and regular proportion of sulphuretted hydrogen, the regular proportionate supply of air could readily be adjusted, but with gas containing an ever varying quantity of sulphuretted hydrogen, variable to an extent often unknown, it is difficult to conceive by what means any system for regulating a proper supply of air could be devised. Under such conditions the air supply could only be regulated to deal with an estimated average of sulphuretted hydrogen, escapes, either of sulphurous acid or of sulphuretted hydrogen, would constantly occur and require to be controlled, and the yield of sulphur obtained would be indefinite and irregular.

Between 1883 and 1886 our efforts were directed towards overcoming this difficulty, amidst an alternation of hopes and fears; but when at last we did overcome it our success was assured. In decomposing vat waste by lime-kiln gases the sulphuretted hydrogen evolved varies in strength, according to the strength of the carbonic acid gas itself and to the various stages of the decomposition of the waste; the fluctuations in the percentage of sulphuretted hydrogen in the gases so produced are very great, ranging from 1 per cent. to 35 per cent. in an irregular manner.

One first condition of success was to obtain lime-kiln gases containing as constant a percentage of carbonic acid as possible, and the experience we acquired in working a lime-kiln during our Schaffner and Helbig experiments was of much value to us.

To Mr. Ludwig Mond, to-day, as in 1883, I desire to acknowledge our indebtedness for his courtesy in placing at my disposal the results of his vast experience in the production and in the pumping of carbonic acid.

Let no one say that the days of chivalry are passed and gone, in face of the fact of so distinguished a manufacturing chemist thus assisting a competitor, by freely giving him valuable personal technical experience, in such a struggle for survival as that which is now being so keenly contested between ammonia soda makers on the one hand and Leblanc soda makers on the other.

From the best worked lime-kiln, however, the escaping gases never contain, on an average, more than 30 per cent. of carbonic acid, the remaining 70 per cent. consisting almost entirely of the nitrogen of the air. The nitrogen inseparable from the carbonic acid thus produced, though without any chemical effect upon the vat waste, has always been a source of embarrassment in these investigations, from the days of Gossage until now, in consequence of the dilution by it of the sulphuretted hydrogen gases finally obtained, a dilution which has hitherto prevented such sulphuretted hydrogen gases from being burnt into sulphurous acid gas for the direct manufacture of sulphuric acid.

In our efforts to obtain sulphuretted hydrogen of REGULAR AND CONSTANT COMPOSITION we have at last so far overcome this difficulty, and succeeded in eliminating so much of the accompanying nitrogen as to render the remaining gases sufficiently rich in sulphuretted hydrogen to serve, by their regular and constant composition, not only for the economical recovery of sulphur by means of the Claus kiln, but also for the successful manufacture of sulphuric acid, by simply burning the sulphuretted hydrogen gases we have obtained.

The method and the apparatus* by which we thus obtain these gases of regular and constant composition I will now proceed to describe. It is well known that a mixture of alkali waste and water may be completely decomposed, with production of carbonate of lime and sulphuretted hydrogen, by passing through it, preferably in a series of vessels, gases containing carbonic acid, such as those evolved from a closed lime-kiln; but the sulphuretted hydrogen so produced is diluted by such large and varying quantities of other gases that it cannot easily be turned to account.

By the invention, which I am about to describe, the sulphuretted hydrogen obtained is accompanied by a *much smaller* and *very constant quantity* of other gases, so that it may be burned directly for the manufacture of sulphurous and sulphuric acids, or be profitably treated for the production of sulphur by the Claus kiln previously described.

To carry our invention into effect we introduce the mixture of alkali waste and water, preferably as a thin cream from which the coarser portions have been removed by means of a sieve, into a series of vessels, connected by pipes and furnished with inlet and outlet ways, and pump through some or all of such vessels lime-kiln gases, such gases consisting almost entirely of carbonic acid and nitrogen.

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* *See* British Patent, No. 8666, June 16th, 1887.

When these gases, entering the first vessel, come into contact with the mixture of alkali waste and water, the carbonic acid is absorbed by any free lime present with production of carbonate of lime, and by the sulphide of calcium with production, in the presence of water, of carbonate of lime and sulphuretted hydrogen. The sulphuretted hydrogen thus formed, being driven forward, passes into another vessel, where it meets with a further quantity of alkali waste, and is absorbed with production of sulphydrate of calcium (CaH_2S_2).

By this process of what may be termed "two-fold absorption," first of the carbonic acid and then of the sulphuretted hydrogen, the gases issuing for a time from the last vessel contain neither carbonic acid nor sulphuretted hydrogen, or merely traces thereof; they are allowed to escape, passing, however, as a precautionary measure through a purifier containing oxide of iron or lime.

The first point achieved by our process is therefore the elimination of a considerable quantity of inert, diluent gases, chiefly nitrogen, which are allowed to escape, leaving the remaining gases proportionately enriched.

When we find that the gases issuing from a certain vessel contain a large proportion of sulphuretted hydrogen, in consequence of the fact that the carbonic acid is now acting upon the calcium sulphydrate formed as above mentioned, and that, therefore, for each equivalent of carbonic acid absorbed, two equivalents of sulphuretted hydrogen are being evolved,

$$CO_2 + CaH_2S_2 + H_2O = CaCO_3 + 2H_2S,$$

we close the outlet from the last vessel and open another outlet from the intermediate vessel from which the sulphuretted hydrogen is issuing in sufficient strength.

The gases thus doubly rich in sulphuretted hydrogen, enriched firstly by the removal of a considerable quantity of the inert gases, and secondly by the decomposition of the sulphydrate just described, now contain sufficient sulphuretted hydrogen to render them fit for profitable treatment.

We therefore conduct them away separately, as long as they continue to contain sulphuretted hydrogen in sufficient quantity, to a gasholder, whence they are utilised for the purpose of making sulphur or sulphuric acid. When the gases cease to be sufficiently rich in sulphuretted hydrogen we close the outlet, and having emptied the first vessel or vessels in which the decomposition of the alkali waste has been completed, and filled another or others later in the series with a fresh mixture of alkali waste and water, we resume our operations as at first, and so proceed continuously.

After the complete decomposition of the waste has been effected, a decomposition so complete that the filtered water does not blacken or darken when a solution of a lead salt is added, the mixture which remains behind consists chiefly of precipitated carbonate of lime in the shape of mud, which may be used in the black ash furnaces in the place of limestone.

The value of this mud for black ash making is considerably enhanced by the presence, in the condition chiefly of bicarbonate of soda, of various salts of soda, contained in the original vat waste, and converted into bicarbonate by the action of the carbonic acid gases.

The value of the soda thus recovered may be estimated by the fact that, of the quantity of soda now thrown away in the vat waste and lost, from 2½ to 3 tons may thus be recovered and saved for every 100 tons of alkali produced, by those who are able to utilise the carbonate of lime for black ash making.

Another profitable means of utilising this carbonate of lime lies in the direction of cement making, for which it seems in many respects well adapted, and to which I called attention in my paper at Liverpool in 1883.*

The carbonate of lime recovered by our process compares very favourably for cement making with that which we formerly recovered by the Schaffner and Helbig process, and we have now under consideration several proposals by which the recovered carbonate of lime may be profitably employed in the manufacture of cement.

The water remaining behind, though somewhat dirty in appearance as it leaves the carbonator, is almost clear when filtered; it need not be any source of embarrassment, as we have ourselves during a series of many weeks used it continually over and over again for mixing with the fresh vat waste. It may also be used in the black ash vats, or may be disposed of by such other means as may happen to be locally available and convenient.

Let us now consider the apparatus by means of which these operations have been conducted by us during the past eight months with continued and uninterrupted success.

The apparatus is in reality very simple, both to construct and to control, although at first sight the numerous taps and pipes seem bewildering.

It consists of a series of tall cylindrical vessels (seven we have found to be a convenient number), as shown in our drawing to-night, furnished with pipes and connexions, as indicated, so that they may be worked in series.

The pipe lettered L L L we call the CO_2 main.

The pipes lettered C C C we call the connecting main.

The pipe lettered E E E we call the exit main.

The pipe lettered R R R we call the return main.

Let me now attempt to describe the actual working of the plant, from recorded observations at Oldbury, from the time a particular vessel is charged until it is discharged again.

Taking advantage of an idea cleverly sketched by Mr. J. C. Stevenson, M.P., after his first visit to inspect this process at our works, I have had prepared the diagram *S S S* which is intended to indicate a horizontal section of the series of seven vessels, and to give their working at the various periods recorded in the following description.

The arrows marked CO_2 indicate the point of entrance of the lime-kiln gases, the arrows marked N indicate the point of discharge of the useless gases, and the arrows marked H_2S the point whence the sulphuretted hydrogen gases are collected.

The sections coloured dark indicate the vessels in operation, the sections coloured light show the vessels not in operation, whilst the sections showing a small circle within the vessel indicate the vessels newly charged with vat waste, being invariably used as the last of the series in consequence of their greater power of absorbing sulphuretted hydrogen gas.

The time between charging and discharging varies somewhat, depending upon the condition of the waste in the vessel, and the quantity and the strength of the lime-kiln gases pumped through.

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* J. Soc. Chem. Ind., Vol. II., p. 208.

At 7.0 a.m., Nos. 7 and 1 vessels were charged with fresh waste. The lime-kiln gases were pumped direct into No. 3 vessel, and then through vessels Nos. 4, 5, 6, 7, and 1 by opening all the intermediate taps; the useless gases escaped from No. 1 vessel into the exit main, and thence through a purifier into the air for a period of 1 h. 40 m.

At 8.40, the sulphuretted hydrogen gases from No. 5 were sufficiently strong for use, the calcium sulphide having mostly been converted into calcium sulphydrate; the sulphuretted hydrogen gases taken from No. 5 tested over 30 per cent. of sulphuretted hydrogen, whilst the useless gases from No. 1 tested only 1 per cent., thus showing that vat waste is a very efficient absorbent of sulphuretted hydrogen.

The connexions were then altered so that the sulphuretted hydrogen gases could be taken from No. 5 to the gasholder; No. 2 vessel, containing the partially carbonated waste, was put into series, and the lime-kiln gases were now pumped through Nos. 2, 3, 4, and 5, the sulphuretted hydrogen gases from No. 5 continuing to be taken to the gasholder for a period of 2 h. 25 m. till 11.5. It was then found that the sulphuretted hydrogen gases were under 30 per cent., and that Nos. 2 and 3 were carbonated so thoroughly that water filtered from the mud did not tinge lead paper; Nos. 2 and 3 were therefore emptied and recharged.

At 11.5 a.m., the lime-kiln gases were pumped into No. 5, and thence through Nos. 6, 7, 1, 2, and 3; the useless gases issuing from No. 3 passed into the purifiers, and thence escaped until 12.25—*i.e.*, during 1 h. 20 m.

At 12.25 p.m., the lime-kiln gases were pumped into No. 4, containing partially carbonated waste, and thence through Nos. 5, 6, and 7; the sulphuretted hydrogen gases from No. 7 passing to the holder from 12.25 to 2.30—*i.e.*, during 3 h. 5 m.

At 3.30, Nos. 4 and 5 were recharged with fresh waste, the lime-kiln gases were pumped into No. 7, and thence through Nos. 1, 2, 3, 4, and 5; the useless gases from No. 5 passed away until 4.35—*i.e.*, during 1 h. 5 m.

From 4.35 till 8.20, the lime-kiln gases were pumped through Nos. 6, 7, 1, and 2, the sulphuretted hydrogen gases from No. 2 being simultaneously taken to the gasholder—*i.e.*, during 3 h. 45 m.

At 8.20, Nos. 6 and 7 vessels having been recharged, the lime-kiln gases were pumped through Nos. 2, 3, 4, 5, 6, and 7, the useless gases from No. 7 passing away until 9.20—*i.e.*, during 1 hour.

At 9.20, the lime-kiln gases were pumped through Nos. 1, 2, 3, and 4 till 1.5, the sulphuretted hydrogen gases being meanwhile taken to the gasholder until 1.5—*i.e.* during 3 h. 45 m.

At 1.5 p.m. Nos. 1 and 2 were recharged, and the series of operations recommenced.

It will thus be seen that during 1 h. 40 m. + 1 h. 20 m. + 1 h. 5 m. + 1 h., = 5 h. 5 m., the useless gases were escaping, whilst during 2 h. 25 m. + 3 h. 5 m. + 3 h. 45 m. + 3 h. 45 m., = 13 hours, the valuable sulphuretted hydrogen gases were being used; but about 45 minutes must be allowed for and deducted whilst the vessels were discharged and recharged and the various taps altered.

Of the changes taking place in the gases, I have not time to speak to-night, but I have had a complete table prepared as an appendix which all who are interested can study at their leisure, together with some analyses of the carbonated mud and of the filtrate.

As contrasted with the working of the Schaffner and Helbig process, the danger of escapes of sulphuretted hydrogen is vastly reduced, for the simple reason that the mere stopping of the carbonic acid gas pump instantly arrests the production of this dangerous gas.

The plant required is extremely simple. From a lime-kiln, erected on any convenient site with powerful carbonic acid gas pumps placed by preference close to it, the gases can be delivered to any convenient distance through a main to the carbonators; these should be placed close to the vats, so as to secure the cheap and quick transfer of the waste from the vats to the carbonators, and to avoid the exposure of the waste to the oxidising action of the air.

A set of seven cylinders, 15 feet high by 6 feet in diameter, should suffice to treat the waste from 300 tons of sulphate of soda per week; but a glance at the diagram will suggest the advantage of erecting a double set of cylinders, of dimensions calculated to treat one-half of the waste in each set, to be worked so that one set is giving off the useful sulphuretted hydrogen gases, whilst the other set is discharging the useless or inert gases, and thus a constant flow of strong sulphuretted hydrogen gases would reach the gasholder.

The site of the gasholder should be selected, as far as practicable, in a conveniently open situation.

Our gasholder, 50 feet in diameter with a 14 feet lift, holds about 30,000 cubic feet of sulphuretted hydrogen gases, and the "dead oil"* recommended by Sir Frederick Abel, continues to act admirably in controlling all escapes. The oil has never been replenished since we first covered the water in our gasholder with it in 1883.

Having now described firstly the Claus kiln and secondly our own method and apparatus for treating vat waste so as to obtain sulphuretted hydrogen in a suitable condition for the recovery of sulphur, it remains for me to record, for the benefit of the alkali trade, the results we have obtained in the manufacture of vitriol.

The moment we had made on a manufacturing scale a sufficient number of tons of brimstone to prove the success of the Claus kiln for the manufacture of sulphur by our method, and to ascertain the marketable value of the sulphur so produced, we turned our attention to the production of sulphuric acid in the hope of proving the value of our process in that direction also.

We should have preferred to have carried on both processes simultaneously, but the limit of our experimental plant was taxed to its fullest capacity, in order to supply the sulphuretted hydrogen required to make sulphurous acid for a complete set of chambers.

Gossage's attempt to burn the sulphuretted hydrogen into sulphurous acid and utilise the latter in acid chambers entirely failed (*see* Lunge on sulphuric acid, Vol. II., 1880, pages 641 to 645), and had we not proved to demonstration this branch of the sulphur recovery question on a manufacturing scale, over a sufficiently extended period of time, there would have gone forth now as of old the boastful cry, "It is naught, it is naught," and our process would have been proclaimed to be a failure. As it is, however, the recovery of brimstone by the Claus kiln has surpassed our warmest expectations, and our success in the production of vitriol has surprised all who have seen the process.

Since November last we have been regularly making vitriol by burning the sulphuretted hydrogen gases obtained from our vat waste in a kiln connected with a complete set of chambers furnished with a Glover's tower and a Gay-Lussac absorbing column.

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* J. Soc. Chem. Ind., Vol. II., p. 203.

The heat generated by the burning of the sulphuretted hydrogen gases has proved to be amply sufficient to work the Glover's tower, and to concentrate, in addition, a considerable quantity of acid in an open evaporating pan placed upon the top of the kiln.

The chamber space required corresponds to our ordinary standard of chamber space, used at our works for many years past in burning Spanish pyrites, and we have been able to reduce our consumption of nitre, taken over a period of several weeks, to figures varying from 1·15 per cent. to 1·44 per cent. on the dry acid (SO_3) produced.

Of the total sulphur hitherto thrown away in our vat waste, we have now for many weeks in succession obtained, as vitriol in our chambers, about 90 per cent. of the average quantity of sulphur proved by the analyses annexed to be present in our vat waste.

Of the 10 per cent. remaining, one-half (or 5 per cent. of the original quantity) has been thrown away in the screenings which we have removed from the vat waste charged to the process, but our new plant will be constructed to utilise the sulphur in the screenings.

Thus 95 per cent. of the sulphur, shown by analysis to be present in our vat waste, has been accounted for.

The remaining 5 per cent. is lost in the sulphur originally present in the vat waste as sulphide of iron, which passes undecomposed into the carbonate of lime mud, and in the small quantities of sulphuretted hydrogen gases passing away with the inert gases into the oxide purifiers, besides other small losses due to oxidation, chamber exits, &c.

From the sulphuretted hydrogen, however, as drawn from our gasholder and burnt into vitriol, we can account for from 98 per cent. to 99 per cent. in the shape of vitriol.

The annexed table, A. B., of daily tests taken on the dates indicated, gives a fair idea of the small escapes of sulphur in the exit gases, when the chambers are in good working order.

For some weeks past we have been regularly making about 40 tons a week of sulphuric acid, computed as dry acid (SO_3), by thus burning the sulphuretted hydrogen, and from first to last the quantity of vat waste operated upon, for the manufacture both of brimstone and of vitriol, by our experimental plant has been upwards of 3,000 tons up to March 3rd, 1888.

The vitriol thus made is extremely pure, being quite free from arsenic, contains a mere trace of iron, and is almost colourless.

The process has been seen in operation by many distinguished chemists and manufacturers, several of whom are present to-night, and they will be able to tell you, at the close of my paper, what they think of the value of our process for vitriol making.

In carrying on investigations of this kind, manufacturers, when engrossed in the routine of current business, must be able to rely upon the ready services of members of their staff to carry out many of the details incidental to such pursuits, and it seems to me that such services, when efficiently rendered, deserve to be publicly acknowledged.

To Mr. France, our general manager, and to the less prominent members of our staff, I desire to record our indebtedness for the patience and perseverance and skill with which they have one and all so ably seconded our efforts, but to our chemist, Mr. Horace W. Crowther, to whom we more particularly entrusted the chemical details of this investigation, we desire in particular thus publicly to record our sense of obligation.

It now remains for us to consider the cost of recovering sulphur by our process in the form of sulphuric acid.

According to the figures I gave in 1883, about 3*d.* per unit of sulphur was generally regarded as the cost of the recovery of sulphur from alkali waste by the Schaffner and Helbig process.

The same royalty still holds good, 1*s.* per ton of salt cake balled, and the one manufacturing item common to both processes, the cost of obtaining and pumping the lime-kiln gases, remains, but every other item is either greatly reduced or altogether unnecessary. The outlay for plant is reduced by one-half, and the absence of wear and tear in this process is as remarkable as was the excessive wear and tear in the Schaffner and Helbig process.

The cost of labour is not nearly so great as that which was required in the Schaffner and Helbig process (in fact it is actually less than the labour required for breaking and wheeling pyrites, for removing burnt cinders and working the pyrites kilns), whilst the heavy outlay for magnesium chloride and for coal is entirely dispensed with as neither is now required. From first to last, with the exception of the fuel required to generate steam for pumping the carbonic acid and for driving such machinery as is common to both processes, *no coal whatever is used.*

The daily cost of working the process for vitriol making is, as compared with the use of pyrites, now reduced to that of obtaining and pumping carbonic acid from one or more lime-kilns, which cost, varying in each locality with the local values of limestone and of coke, each manufacturer can estimate locally for himself.

Nearly every alkali maker to-day makes either caustic soda or bleaching powder, many make both; and each of these articles requires more lime than the quantity yielded by a lime-kiln, fired by coke, erected to produce the carbonic acid necessary for recovering the sulphur from the alkali waste corresponding to the quantity of salt originally decomposed.

Therefore let every alkali maker henceforth burn his own lime and use the hitherto waste gases of the lime-kiln to recover the sulphur from his alkali waste, thus taking advantage of the economy of science in using one waste to catch another.

The following table may be useful for reference in connexion with this subject:—

RETURNS OF THE ALKALI ASSOCIATION FOR THE UNITED KINGDOM.

——	1881.	1882.	1883.	1884.
	Tons.	Tons.	Tons.	Tons.
Salt decomposed by both processes	675,099	679,935	705,732	690,502
Alkali, 48 per cent.......	259,087	272,213	280,034	265,552
Caustic soda, 60 per cent.	108,310	116,864	119,929	141,639
Bleaching powder.......	135,826	135,170	141,868	128,651

——	1885.	1886.	1887.
	Tons.	Tons.	Tons.
Salt decomposed by both processes	722,172	713,112	731,199
Alkali, 48 per cent.......	262,127	250,782	255,272
Caustic soda, 60 per cent.	144,951	153,884	169,463
Bleaching powder.......	132,761	136,234	139,925

In estimating the gain to be effected by our process, the cost of carriage of pyrites from the port to the consumer's works is an item always to be remembered.

We, like some other inland makers, are terribly handicapped by this cost of carriage, equal in our case to 1½*d*. per unit of sulphur, or 6*s*. carriage per ton of pyrites.

The average rate of carriage is, I believe, 2*s*. per ton of ore, equal to ½*d*. per unit of sulphur, or, in other words, to 1*s*. per ton of salt cake, which is the royalty for using our process.

The pyrites companies, by reducing in 1884 their price from 6*d*. per unit to 3*d*. per unit, stopped the Schaffner and Helbig process, but to-day they have to face a very different condition of affairs.

Three alternatives may be considered, namely, that the prices of sulphur in pyrites will—

1stly—remain as at present; or
2ndly—advance (by reason of war or short supplies); or
3rdly—fall.

As compared with the prices, 3*d*. to 4½*d*. per unit according to quality charged at present, our process will pay handsomely for the production either of vitriol or of brimstone, without putting any value whatever on the carbonate of lime recovered.

If the price of pyrites advances, the value of our process is by so much enhanced for making vitriol.

If the price were reduced our process would become proportionately more profitable for making brimstone.

But a reduction of, say 2*d*. per unit, would mean to the pyrites companies, on the 600,000 tons a year imported into the United Kingdom, 8*s*. per ton, or 240,000*l*. a year.

I have been assured again and again on the highest authority that any further reduction in price is out of the question, as the Spanish companies would prefer rather to leave the ore in Spain and to extract the copper from it at the mines.

The probability of such a course being adopted is enhanced by the fact that, in proportion as soda made by the ammonia process displaces soda made by the Leblanc process, so the consumption of pyrites will be diminished, and a diminution in the consumption of pyrites would naturally cause the Spanish companies to seek new means of recouping themselves for this falling off in their sources of income, by adding to their means of increasing on the spot, at their mines in Spain, their output of copper.

But, on the other hand, recent events, which *Punch* has wittily described as the "Riot in two Mines," seem to indicate that certain provincial Spaniards have, as regards their capacity for inhaling sulphur fumes, reached, what chemists term, the saturation point; a chemical condition which even the point of the bayonet cannot overcome.

The whole aspect of affairs may, therefore, at any moment be changed; the fumes so destructive in Spain would be welcome in England, and Leblanc soda makers would readily accept the free gift at home of the sulphur now thrown away abroad.

The progress of modern science tends more and more towards the utilisation of waste: waste, like dirt, being merely matter in the wrong place.

With the sulphur in pyrites free of cost, the manufacture of soda by the Leblanc process would rapidly revive.

The sulphur in alkali waste, however, would by the process described to-night, be still entirely recovered, no longer as vitriol, it is true, but exclusively in the form of brimstone, the quantity to be thus recovered amounting, by my estimate, to about one hundred thousand tons per annum (100,000 tons), which quantity, after supplying the entire home requirements, would leave from 60,000 to 70,000 tons available for America, into which country crude brimstone is admitted free of duty.

The quantity of pyrites used exclusively for making soda by the Leblanc process, the sulphur of which is now thrown away in the waste, I estimate at about 300,000 tons a year, amounting to one-half of the whole quantity imported.

The following tables relating to pyrites and brimstone may be of interest in connexion with this subject, and I desire to acknowledge the services of Messrs. William Smith and Co., of Bristol, in obtaining these figures for me:—

TABULATED RETURNS RELATING TO PYRITES AND BRIMSTONE, 1882–1887.

—	1882.	1883.	1884.	1885.	1886.	1887.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Pyrites imported into United Kingdom	627,700	601,283	563,073	654,521	556,983	597,595
Brimstone imported into United Kingdom	46,466	40,720	36,593	33,919	30,111	32,624
Brimstone exported from Sicily to all parts	288,129	333,349	316,227	314,170	329,937	312,446

DETAILED STATEMENT OF BRIMSTONE EXPORTED FROM SICILY IN 1887.

	Tons.
Shipments to America	88,593
" England	31,086
" France	56,221
" Italy	46,818
" Spain and Portugal	23,836
" Turkey and Greece	25,541
" Germany	9,669
" Austria	7,654
" Belgium and Holland	6,681
" Russia	13,866
" Norway and Sweden	1,776
Sundries	705
Total	312,446

The following extract from *The Board of Trade Journal* for February should also be recorded:—

"PRODUCTION OF SULPHUR IN SICILY.

"The French *Bulletin du Ministre des Travaux Publics* for November last, says: 'The total quantity of sulphur contained in the Sicilian mines before workings were commenced is estimated at 65,000,000 tons. The quantity produced from 1831 to 1835 is stated to be 8,353,091 tons, and previous to this period about 2,000,000 tons, making a total of 10,353,091. When it is considered that, to obtain this quantity, about 15,000,000 tons were turned over (as generally a third is lost in the treatment), it results that the quantity still available is 50,000,000 tons, and supposing that the average production should be maintained at about the same proportion as in past years, the Sicilian mines may continue to be worked for another century.' "

The progress of science upon industrial chemistry is causing perplexity both to the hard-working and beneficent producers of the refinements of civilisation—soap, glass, paper, cotton, and woollen goods, &c., all more or less depending upon the alkali trade—and to the keen-witted speculators of the Stock Exchange.

The mere mention at Manchester, before the British Association last September, of this process in the barest outline, by Mr. A. E. Fletcher, Chief Inspector of the Alkali Works, &c. Regulation Act, caused a marked depression in the prices of the shares of the leading pyrites companies—a depression from which there has been an altogether unexpected rebound, due to the recent rapid rise in the value of copper.

To hold their own against the ammonia soda process the Leblanc soda makers must adopt every possible economy from whatever source, and to satisfy the requirements of the Alkali Act* they must also comply with the provision that "alkali waste shall not be deposited or discharged without the best practicable means being used for effectually preventing any nuisance arising therefrom."

Thus, a double motive will now impel the producers of alkali waste to recover their sulphur, and a curtailment in the demand for imported sulphur seems inevitable. The owners of shares in pyrites companies must accept the inevitable, and disguise their sadness with the same good grace that the owners of Leblanc soda works display whilst recognising their most formidable competitors in the ammonia soda process, as carried on so skilfully abroad by Messrs. Solvay and Co., and at home by Messrs. Brunner, Mond, and Co.

Hitherto all the sulphur has been lost by the one process and all the chlorine by the other.

Henceforth the sulphur will be saved, and the old process makes one stride ahead; but if ever an economical method of utilising the chlorine now lost by the ammonia process is discovered, the position of the owners of the Leblanc soda works will be imperilled to an extent which will arouse the pity even of the perplexed holders of pyrites shares.

As the matter stands to-day, in the case of the general adoption of our sulphur process by the Leblanc soda makers, a total quantity of sulphur, in the shape of pure sulphur and of sulphuric acid, might be recovered from alkali waste equal to the sulphur contained in about 80 per cent. of the pyrites now sold for alkali making.

By the universal adoption of the ammonia soda process to the entire displacement of Leblanc soda, the whole of the pyrites now sold for alkali making would be displaced.

Therefore, the survival of the Leblanc soda works is to be desired both by the manufacturers themselves and by the pyrites companies; and, since such survival seems only possible by the Leblanc soda makers saving the sulphur which they now waste, we may claim the gratitude of all concerned for having successfully solved the problem of the "recovery of sulphur from alkali waste by means of lime-kiln gases."

APPENDIX I.

COMPARATIVE ANALYSES of RECOVERED CARBONATE of LIME.

—	By Schaffner and Helbig's Process, 1883. (*See* "J. of Soc. Chem. Ind.," Vol. II., p. 208.)			
	1.	2.	3.	4.
Calcium carbonate	75·62	79·32	76·48	71·14
Calcium sulphate	4·60	3·89	4·62	4·52
Calcium chloride	·33	·25	·30	1·51
Calcium silicate	..	..	..	..
Magnesium carbonate	·60	1·77	·70	..
Magnesium oxide	2·50	1·67	2·85	3·20
Magnesium chloride	·88	·78	1·70	2·58
Sodium carbonate	..	..	..	..
Sodium sulphate	..	..	..	..
Sodium silicate	..	..	..	..
Soda	·95	·85	·70	1·75
Alumina	·96	·80	·76	·94
Ferrous sulphide	..	..	..	..
Ferric oxide	2·30	2·60	1·34	1·07
Coke	5·80	3·72	3·00	3·80
Sand	..	..	..	..
Silica	·50	·30	1·12	3·45
Sulphur (free)	..	..	..	..
Moisture (at 212° F.)	..	..	..	..
Water	4·65	4·30	6·00	6·00
Combined water and loss	..	..	..	..
	99·72	100·25	99·57	99·96

—	By Chance's Sulphur Recovery Process, 1888.		
	A.	B.	C.
Calcium carbonate	84·79	87·16	86·32
Calcium sulphate	·36	·49	·36
Calcium chloride	..	..	..
Calcium silicate	1·91	2·30	2·35
Magnesium carbonate	1·34	1·03	1·07
Magnesium oxide	..	..	..
Magnesium chloride	..	..	..
Sodium carbonate	·45	·55	·63
Sodium sulphate	·07	·21	·07
Sodium silicate	1·47	1·42	1·00
Soda	..	..	..
Alumina	1·19	1·47	1·35
Ferrous sulphide	1·05	·71	·99
Ferric oxide	..	..	..
Coke	4·06	2·06	2·98
Sand	·97	·56	·85

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* Alkali, &c. Works Regulation Act, 1881, Part I., sec. 6.

Appendix I.—*cont.*

——	By Chance's Sulphur Recovery Process, 1888.		
	A.	B.	C.
Silica	..	..	..
Sulphur (free)	·45	·51	·40
Moisture (at 212° F.)	·58	·39	·34
Water	..	..	..
Combined water and loss	1·31	1·11	1·29
	100·00	100·00	100·00
Silica (combined)..Per cent.	1·71	1·89	1·72
Sulphuric acid (SO_3)	·25	·41	·25
Sulphur as sulphide	·38	·26	·36
Sulphur (free)	·45	·54	·40
Soda (soluble)	·26	·32	·37
Soda (insoluble)	·75	·72	·51

A and C taken from carbonators. B taken from vacuum filters.
Sulphides estimated in wet mud and calculated on the dry.

Appendix II.

Analyses of Vat Wastes.

(Chance Bros.)

——	Caustic Process.		Ash Process.	
Calcium sulphide	23·76	26·46	30·17	31·56
Calcium carbonate	28·29	24·16	19·88	25·15
Calcium hydrate	1·43	6·33	1·22	..
Calcium sulphate	Trace.	..	Trace.	..
Calcium hyposulphite	..	..	..	..
Soda (Na_2O)	1·63	1·18	·84	1·30
Alumina	·87	·87	·91	1·16
Ferrous sulphide	·91	·49	·67	·85
Magnesia	·35	·30	·43	·33
Silica (combined)	1·37	1·73	1·29	1·27
Sulphur (precipitated)	·36	·15	·47	·17
Coke	6·90	3·84	8·46	7·21
Sand	1·06	·61	1·34	·88
Moisture, dried at 212° F. in N.	33·34	34·69	35·01	30·50
	100·30	100·81	100·69	100·38
Total S. present as sulphides of calcium and iron	10·90	11·94	13·65	14·31

Particulars of Mixings.

(Hand Furnaces.)

——	Caustic Process.	Ash Process.
Salt cake	100	100
Limestone	55	100
Caustic lime mud	100	—
Coal	65	70

Appendix III.

Analyses of Vat Wastes for Sulphur (as Sulphides only).

Date.	Sulphur.	
	Caustic Process.	Ash Process.
1888.	Per Cent.	Per Cent.
January 24	10·90	..
„ 31	11·27	12·59
February 1	11·51	14·07
„ 2	11·93	..
„ 3	12·48	..
„ 4	12·34	..
„ 6	9·16	11·30
„ 7	..	11·81
„ 15	11·94	13·65
Average	11·44	12·68

Appendix IV.

Composition of Gases from each Vessel at 7 a.m.

Gases passing *from* Vessel.	H_2S.	CO_2.	H_2S and CO_2 together.
	Per Cent.	Per Cent.	Per Cent.
No. 3 to No. 4	28·0	8·0	36·0
No. 4 to No. 5	15·0	3·0	17·0
No. 5 to No. 6	..	..	8·0
No. 6 to No. 7	..	..	2·0
No. 7 to No. 1	..	..	0·5
No. 1 to purifier	Traces	Traces	..

Appendix V.

Analyses of Lime-kiln Gases for CO_2.

——	Average of Four Three-Hourly Tests.	
	Day.	Night.
1888.	Per Cent.	Per Cent.
February 8	28·1	26·6
„ 9	27·0	29·0
„ 10	28·6	28·1
„ 11	29·6	29·1

Analyses of H_2S Gases from Gas-holder to Burner.

——	9.0 a.m.		4.30 p.m.	
	H_2S.	CO_2.	H_2S.	CO_2.
1888.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
February 8	33·4	1·6	34·0	2·0
„ 9	32·3	1·7	33·0	2·0
„ 10	34·0	1·0	33·4	1·6
„ 11	34·0	2·0	34·0	2·0

APPENDIX VI.

WATER FILTERED from CARBONATED MUD.

—	Grains per Gallon.			
	January 16.	February 10.	February 13.	February 27.
"Alkalinity" due to $NaHCO_3$ (as Na_2O)	464·5	476·3	516·6	603
Carbonates of Ca and Mg (as $CaCO_3$)	105·3	124·3	101·2	151·2
Total S	77·6	25·9	15·05	35·9
S. as SO_4	..	1·0	·75	Traces
S. as Hyposulphites	16·1	12·85	3·6	14·3
S. as Sulphides	Nil.	Nil.	Nil.	Nil.
Silica	..	..	5·6	5·25
Al_2O_3, Fe_2O_3	..	..	Traces	Traces

TABLE A. B.

EXIT TESTS from CHAMBERS WORKING H_2S GAS.

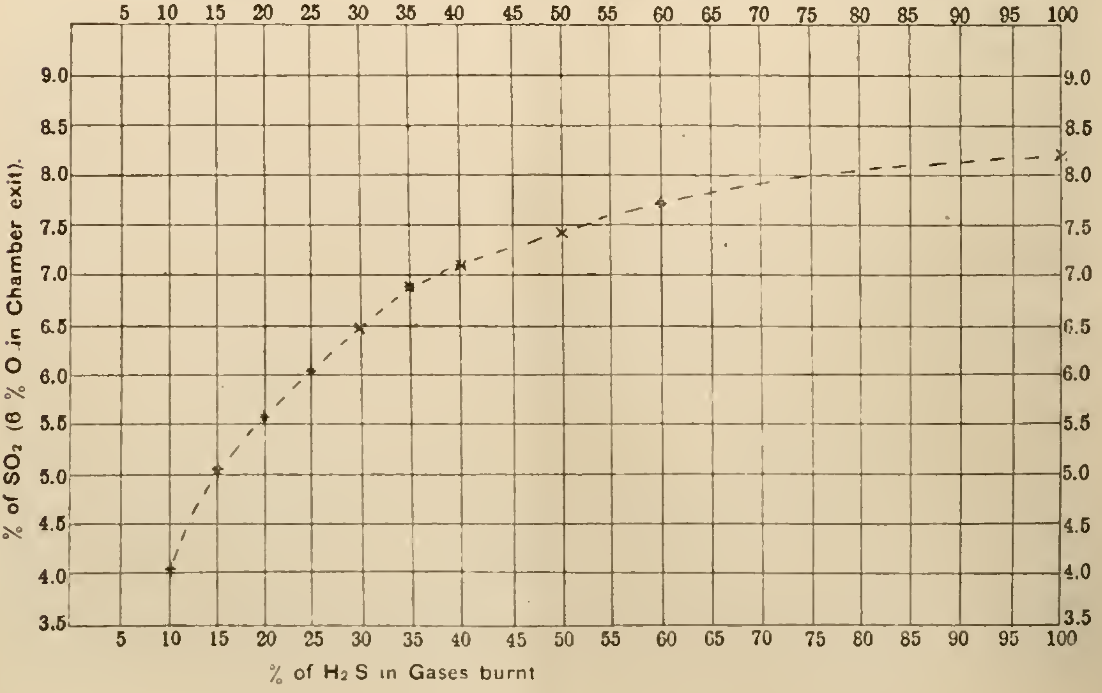
Date	Grs. SO_3 per Cubic Foot.	Date.	Grs. SO_4 per Cubic Foot.	Date.	Grs. SO_3 per Cubic Foot.	Date.	Grs. SO_4 per Cubic Foot.	Date.	Grs. SO_3 per Cubic Foot.	Date.	Grs. SO_4 per Cubic Foot.
1887. Dec. 3	·10	1887. Dec. 17	·70	1888. Jan. 7	2·20	1888. Jan. 21	4·00	1888. Feb. 1	·70	1888. Feb. 18	·97
„ 5	·20	„ 19	·50	„ 9	1·30	„ 23	1·40	„ 3	1·50	„ 20	1·94
„ 6	·90	„ 20	·70	„ 12	·80	„ 24	·80	„ 10	·50	„ 21	·63
„ 7	·20	„ 21	·20	„ 13	1·00	„ 25	·70	„ 11	1·50	„ 22	·54
„ 12	·10	„ 22	·10	„ 14	1·00	„ 26	Trace	„ 13	·67	„ 23	·70
„ 13	·70	„ 29	·90	„ 16	1·30	„ 27	·10	„ 14	·93	„ 24	·83
„ 14	Trace	„ 30	·70	„ 18	1·80	„ 28	Trace	„ 15	1·78	„ 25	1·40
„ 15	·60	„ 31	1·70	„ 19	2·30	„ 30	·20	„ 16	2·86	..	..
„ 16	1·70	..	..	„ 20	1·20	„ 31	Trace	„ 17	·85	..	.

The foregoing analyses were made by us.

5th March 1888.

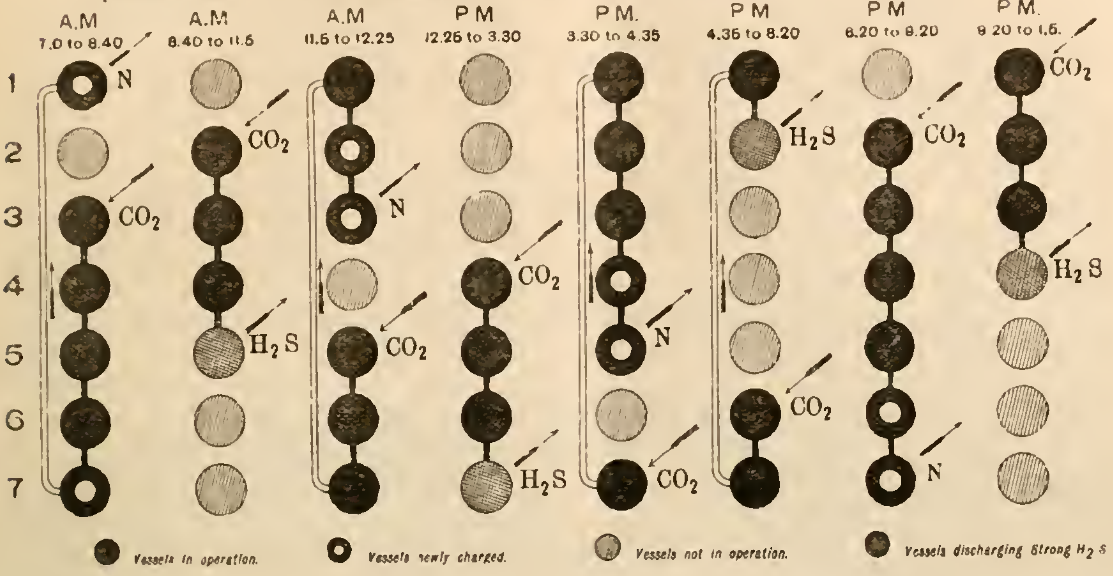
HORACE W. CROWTHER, F.C.S.
E. CLEMINSHAW, M.A., F.C.S., F.I C.

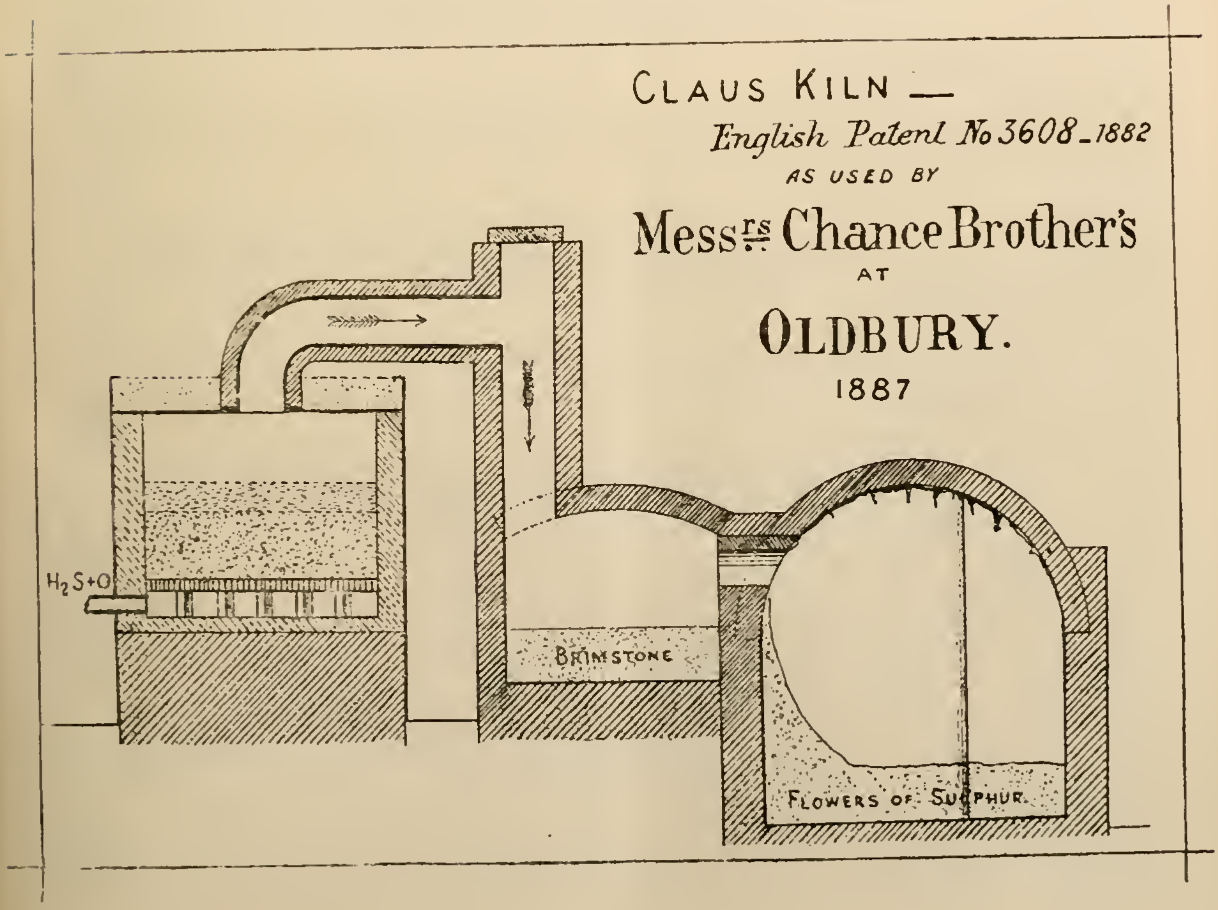
Diagram showing the °/o of SO_2 in Burner Gases with different percentages of H_2S (6 % of O in Chamber exit).

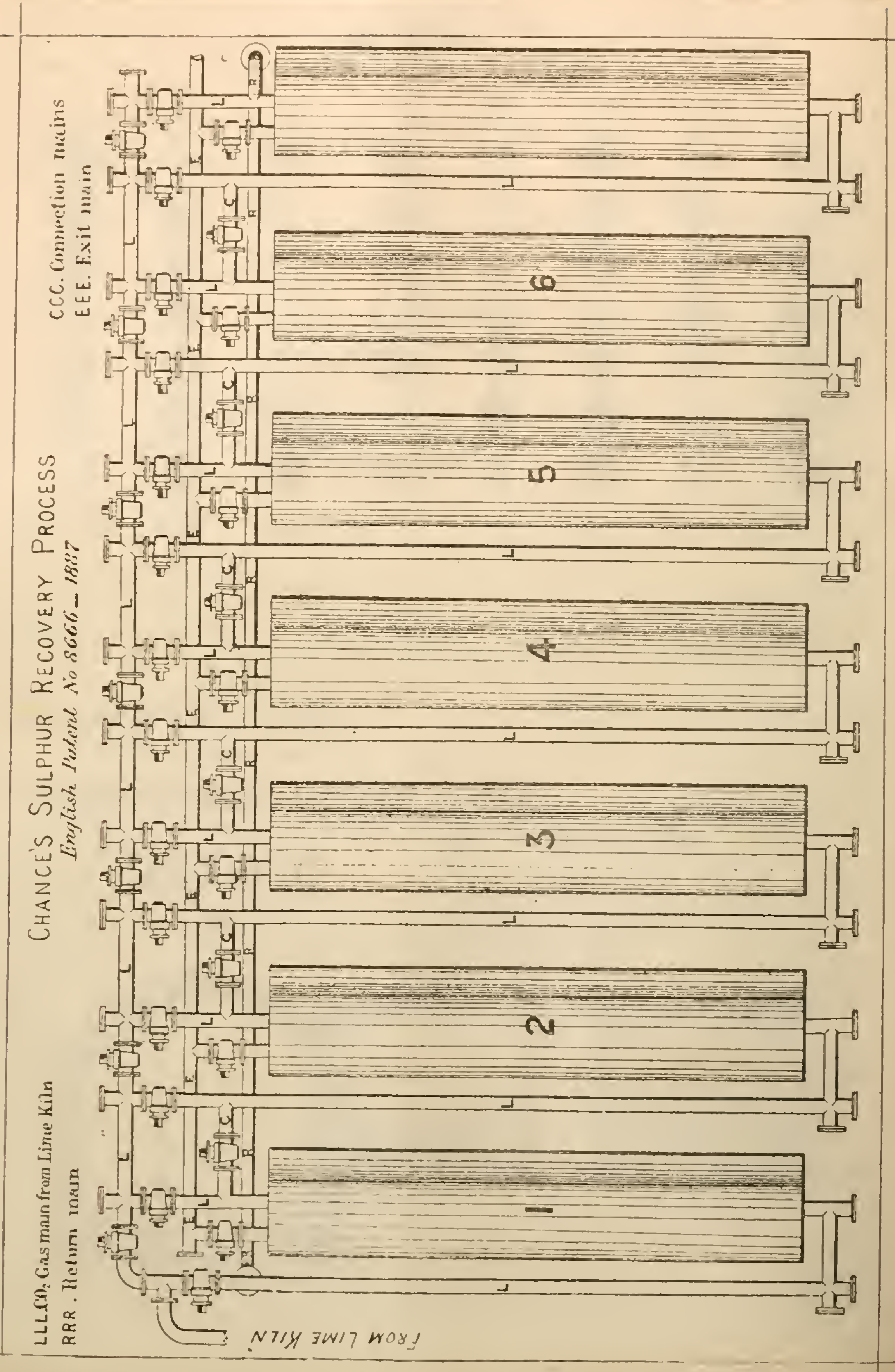


S.S.S.

Diagram to illustrate the working of the series of decomposing Vessels from the time of charging particular Vessel to the time of discharging it






CHANCE'S SULPHUR RECOVERY PROCESS
English Patent No 8666 _ 1887
CCC. Connection mains
EEE. Exit main
LLL.CO2 Gas main from Lime Kiln
RRR. Return main
FROM LIME KILN
1
2
3
4
5
6
L
C
R
E

DISCUSSION.

The President said he would, with the permission of the meeting, call upon some gentlemen present who had seen the process in operation, and in the first instance he would ask an impartial witness, a former President of the Society, Sir Frederick Abel, to give the meeting his impressions, as a scientific man, of the process as he had seen it.

Sir Frederick Abel had watched with much interest the efforts made by Messrs. Chance to effect the recovery of sulphur from alkali waste, first by the Schaffner and Helbig process—which unhappily had not proved so successful in practice as in theory—and latterly by the process which Mr. Chance had just described. Having recently had an opportunity of inspecting the process in operation, he had examined the working of the apparatus with the greatest interest, and though at first a little dismayed by the elaborate arrangement of pipes and stop-cocks, he had been re-assured, in regard to the actual simplicity of the working details, by the ease with which the intelligent workman in charge controlled the succession of operations which had been so clearly described by Mr. Chance. The process itself was indeed charmingly simple, and recommended itself to him as a thoroughly practicable one. Others present might be better able to criticise its commercial merits; it was for him to say how interested he had been to see the combination of simple chemical reactions with the perfection of simple chemical engineering bring about such thoroughly successful results. He must congratulate the Messrs. Chance on the ultimate success which had attended the remarkable perseverance they had displayed in their attempts to recover sulphur in a profitable manner from alkali waste. In conjunction with his former colleague, Mr. Stevenson, and others composing the late Royal Commission on Noxious Vapours, he had had to inquire a good deal into methods of dealing with this *bête noir* of alkali works, and, quite apart from the question of mercantile profit, had taken great interest as a scientist in watching the progess made towards recovering the sulphur which, in the forms in which it left the alkali works, had been in so many ways a mischief, instead of being recovered, to the advantage of scientific and practical chemists as would evidently be the case in future. He would conclude by congratulating Mr. Chance upon the lucidity with which he had brought before the meeting the remarkable results obtained in his long series of experiments, which had involved not merely the expenditure of much capital, but the expenditure of much thought and labour, and of that energy and perseverance which Englishmen were pre-eminent in devoting to the elaboration of the problems which the chemist, the engineer, and the man of science had to solve.

Mr. J. C. Stevenson, M.P., had twice had the advantage of examining the experimental plant which had been in operation at Oldbury for some time, and the best testimony he could give of his appreciation of the process was that he and his partners had decided to put it in operation at their own works at once. All chemists were aware of the efforts which had been made from the time of Gossage down to the present to get rid of this *bête noir*, sulphuretted hydrogen gas. Sir Frederick Abel having referred to their having been associated as members of the Royal Commission on Noxious Vapours, he might say that in his opinion, but for this dreadful product (H_2S), that Royal Commission would never have existed; and if Mr. Chance had shown them the way to get rid of this nuisance and turn it into a source of profit, he had given a great boon, not only to the alkali trade, but also to the outside public. Previous efforts to obtain sulphuretted hydrogen from waste in a combustible form, so as to make sulphuric acid or brimstone, might have failed because it was attempted to obtain a continuous supply of H_2S; and a great merit of Mr. Chance's process was that it did not attempt to make the supply continuous, but intermittent. He had at first been much puzzled by the complication of pipes and taps in the apparatus, and had requested Mr. Chance to put upon paper a complete round of operations lasting a whole day, and showing for each hour the particular pipes which were open and the particular gases being evolved in those intervals. To make the thing clear to his own mind he had transferred the operations to a plan, and Mr. Chance had been good enough to adopt his diagram and put it before the meeting. He had been much struck by the law of symmetry which prevailed in these apparently complicated operations. It would be observed that when the inert gases were being produced there were always six vessels in series, whereas when rich gases were being produced there were only four vessels in series, and this rule obtained throughout the round of operations. Another uniformity was that the time during which inert gases were escaping was about half that during which rich gases escaped—subject to varying circumstances, the escape of the former being for about 1 hour 20 minutes, and of the latter from 2 to 3 hours. Again, the law of symmetry was observed in the sequence followed by the carbonic acid in entering the series at regular intervals, two cylinders always intervening, and in the exit of the rich gases from cylinders at similarly regular intervals. He was also struck by the fact that during his examination of the process no smell of sulphuretted hydrogen could be detected. He felt strongly that the alkali trade had never adequately acknowledged the great services rendered by Mr. Chance some years ago in bringing about a reduction in the price of pyrites; and he hoped that he would get a substantial reward for the still greater service he had now done.

Mr. Alfred E. Fletcher, in endorsing the remarks of previous speakers as to the character of Mr. Chance's work and his lucid treatment of the subject, said Mr. Chance had succeeded because he had persevered and had made his previous work a foundation on which to rear a still more successful superstructure. It was interesting to consider how Mr. Chance had varied the work originated by Mr. Gossage, and had succeeded where he and others had failed. There were three points of difference between this process and its predecessors. First, Mr. Chance reduced the alkali waste to the consistency of cream, mixing it with water, whereas Mr. Gossage used it dry. Secondly, Mr. Chance did not simply force carbonic acid through the mixture, but by watching the results of that operation had discovered a means of separating the poor gas from the rich. He found that the sulphuretted hydrogen did not at once come off in a constant stream, but that the first portions were absorbed; then, after an interval the gas came off sufficiently pure to be of use. Thirdly, Mr. Chance had introduced a novel feature—a gas-holder—which, though not concerned with the production of the sulphuretted hydrogen, was most essential to its utilisation. These were the three causes which, in his opinion, accounted for Mr. Chance's success. It had been suggested that the apparatus was complicated, but really it was most simple in its working. The method of testing the sulphuretted hydrogen before allowing it to enter the gas-holder was unique. There was no elaboration of apparatus and no staff employed, but simply a Bunsen burner. The sulphuretted hydrogen gas being turned on, if it burned the man knew that it was strong enough; if the light went out, he turned it on to the next cylinder of waste. When it burnt readily he knew it was strong enough to send on to the gas-holder. The Claus kiln employed was familiar as being in several places employed in the manufacture of sulphate of ammonia. But there was a curious result which often occurred in working it, to which he would like to call attention. The formula $(H_2S + O = S + H_2O)$ looked very simple. If the right quantity of air was mixed with the gases the result was sulphur and water; if there was too much air one got sulphurous acid; and if the air was deficient H_2S passed away. One might, however, have both going away at the same time if the apparatus was not properly managed. He would like to know whether that experience had occurred to Mr. Chance. He had suggested that the working of the kiln or burner should be reversed, and the gases drawn in at the top instead of at the bottom. He thought, too, that the working of the burner would be improved by superheating the air; the kiln would then be sufficiently hot, and no H_2S would pass off undecomposed. Mr. Chance had stated that 98 per cent. of the H_2S was converted into sulphuric acid; he would like to know also what proportion of the H_2S was decomposed in the other form of the process, and collected as brimstone. With respect to the suggestion that this process would interfere with the interests of the pyrites companies, it seemed to him that it would have far more effect upon Sicilian sulphur. Sicily produced three times the quantity of sulphur that could be recovered from the waste. It looked, therefore, as if the same quantity of pyrites would be used as at present, but that one-third less sulphur would be exported from Sicily. As an inspector of alkali works he rejoiced at the prospect of a time arriving when there would be no more nuisance from tank waste. He had been told that his vocation would soon be gone, in consequence of so many improvements. He did not think so; but, however that might be, he heartily congratulated Mr. Chance on his present well-merited success.

Mr. Gossage, on rising, said he had not expected to be called upon to speak, and was therefore quite unprepared. He thanked Mr. Chance for the recognition which he had given to his father's discovery of the decomposition of calcium sulphide by carbonic acid. It was generally admitted now that at the time of his father's discovery (1837) that decomposition was not known to chemists. It was evolved in his laboratory at Stoke Prior; and as Mr. Chance had said, the credit of the practical recovery of sulphur from alkali waste belonged to the county (Worcestershire) in which that idea originated. His father had devoted much time and money to the problem of the recovery of sulphur from alkali waste. It was patent to everybody now why he had failed. He had made the mistake of passing carbonic acid (pure gas) through the waste when it was in a comparatively dry state. Thus channels were formed through which the carbonic acid escaped, and the waste was only imperfectly decomposed. The cost of carbonic acid was very great before the manufacture (also an invention of his father's) of solid caustic soda, because there was no extensive use for caustic lime in alkali works. Another difficulty his father experienced was that there was no method known for using comparatively weak sulphide of hydrogen in vitriol chambers, and the only known process for obtaining solid sulphur was so imperfect as to yield not more than 50 per cent. of the sulphur in the sulphide of hydrogen. He was sincerely glad to find that Mr. Chance had succeeded where his father had failed. The process of hydrosulphuration was however, he believed, not absolutely new, but all alkali makers should feel grateful to Mr. Chance for having successfully applied it. In conclusion, he would only say that whenever sulphide of sodium should be practically made, there would be no more alkali waste. Soda would then be made from sodium sulphide and the sulphur recovered without the production of that *bête noir* (to alkali makers), alkali waste.

Mr. Brock had examined the process several times at Messrs. Chance's works. He had also, in 1881 and 1882, examined there the magnesium chloride process, and well remembered that when Mr. Chance read his paper on that process before the Society of Arts, he himself had ventured to predict that sulphur recovered by that method would cost about 3*d.* per unit, and that, consequently, if the pyrites companies reduced their price to 3*d.* per unit, that process would be valueless. Strangely enough it had fallen to his lot to be selected by a number of his brother alkali makers to open negotiations with the Tharsis Company, and to use Mr. Chance's process as a lever to induce them to lower their price to 3*d.* per unit After several days' anxious negotiations the Tharsis Company did reduce their price to 3*d.*, and that was the death-blow to Mr. Chance's former process. On Mr. Chance's account he did not regret that result, because, if the price of pyrites had not been reduced, Mr. Chance would probably have been satisfied with what he had then done, and would have gone on with that process—which, in the long run, he did not think would have been successful. But that process being no longer a commercial success, Mr. Chance had, after a time, turned his attention to the present process, with the result that he had now succeeded in decomposing alkali waste profitably, obtaining the sulphur either as sulphuric acid or as brimstone. Mr. Chance had not told them in his paper, and perhaps was not yet quite sure, what was the exact cost of that method. But he (Mr. Brock) thought he might venture on the prediction that that cost would not exceed 1*d.* per unit. Supposing it to cost a good deal more—say 20*s.* per ton of brimstone—there was still a large margin for all who chose to recover their sulphur by this method. He had shown his faith in the success of the process by taking a license for his company, and had already ordered some of the more important parts of a plant for treating 700 tons of waste per week. He had given his opinion, and thought he had also shown that he had the courage of his opinion. His company intended to push on as quickly as possible, so as to be in the market while other manufacturers were considering, because he thought that this was one of those cases in which those who went in early were likely to win a substantial profit. Of course, the first effect would be to kill off (so far as sulphur recovery was concerned) those manufacturers who had the Mond sulphur recovery process—if they were not already killed off by the increased value of hydrochloric acid. Considering that by that process about 5 tons of hydrochloric acid were required to make a ton of brimstone, and that hydrochloric acid had gone up in value to about 12*s.* a ton, he could not see much room for profit by that process. He felt sure that when the alkali trade, as a whole, examined Mr. Chance's process they would come to much the same conclusion that he had. Some thought him rash perhaps, but one had to try new processes and venture something if progress was to be made, and having satisfied himself, he was going to try this. If he failed, he failed. If he succeeded—well, at any rate he should make some money. As far as he could judge he thought Mr. Chance had solved the problem of sulphur recovery, and he hoped there would be such a demand for licenses that any feeling he might have had that his former efforts were not properly acknowledged, would now be completely done away with.

Mr. Alfred Allhusen could add nothing to Mr. Brock's observations except the statement that his own company had decided to follow in his steps. He proposed to commence immediately the designs for a plant for the treatment of the waste from 1,000 tons of saltcake per week in five sections, the first section of which would be erected at once. That, he thought, would prove that he thought the process a satisfactory one.

Mr. David Howard desired to express the deep gratification with which he had listened to Mr. Chance's recitation of the history of his process. It could not be said that there was no poetry, no chivalry, in science, for surely the history of these heroic efforts for the recovery of sulphur were at least as interesting as Sir Thomas Mallory's *Mort d'Arthur*. True knight after true knight had ridden out in quest of the prize. Some had gone down, but their work had not been lost. That was a lesson full of importance to every chemist; for as the great master, Faraday, once said: "Unsuccessful work ought to be as valuable as successful work." The unsuccessful work of Gossage and others had not been lost, but had borne fruit now. One after another had tried; and in that Mr. Chance had been successful in winning the goal, he was to be congratulated on giving an example of the true science of applied chemistry. Two things were required for all such success--high chemistry and good engineering.

Dr. D. B. Hewitt could not but re-echo the remarks of previous speakers as to the excellence of Mr. Chance's work and his lucid description of it. His own opinion, based on an intimate knowledge of the processes used, was that there was no difficulty in carrying out the process described by Mr. Chance, not for "less than nothing," but probably without exceeding the limit of cost suggested by Mr. Brock. That nuisance should be diminished and waste prevented was an object which commended itself to all, whether in competition or not; and he could express his satisfaction that Mr. Chance should have succeeded in bringing the Leblanc process one step nearer to perfection. He did not think research was yet ended with respect to that process. Dr. Hurter had clearly put before the Society at Liverpool that there were possibilities in the future of that process which none perhaps could then anticipate. Seeing that hitherto all its sulphur and something like 80 per cent. of its chlorine had been wasted, no chemist would deny that there was a future before the Leblanc process. And if the figures given by Mr. Chance were studied, it would be seen that that process, so far from expiring, had got into a strong position and was thriving. Leblanc soda makers had taunted the pyrites companies a few years ago with establishing a monopoly to keep up the price of sulphur compounds. They themselves were now open to a similar taunt for combining to keep up the price of chlorine products; and he hoped the time would soon come for that stigma to be removed. It was encouraging to those in a different industry, and especially to himself who had so many friends in the Leblanc soda industry, to see that there was still left for the perseverance and research of such men as Mr. Chance so large a field for improvement. He had no doubt that before another 20 years had passed the Leblanc soda makers would have faced the question, and would no longer be wasting 60 to 80 per cent. of their chlorine. Looking at the figures published, he already saw evidence of such improvement; for while the quantity of salt decomposed had increased, the yield of chlorine products had increased in a much greater proportion. Remembering that Mr. Deacon had promised a decomposition of 95 per cent. of the hydrochloric acid used in his process, he thought that process still had in it the means of enabling Leblanc manufacturers to diminish their present enormous losses on soda products to a much lower figure by making their bleaching powder and chlorate of potash with a smaller output of soda products. The same perseverance, the same skill in chemistry and engineering that had brought Mr. Chance success to-day would bring success to the Leblanc people in the future, if they were only determined to face it.

Dr. Alder Wright was not quite clear whether in the manufacture of vitriol the sulphuretted hydrogen was burnt simply as such, or in a modified form by the aid of peroxide of iron or some such body.

Mr. Chance replied that it was burnt in the kiln by simply lighting a match.

Dr. Alder Wright, continuing, asked why it was that the same amount of chamber space was required for the manufacture of vitriol from the gases produced in the described combustion as was necessary in the case of pyrites. He would have expected that, notwithstanding the presence of a certain quantity of nitrogen, the chamber space required would be less than in the case of pyrites.

Mr Chance replied that 65 to 70 per cent, of dilute gas entered the kiln continuously. If Dr. Wright would examine the diagram accompanying the paper, he would find all his questions answered.

Mr. F. S. Newall had not had the pleasure of seeing Mr. Chance's process at work. Nevertheless, he thought some remarks he wished to make might interest the meeting. He had for the last four years been trying to recover sulphur from sulphuretted hydrogen. In 1884 his firm adopted Schaffner and Helbig's process for the decomposition of tank waste, as it happened that they produced waste magnesium chloride. They worked that process on a scale of about 70 tons a week for two years; but although they burnt some 200,000 cubic feet of gas a week, they found great difficulty in getting their consumption of nitre as low as Mr. Chance's, in fact it had increased, not decreased. They therefore decided to recover the sulphur as sulphur, and after several trials they adopted a kiln similar to that used by Mr. Chance, not knowing that he was working in the same direction. He believed that their kiln dated as far back as 1842, when Gossage first patented the decomposition of tank waste by carbonic acid. Gossage had adopted the plan proposed by Mr. Fletcher, of allowing the sulphuretted hydrogen to enter at the top and the sulphur to be taken out at the bottom. At Washington they had recovered two or three hundred tons of sulphur by means of that kiln; but they did not manage to recover the flowers of sulphur dry as Mr. Chance did, there being always a fairly large quantity of liquid acid condensed along with the flowers. On the whole, they recovered 60 per cent of the total sulphur in the waste after taking out screenings. (The process was given up about the end of 1886, as the manufacture of soda was discontinued and hence no tank waste produced.)

Mr. Chance: I will endeavour to reply to the criticisms of my friends in the order in which they were made. But before doing so, I should like to call your attention to the very interesting portrait we have before us of our deeply lamented friend the late Mr. Walter Weldon, with the distinguished French chemical engineer M. Pechiney standing by his side. Soon after Mr. Weldon's death I endeavoured to arouse sufficient enthusiasm among the members of our Society to perpetuate his memory by a subscription engraving of his presentation portrait by Frank Holl; and it has always been a source of pain to me that my efforts were unsuccessful. But it is not too late yet, and I hope that the time will come when the efforts I then made may bear fruit. I am indebted to Mr. Brock's kindness for the gift of the enlarged photograph before us. Not liking the first frame I had made, I sent the portrait to London to be re-framed, and by a special effort I was able to get it here to-night, so that we may look at Mr. Weldon though he can no longer be in our midst. The alkali trade little know how much they owe to Mr. Weldon; and certainly this meeting would not have been complete without his portrait.

With regard to the apparatus required for this process, I want to make one distinct and emphatic statement, arising out of an inquiry made in a letter from an eminent firm of engineers in regard to our plant. They asked me if they were to reserve any commission for us on the apparatus they might supply, and I said, "No, certainly not; we charge a small royalty for the use of our invention, we expect that to be paid loyally; but as to the apparatus, we wish our licensees to get it of the best kind and on the best terms they can." Of course, the engineering firms who supply the apparatus will take care to ascertain from us that licenses have first been taken out. Messrs. Galloway, of Manchester, Messrs. W. Neill and Son, of St. Helens, Messrs. R. Daglish and Co., of St. Helens, Messrs. Carrick and Wardale, of Gateshead-on-Tyne, and others are already prepared to supply the apparatus to our licensees.

Sir Frederick Abel referred in his genial way to the number of pipes and taps in our plant. But when I tell you that those most successful manufacturers, Messrs. Brunner, Mond, and Co., have at least 100 taps for every tap that we have, and that they are very successful in controlling the escape of ammonia (which they would be very sorry to lose), nobody need hesitate to embark in our process on that account. There is also another point in common between Messrs. Brunner, Mond, and Co., and ourselves,—they look upon a lime-kiln with great respect, and so do I. In years to come, I think I might read a very interesting paper on the history of the lime-kiln, and what it has done for the alkali trade. I will now pass on to the criticisms of Mr. Fletcher. With regard to the three points of difference which he has pointed out between Mr. Gossage's process and ours, I agree with him that our success has depended a good deal on the combination of those three points. I should be inclined to lay more stress on one point and less on another, but on the whole he is quite correct. With regard to the Claus kiln and the escaping gases, Mr. Fletcher has asked me a question which I am not prepared to answer, not having had a sufficiently long experience of the working of this kiln. He has a staff of very able assistants who come in and out of our works at their pleasure; and it is rather for them to ascertain and tell him what is escaping. We next had the pleasure of listening to Mr. Gossage, and I can only say I thank him warmly for the kind way in which he received my humble recognition of his father's work. I have a profound respect for the good seed sown by Mr. Gossage, some fruit of which has been shown to-night. Mr. Brock tells us that he has ventured to prophesy before he knows; but I think he does know and that the price will probably not be more than the figure he has named, because our process is still open to improvement. I honestly never felt that any acknowledgment was due to us for our work on the Schaffner and Helbig process. It was a speculation on which we spent 10,000*l.* We should have made many thousands a year if it had been generally adopted, and I could never see why the alkali trade should contribute towards what we lost by embarking in an experiment the profits of which we should certainly not have asked them to share. I am delighted to hear that Mr. Allhusen will apply for a license, which of course will be granted. Dr. Hewitt has spoken in the kindest way of our efforts. I am only sorry that Mr. Mond is unable to be present. With respect to Dr. Hewitt's reference to the process being worked for "less than nothing," I did not say that. All I said was that the labour would cost less than nothing, inasmuch as the labour of working our new process will cost less than the labour of dealing with an equivalent quantity of pyrites. In my estimates I have absolutely disregarded any profit on carbonate of lime, the removal of which so far entails an expense. But I think the cement trade will come in and take that carbonate of lime, and we shall then have the advantage of profits not accruing at present, and this process may after all eventually be worked for less than nothing.

The President: It is now my pleasant duty to ask you to return thanks to Mr. Chance for his admirable paper. I should fail in my duty if I did not draw from his work on the one hand and the discussion on the other some inferences bearing not only on the progress of science at large, but on the relations of applied chemistry at the present time in England. There is at present an agitation in this country with regard to what is called technical education, and as to how far and in what way the Government should encourage the institutions concerned with it. I was recently asked, as President of this Society (but without time to consult the feelings of the Council as to the course I should adopt), to take part in a deputation to the Privy Council with regard to Government grants in respect of applied science. If we try to draw a moral from this paper, we shall see that there are some remarkable coincidences. Taking the alkali trade alone, we see that a revolution is taking place at the present time, or has taken place recently, in the ammonia soda process, the Weldon-Pechiney chlorine process, and in Mr. Chance's sulphur-recovery process. We have heard Mr. Chance confess that he was not the discoverer of the chemical reaction involved in his process—that to Mr. Gossage the credit of that discovery was due. Again, when I lately brought before you the results of the Weldon-Pechiney chlorine process, I told you that I had failed to find the simple decomposition of magnesium chloride by oxygen mentioned in modern text-books, though Graham was well acquainted with it. Taking the case of ammonia soda, did the present successful manufacturers of that product in England discover the reaction? No; that reaction was discovered by a poor chemist in Scotland, who derived no benefit from it. We have here, then, three important discoveries which did not bear fruit till long afterwards. Considering these results, I ask you whether the ends of technical science are likely to be fulfilled by merely instructing an individual in that limited course of knowledge belonging to his own manufacture—whether an individual so instructed would have been likely to work out the results of either of these three processes? To my mind it is perfectly clear that if you want to succeed you must teach what Mr. Howard has called the higher chemistry. We have been to the front with this higher chemistry; we have discovered these reactions; but have had to wait a long time for their application. That being the case, is it specific knowledge or larger general knowledge that is required? Is it not really the higher scientific education, apart from any question of results, that ought to be disseminated? It seems to me that if we taught chemistry for ever in a rigid and restricted way we should probably go backward rather than forward. It is in the wider general cultivation of science and the proper and intellectual method of teaching it that we are deficient, and it is that which will in future, I hope, be appreciated by the country and supported by the Government. There is a remarkable lesson to be drawn from this process if we analyse the small apparent difference which has made it a success where similar processes have failed. We find the same reagent used with a little additional pressure. But the problem was how to get quit of a nuisance, how to get quit of an inert gas, useless as far as the reaction was concerned, and how to economise the resulting product. If we are not to the front in the higher chemistry, we are at least to the front in that acumen which is commonly called *νοῦς*, and I can congratulate Mr. Chance and England that with regard to the ancient manufactures which have been our staple industries we are not behind in applying the resources of modern science. I admit that we are deficient in the novel application of the highest chemistry. That deficiency must be met, but it will not be met by restricted intelligence to be confined to one department of science, but by the higher cultivation of chemical engineering. It is only to be met by producing men who in addition to a thorough knowledge of these reactions will have an intelligence wide enough to enable them to operate fearlessly with the most complicated apparatus in order to achieve their results. Mr. Chance tells us that he spent 10,000*l.* in elaborating a process which was a failure, so far as commercial results were concerned. How must we look as a nation when compared with Germany! In the whole course of a life spent in scientific investigation this question of *£ s. d.* has always been pressed before me and hampered me. How can science be properly cultivated if we have not in our midst the means of at least giving us the material with which to elaborate those scientific results upon which the future applications of chemistry depend? You talk of building new laboratories, but I say (as I have said to certain learned and reverend dons in a town with which I am connected) what is the use of that unless you will also give us a thousand pounds to put down the sink? They want to see something for their money; but I say you will see nothing for it in our generation, but posterity will inherit the benefits of our work. I hope, therefore, that in congratulating Mr. Chance on the success which he has achieved as the result of perseverance and the risking of capital, that you will not forget the claims of pure science, which is dependent on the same resources for its success.

The vote of thanks having been carried unanimously, Mr. Chance briefly responded, and, after stating that he desired to give a share of the credit to his cousin, Mr. J. F. Chance, whose name appeared in the patent, as well as to the other members of the firm, said there was one remark made by Mr. Gossage which he had omitted to refer to. Mr. Gossage had intimated that if ever soda from sulphide of sodium should be manufactured on a large scale, soda waste would cease to exist, and then this process would cease to have a *raison d'être.* In regard to this, he would simply say that the question of sulphide of sodium was now receiving his attention, and they might hear something of it on a future occasion. If it did come to the front, the greater part of the plant belonging to this new sulphur-recovery process would still be required, and therefore no one need be deterred by Mr. Gossage's final reference to the unknown future from taking advantage of the opportunity of going in for Sicilian brimstone and pure sulphuric acid in competition with other sources of supply.

* * *

Meeting held Monday, February 20th, 1888.

MR. THOS. TYRER IN THE CHAIR.

ON A NEW SERIES OF COTTON COLOURING-MATTERS.

BY ARTHUR G. GREEN, F.C.S., F.I.C.

Up to within three or four years of the present date, in spite of the great number of colouring-matters known, only a few were capable of dyeing cotton with any degree of fastness.

The cotton dyestuffs now known may be classified as follows:—

(1.) Hydroxy compounds capable of forming stable coloured lakes with metallic oxides.

(2.) Insoluble colours formed in the fibre.

(3.) Strongly basic nitrogenous colouring-matters.

(4.) Non-nitrogenous natural dyestuffs.

(5.) Azo cotton colours.

Group I.

Alizarin is typical of the first group, and is the most important of them. This body, though not a dyestuff in itself, is capable of combining with the hydrated oxides of such metals as iron, aluminium, chromium, &c. to produce coloured insoluble lakes which, when the oxide has been previously fixed upon the fibre, remain firmly adherent thereto. In spite of the great fastness of this colour, the cotton cannot really be considered as "dyed" in the proper sense of the term, for the alizarin does not penetrate the substance of the fibre, but merely forms an insoluble pigment upon its surface. In a recent paper in the *Berichte* of the German Chemical Society (Ber. **20**, 3146), St. v. Kostanecki has shown that all the artificial colouring-matters which combine with oxide-mordants, like alizarin, are *ortho* compounds. Thus alizarin, anthrapurpurin, anthragallol, gallëin, cœrulin, galloflavin, styrogallol, nitropyrogallol, and nitropyrocatechin, which all combine with mordants, contain a pair of OH groups in the *ortho* position to each other; in a similar manner α-nitroso-β-naphthol, β-nitroso-α-naphthol, nitroso-β-orcin, mono- and di-nitroso-resorcin, which also have this property, contain the hydroxyl (OH) group in the *ortho* position to the nitroso (NO) group. On the other hand the compounds isomeric with the above, having the OH group in some position, other than ortho to the NO or second OH group, exhibit for mordants no affinity whatever. Probably the mordant dyeing natural colouring-matters also derive this property from being ortho compounds.

Group II.

The colours of this class are produced by padding the cotton with a soluble compound which, when brought in contact with another soluble compound, or when exposed to atmospheric oxidation, will precipitate upon the fibre an insoluble colouring-matter. The adherence to the fibre of the colour produced appears to depend merely upon its insolubility, and not to any natural attraction for the cotton.

In this group may be included most of the old mineral colours, such as chrome-yellow, Prussian blue, &c., also aniline black, indigo, and the insoluble azo-colours produced upon the fibre by the methods of Read Holliday, and A. Spiegel (Ber. **18**, 1479).

Group III.

To this group of cotton colours belong the strongly basic compounds—methylene blue and saffranine—which both have a decided substantive affinity for the cellulose fibre. The natural affinity of the less basic colours (*e.g.*, rosaniline, methylviolet, malachite-green, &c.) is far less, though they can readily be applied by the aid of a tannin mordant. The colours produced in this way, however, are never very fast, as the attraction of the cotton for the basic colour appears to be overbalanced by the presence of alkalis or soap.

Group IV.

This group includes certain natural colouring-matters such as bixin (from annatto), carthamin (from safflower), curcumin (from turmeric). They consist of carbon, hydrogen, and oxygen only, and dye cotton readily without a mordant. The colours, however, are very fugitive to light.

Group V.

In addition to the four preceding groups, which until recently were the only ones known, a fifth group of cotton colours has been introduced into the market since 1885. The latter, which dye cotton without a mordant from a neutral or alkaline bath, are all soluble azo compounds containing a sulpho (SO_3H) or carboxy (CO_2H) group.

All those which have at present been described are derived from a few diamido bases.

Such bases are:—

(*a.*) Di-*p*-amidodiphenyl—
$C_6H_4(NH_2).C_6H_4(NH_2)$
(benzidine) or di-*p*-amido-ditolyl (tolidine) $C_7H_6(NH_2).C_7H_6(NH_2)$, which give rise to Congo-red, benzopurpurine, chrysamine, &c.

(*b.*) Di-*p*-amidostilbene—
$C_6H_4(NH_2).C_2H_2.C_6H_4(NH_2)$
which gives rise to Hessian-purple, Hessian-yellow, chrysophenine, &c.

(*c.*) Diamidonaphthalene $C_{10}H_6(NH_2)_2$ (Germ. pat. 39,955).

(*d.*) Di-*p*-amidobenzene $C_6H_4(NH_2)_2$.

(*e.*) Di-*p*-amidoazobenzene—
$C_6H_4(NH_2).N_2.C_6H_4(NH_2)$.

Upon what the affinity of these colours for cellulose depends still remains quite undetermined. At first it was supposed to be a function of the diphenyl group (R. Möhlau, Ber. **19**, 2014), until this was disproved by the discovery of the cotton colours from (*b.*), (*c.*), (*d.*), and (*e.*). More recently it has been attributed to the fact that all these bodies are *di-para* compounds, but against this it may be urged that the very similarly constituted di-*p*-amidobenzophenone $C_6H_4(NH_2).CO.C_6H_4(NH_2)$ and di-*p*-amidodiphenylmethane $C_6H_4(NH_2).CH_2.C_6H_4(NH_2)$ give azo-compounds which have scarcely any affinity for cotton, whilst on the other hand the azo-colours from di-*meta*-amido-diphenyl have a decided affinity, though less than the isomeric *para* compounds (Ph. Brunner and O. N. Witt, Ber. **20**, 1029). It is not even necessary that an azo cotton colour should contain two N_2 groups, for I have obtained direct cotton colours, with a very marked affinity for cotton, containing only one azo group. It is to be remarked that although all the colours of this group are sulphonic or carboxylic acids, they nevertheless dye cotton (or other fibre) from a neutral or alkaline bath, but not from an acid bath.

Group VI.

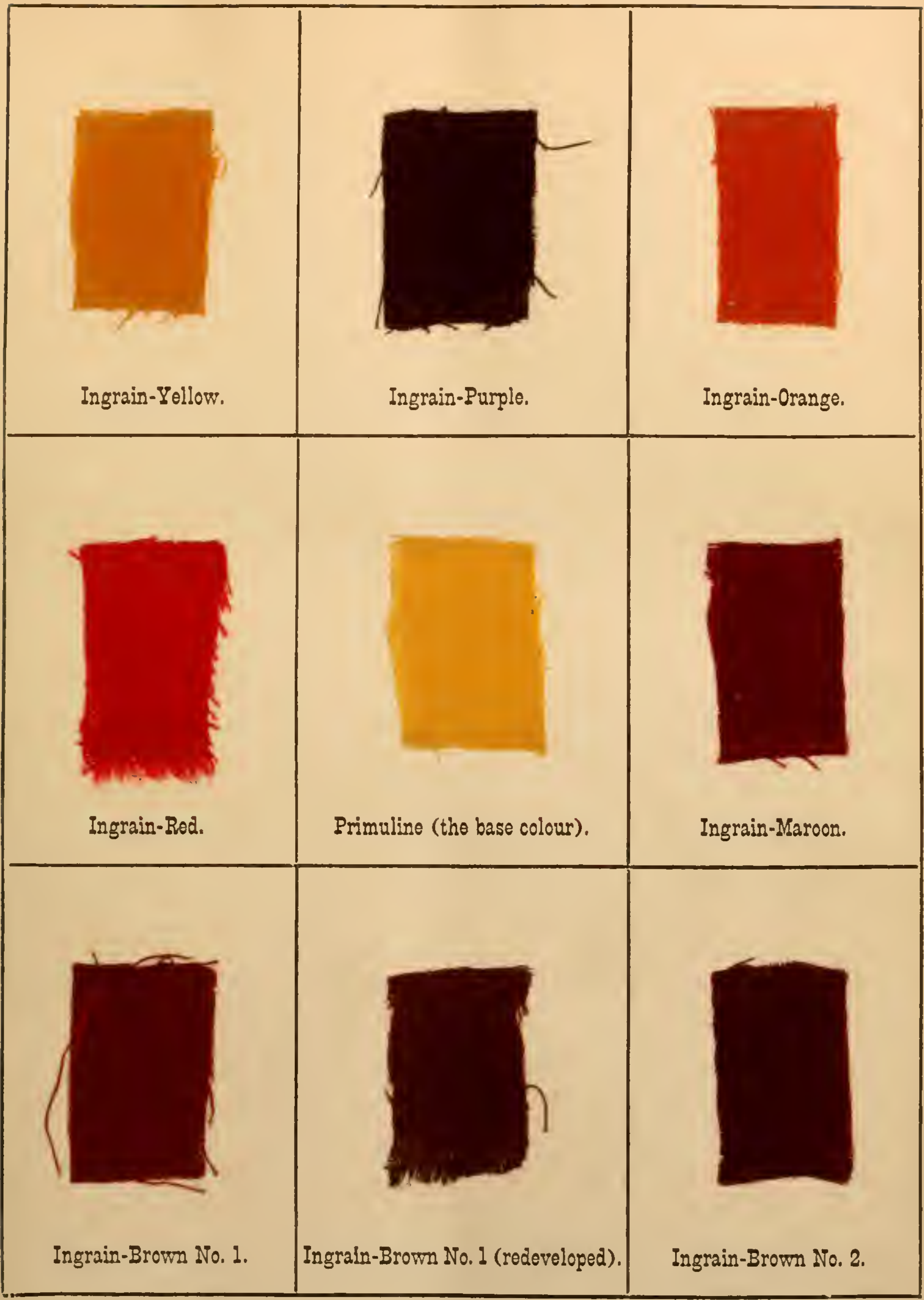
Until the beginning of last year all the colouring-matters known, which had a direct affinity for the cellulose fibre, were comprised in the last three groups.

In February last I discovered an entirely new class of cotton colours. The only representative of this at present introduced into the market is the yellow colouring-matter called "*primuline*." This body differs from the other direct cotton colours in being an amido-sulphonic acid.

The commercial product forms a yellow powder, which is very soluble in hot water. It dissolves in strong H_2SO_4 with a yellow colour and bluish fluorescence; on dilution with water an orange precipitate of the primuline acid is produced. The very dilute aqueous solution of "*primuline*" has a blue fluorescence. Like the last-mentioned group of colours it dyes unmordanted cotton directly from a neutral or alkaline bath. The colour produced is a primrose yellow (hence its name from *primula*, the primrose). The affinity of the colour for the fibre is increased by the addition to the bath of some salt such as sodium sulphate, sodium nitrate, sodium carbonate, or common salt, preferably the latter; in this way any depth of shade can readily be obtained. The yellow is tolerably fast to scouring, is entirely unaffected by alkalis, but by acids it is turned to a golden yellow. Reducing agents have no effect upon it, but it is attacked by oxidising agents, such as chromic acid and bleaching powder. The former changes the shade to an olive, whilst an alkaline solution of bleaching powder or of sodium hypochlorite converts it, on boiling, into an orange yellow, which is very fast to all agents.

Ingrain Colours.—By diazotisation of "*primuline*" and combination with phenols and amines, azo-colours are produced. These reactions, as I have discovered, can be very readily performed up the fibre, the colours so produced being named "ingrain colours" on that account. In this way a great variety of shades can be obtained, which are characterised by their extraordinary fastness to scouring, milling, acids, &c. Their fastness in this respect is far greater than that of the benzidine colours, and is only equalled by alizarin and its congeners.

As the ingrain colours are all easily soluble compounds when prepared without the fibre, their fastness, when prepared within the fibre, must depend upon some very intimate combination with it, and not insolubility, as is the case with the azo-colours



Ingrain-Yellow.

Ingrain-Purple.

Ingrain-Orange.

Ingrain-Red.

Primuline (the base colour).

Ingrain-Maroon.

Ingrain-Brown No. 1.

Ingrain-Brown No. 1 (redeveloped).

Ingrain-Brown No. 2.

A NEW SERIES OF COTTON COLOURING MATTERS, by A. G. GREEN.

formed upon the fibre by Read Holliday's process. In the latter process the first bath merely impregnates the fibre with a compound which does not combine with it and could be washed out, whereas in my process the cotton is firmly *dyed* with the "*primuline*," and may be thoroughly washed before being developed. The phenols and amines employed as developers are sold in solution. The method of procedure for dyeing an ingrain colour is as follows:—

The cotton is dyed with "*primuline*" from a strong boiling bath containing common salt; this bath is made with about 5 per cent. of "*primuline*," and is kept up by the addition of 2—3 per cent. more colour for every fresh lot of cotton dyed. After having been dyed with the "*primuline*," the cotton is thoroughly washed in cold water to remove surface colour (which would cause bleeding), and is then passed through a bath of sodium nitrite containing about ½ lb. of $NaNO_2$ to 10—20 gallons of *cold* water, and made slightly acid with H_2SO_4. The formation of the diazo-compound is complete in less than a minute, the colour changing to an orange. After washing in cold water the cotton is ready to be developed to the required colour; this development should be proceeded with without unnecessary delay, for like all diazo-compounds the diazotised "*primuline*" is unstable and begins to decompose in the course of an hour or two, or even quicker when exposed to a strong light. If, for instance, it is required to produce the "*ingrain-red*," the diazotised cotton after being washed is passed at once into a bath containing to every 20—40 gallons about one gallon of the red developer. The red colour appears at once and the development is quite complete in two or three minutes (except in the case of very close impervious materials). The red developing bath may be cold, warm, or even boiling, the result in either case appears to be almost exactly the same; soap or alkalis may also be added if desired. Very impervious materials are best developed hot or boiling.

The *Ingrain-Red* compares most favourably with alizarin in fastness to milling, scouring, hot-pressing, acids, alkalis, and other tests. Unlike the reds of the benzidine series it is entirely unaffected by acids, even when very strong. It also resists very severe soaping and milling. If insufficiently developed it is not so fast to light, and hence it is of great importance that the developing baths should not be too weak. It can be produced at a far lower cost than alizarin.

All the other ingrain colours are produced by exactly the same process as has been described for the red, except that in the last operation the corresponding "developers" are employed. The depth of shade obtained will of course depend entirely upon the depth of the original "*primuline*." The nitrite bath can be used repeatedly as long as it smells distinctly of nitrous acid and tastes distinctly sour; when this is no longer the case more sodium nitrite or sulphuric acid must be added. This bath should be quite cold. The developing baths can also be used continuously if fresh developer is added as it becomes exhausted. If the diazotisation or the development is not complete from the baths being too weak or other cause, the colours produced will be very fugitive to light. As is often the case with azo-compounds, small traces of copper salts have a very dulling effect upon the ingrain colours, and hence it is advisable to avoid the use of copper vessels as much as possible. The red and orange are especially sensitive in this respect, being converted into browns by boiling for some time in a weak solution of copper sulphate.

The *Ingrain-Maroon* produced with the "maroon developer" gives bluer shades of red, and from light shades of "*primuline*" produces very good pinks. As the reaction is much slower than with the other developers, it is necessary to use the developing bath much stronger.

The *Ingrain-Brown No.* 1 is a terra-cotta shade, the *Ingrain-Brown No.* 2 a chocolate brown. Both are very fast to acids, alkalis, scouring, &c.

The *Ingrain-Yellow* is an orange-yellow shade, which may be used advantageously to replace chrome yellow. It has the advantage over the other ingrain colours in being quite fast to light.

The *Ingrain-Orange* is a reddish orange, which may be used to replace the redder shades of chrome orange.

The *Ingrain-Purple* gives reddish indigo shades. Unfortunately, however, although it is not washed out by soap or alkalis, they nevertheless change its colour to a brown. Acids (even weak acids, such as tartaric acid) bring back the shade to the original purple.

As the brown and purple developers are solutions of amines, the ingrain-browns and ingrain-purple which they produce are amidoazo compounds. The latter, like amidoazobenzene, are capable of re-diazotisation, and when combined with amines and phenols, give a variety of dark shades. The following ingrain colours belong to this class:—

Ingrain-Brown No. 3 is a fine nut brown, produced by re-diazotising the ingrain-brown No. 1 in a strongly acid nitrite bath, and then re-developing with the brown developer No. 1.

Ingrain-Brown No. 4 is a deep brown produced by re-diazotising the ingrain-brown No. 2 and re-developing in brown developer No. 2.

An enormous variety of other shades of brown can be obtained by re-developing the No. 1 and No. 2 ingrain-browns in the yellow-orange, red, maroon, and purple developers.

Ingrain-Blacks are obtained by re-diazotising the ingrain-purple with a strongly acid nitrite bath, and re-developing in the red or purple developers. The fullest black is obtained with the purple developer; it is quite unaffected by acids, slightly by alkalis. By combination of the diazotised ingrain-purple with the yellow, orange, maroon, and brown developers a variety of dark shades can be obtained.

Intermediate Shades.—The yellow, orange, red, and maroon developers are all alkaline solutions of various phenols. In order to develop properly, the developing baths must remain alkaline.

On the other hand the purple and brown developers, being salts of amido-compounds, are acid and develop in acid solution. Hence a developer of one class cannot be mixed with a developer of the other.

Moreover, the developers of the same class can only be mixed to a limited extent, because their rate of development varies very considerably. If, for instance, a mixture of the yellow and orange developers in any proportion is used, the result is the same as if the orange alone had been employed. On the other hand, the rates of development of the red and orange being nearly equal, they can be mixed to produce intermediate shades.

Mordanting Power of "Primuline" and Ingrain Colours.—Both the "*primuline*" itself and all the ingrain colours act as powerful mordants for all basic aniline colours. In this way it is possible to modify the shade of the ingrain colour or to produce a whole series of other shades. Of course the topped colours obtained in this way cannot claim any very remarkable fastness, though those produced with methylene blue are fairly fast. The ingrain colour takes up the basic dyestuffs very readily, in some cases exhausting the bath. When cotton has been dyed with an ingrain colour it will only take up more "*primuline*" with great difficulty.

Application of "Primuline" and Ingrain Colours to Wool, Silk, Linen, &c.—The method of application of the "*primuline*" colours to wool, silk, jute, linen, straw, &c. is quite the same as for cotton.

Upon linen, which is very difficult to dye satisfactorily with ordinary aniline colours, very good results are obtained.

Wool and silk can be dyed with "*primuline*," either in a neutral alkaline, or acid bath, but preferably in a bath made slightly acid with acetic acid. If dyed from a neutral or alkaline bath, salt must be added. The development takes place in exactly the same way as for cotton, but is rather slower. The maroon developer cannot be used for wool, as it is too slow in developing.

"*Primuline*" works very well upon wool in combination with other colours for the production of fast shades; thus with indigo-extract it can be used as a substitute for fustic to produce dark greens fast to milling. The ingrain colours upon wool and silk are extremely fast to milling, scouring, light, acids, alkalis, &c.

Application to Mixed Goods.—For the dyeing of mixed goods "*primuline*" and the ingrain colours ought to possess especial advantages, as they afford a means of producing fast shades upon both fibres together without the necessity of mordanting. Upon mixtures of cotton and wool, or cotton and silk, very even results can be produced by dyeing the "*primuline*" from an alkaline bath with the addition of salt.

The affinity of the colour for the two fibres can be controlled by regulating the alkalinity and temperature of the bath; the addition of soda or a reduction in temperature tend to diminish the affinity of the "*primuline*" for the wool, whilst a slight addition of acid or raising the temperature has the contrary effect.

Printing.—Although it has not yet been tried upon any scale, the principle should be readily applicable to calico-printing.

For instance, the cloth might be dyed with "*primuline*," diazotised, and then printed with the developers. Or the "*primuline*" suitably thickened might be printed on, steamed, and then diazotised and developed. Many other methods might also be employed.

Other Reactions of "Primuline" upon the Fibre.—It has already been mentioned that "*primuline*" is converted into an orange-yellow by boiling with alkaline hypochlorites; the shade so produced is very similar to ingrain-yellow and is extremely fast.

The whole of the diazo-reactions can be performed upon the fibre with diazotised "*primuline*." If, for instance, after passing from the nitrite bath, the cotton is immersed for a minute or two in a cold weak solution of stannous chloride and hydrochloric acid, the colour becomes much paler, the corresponding hydrazine being formed. A whole series of yellows can now be produced by immersing the cotton, after washing, in solutions of various aldehydes and ketones (such as benzaldehyde, acetone, glucose, &c.). All the hydrazides of this kind which I have at present prepared are very fugitive to light, so that they are only of theoretical interest.

If the diazotised "*primuline*" is boiled with a solution of sodium sulphite, it is converted into a very light yellow which is no longer capable of development; this product is probably a sulphonic acid produced by replacement of the NH_2 group of "*primuline*" by HSO_3.

The diazotised "*primuline*" may be boiled for some time with acid water without much decomposition, but is very quickly decomposed by a hot alkaline solution.

The diazo-compound is also very quickly destroyed by the combined action of sunlight and air; if kept in the dark, however, very little decomposition takes place within 24 hours.

Reduction of Ingrain Colours to "Primuline."—All the ingrain colours can be readily reduced back to the original "*primuline*" by boiling the material for a few minutes with a solution of sodium hydrosulphite (Na_2SO_2). This takes place without loss of colour, for on redevelopment the shade obtained is as deep as the original.

Liverpool Section.

Chairman: Prof. J. Campbell Brown.
Vice-Chairman: Dr. F. Hurter.
Committee:

J. Affleck.
E. G. Ballard.
Ernest Bibby.
H. Brunner.
J. C. Gamble.
D. Herman.
J. W. Kynaston.
E. K. Muspratt.
Jas. Simpson.
A. Norman Tate.
A. Watt.

Hon. Local Sec. and Treasurer:
W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held at University College, Brownlow Street, March 7th, 1888.

DR. J. CAMPBELL BROWN PRESIDING.

A NEW COMMERCIAL APPLICATION OF OXYGEN.

BY THOS. FLETCHER.

The want of some simple method of obtaining a powerful source of heat under perfect control is an experience, and often an unpleasant one, which all who have charge of machinery and chemical plant must have felt more or less frequently. Up to the present time the only practical methods have been either the use of a basket of live coke or a blowpipe connected to the nearest gas supply. Neither of these methods is satisfactory in many cases, and to overcome the difficulty, I have devised some special forms of blowpipes which can be used with the ordinary coal gas supply and compressed oxygen made by the Brin process. These blowpipes are essentially different from the usual form, and also from the well-known mixing jet, the latter requiring both gas and oxygen to be equally compressed, which at once excludes it as an emergency arrangement for repairs and accidents. It is pretty well known that air gas produced from gasoline vapour, when used with an air blast in a blowpipe, is peculiarly liable to be extinguished; the speed of combustion is sufficiently slow to enable the flame to be blown out, or away from the unburnt vapour, with the greatest ease, probably owing to the fact that the gasoline is not diffused through the air as a true gas, but as a vapour, which requires further heating and considerable expansion before it will burn. On this point I have a rather pretty experiment here, showing you the particles of vapour in the so-called air gas, burning separately, the flames of the separate suspended beads of gasoline vapour being distinctly visible as independent centres of combustion. When we apply an oxygen blast to gasoline vapour this brittleness or want of persistence disappears, but owing to the air mixed with the vapour, the temperature obtainable is far lower than that from permanent combustible gases, and up to the present time high temperatures have not been obtained with blowpipes using the light petroleums owing to the necessary mixture of air to obtain the vapour. We must not forget, when gasoline or benzoline vapour is used, that it has one special point in its favour for some classes of work in the fact that the products of combustion are quite free from sulphur, which in many ways is a great source of trouble in laboratory work. The use of a petroleum or spirit spray, if it were practicable, would overcome the difficulty of the admixture of air; but the spray formed by an oxygen blast is of a most unpleasantly uncertain and explosive nature, so much so that after my own experience I can only give a strong caution as to the excessive care required to prevent disastrous accidents. A spray burner may start and work satisfactorily, and then suddenly, without any apparent cause, the whole apparatus may be shattered into fragments. When we burn a permanent gas, such as hydrogen or coal gas, in a blowpipe with an air blast, the flame will bear a heavy air pressure on the jet, giving a correspondingly high temperature flame. If we take the same permanent gas, and use it with a jet of oxygen instead of air, the persistence and "toughness" of the flame is again greatly increased, the speed of traverse of flame backwards is so great that the amount of combustion which may be going on in a given space is almost unlimited, and enormously high temperatures can, therefore, be obtained with the greatest ease, the absence of nitrogen in the flame, of course, greatly assisting the result by reducing the loss of heat, and we gain also by the area of flame containing a given number of available units of heat.

In the construction of powerful blowpipes for compressed oxygen, and coal gas at ordinary pressures, the form of the jet is a very important matter. The centre jet, instead of being formed with a single hole (except in the very smallest sizes), should be flat on the end, and drilled with a circle of very fine holes, each large enough to pass from three to four cubic feet of oxygen per hour at a heavy pressure. The gas outlet which surrounds this jet should be an annular space about ¼ in. wide surrounding the jet, and should project ⅜ in. beyond the tip of the jet, this projection being the same in all sizes and powers. Such an arrangement is useless for a gas and air blowpipe, as it extinguishes itself instantly, and some amount of experimenting has been necessary to arrive at the details now given. I have here three sizes of these blowpipes, requiring respectively about 7, 20, and 40 cubic feet of oxygen per hour; and with a small bottle of compressed oxygen, which can readily be carried under the arm, I will now give you some idea of their power. The quantity of oxygen required for each has not been measured by myself, but has been estimated from a bottle supplied by the Brin Oxygen Company, which I was informed contained 20 cubic feet, and which supplied the largest blowpipe at full power for half an hour continuously. The smallest of these blowpipes will fuse the end of a 3-16 wrought-iron rod; the next size will do the same with a ½-inch wrought-iron rod, or will braze copper pipes ¼ in. thick about as quickly as a tinman can soft solder light sheet tinned iron. The largest will fuse a hole through a 4-in. wrought-iron steam pipe, and will braze, and probably also weld, heavy flanges and couplings on work of the same size. Larger blowpipes can be easily made on the same lines, and it is now both possible and easy to braze and make repairs in parts of complicated machines without removal, in any place into which a man's hand can be got. The heat is so short and so quickly obtained that, with the assistance of wet cloths, polished work or wood lagging can be preserved without injury or mark, within two or three inches from a place where a heavy brazing repair has been done. Breakdowns in copper pipes or vessels can be made good and work restarted in a few minutes which under ordinary conditions would necessitate a stoppage for days. Using the same blowpipe and bottle of oxygen, I will show you, with a block of lime, an emergency light which will often be found useful; amongst other things it will enable you to get by photography a permanent record of any accident or unusual state of things in places where no natural light can be obtained, and where magnesium would fail owing to the dense fumes evolved. This light is, of course, anything but silent; but, as we are now considering only works emergencies, the noise is not of any great consequence.

Turning now to the laboratory, as most of you will know, I have identified myself for many years with apparatus for the production of high temperatures for experimental purposes, and the cheap production of oxygen has advanced our powers in this direction very considerably. When any new application of a power is discovered, my own instinctive feeling turns at once to its application in the chemical laboratory, that source from whence a very large proportion of our commercial knowledge and power has originally sprung.

It is not only necessary that a new power shall be known in the laboratory; the most important point from a practical point of view is that it shall be easily and quickly applied to useful research by those whose time is limited, and the elements of time and personal trouble must be eliminated as much as possible.

My first attempts to utilise compressed oxygen for laboratory gas furnaces proved total failures, owing to the intensely local heat evolved, which entailed cutting and destruction of any and every crucible, an experience which your Secretary also had in some trials he made in the use of oxygen. The direct application of the heat to the contents is, in many cases, out of the question; and, after some experimenting, I found that the desired result could be obtained by mixing air with the oxygen blast, so as to increase the size of the flame, and spread the heat more evenly over the surface of the object to be treated. The form used for this purpose is similar to the well-known injector blowpipe, the air jet being, for a small laboratory furnace, ¼-inch bore and open at both ends; behind this is a small oxygen jet, pointing directly along it. When the oxygen blast is turned on it carries along with it about four or five times its bulk of air. Having got so far, I was again blocked by the fact that no known casing suitable for gas furnaces would stand the heat obtained, even for a few minutes. The only kind of casings which can be satisfactorily used for laboratory gas furnaces are composed of a mixture of very refractory clay and ground cork or sawdust. When these are fired in a kiln, the woody matter is burnt out, and a porous material is left which offers a most extraordinary resistance to the passage of high temperatures through it. It is, as is very well known, an easy matter to fuse cast iron in a crucible in a casing of this material only one inch thick, before the outside of the casing has time even to become slightly warm to the hand. The objection to this mixture is, that the salts contained in the wood or cork are not burned out, and they remain, acting as a flux on the refractory clay, reducing its resistance to fusion to a very serious extent. This difficulty has, however, with the assistance of the Morgan Crucible Company, been at last overcome; and, as the increase of power in our guns leads to improvement in armour plates, so has the increase in power of our laboratory-furnace burners led to an improvement in the resisting power of the crucible casings which have to stand their destructive power. By the discovery of a very refractory clay, which has practically the same contraction as the porous mixture, it is now possible to line the furnace casings with a thin layer, which offers an extraordinary resistance both to fusion and also to the action of fluxes. That these casings are only in their preliminary stage, and not at their most perfect point, goes practically without saying, and only a few have been made up to the present time. One difficulty not yet perfectly overcome is the tendency of the refractory lining of the lid to tear loose, owing to the thinness and the slight hold available; this is, however, only a question of detail, which will shortly be overcome.

With the injector furnace, which is undoubtedly of great value for chemical research, I have been for some years held in check by the fusibility of the casings, and this has of necessity put a very definite limit to the power of the burners which could be employed. As this limit is now, or very shortly will be, greatly extended, there is an opportunity for further experiments on the air and gas burners for ordinary use, irrespective of the new power we have now at command. Using the combined air and oxygen burner with one of the new casings, you will see that any power, from the lowest to the highest, can be obtained with the greatest ease, and without attention, as one of the small 20 ft. oxygen cylinders will work this furnace at full power for about 2½ or 3 hours, and at lower powers for a correspondingly longer period.

I have already expressed an unfavourable opinion as to the use of gasoline or benzoline vapour for use in open blowpipes, but this objection does not exist with furnaces where the mixture is blown on to a surface at a high temperature, which ensures perfect combustion and persistence of the flame. The only working objection to the oxygen blast in gasoline or benzoline vapour furnaces at present is that a supply of air must be blown through the generator to produce the combustible vapour.

Whilst experimenting, it is the nature of chemists to consider the expense after the money has all gone; in fact, if this were not fortunately the case, very little original work would be done, and, to follow this old-established rule, now the oxygen is gone, we will consider the expense. In the first place, owing to the great concentration of the heat, the loss in use is exceedingly small, the nitrogen, which in an ordinary blowpipe flame is a source of great waste, is partly or entirely absent, and, as a consequence, the coal gas consumed is in practice only about one-sixth of that required to do the same work if an air blast is used. The oxygen, if made on a large scale, can be produced by Brin's process at a cost varying from 2*s.* to 7*s.* per 1,000 cubic feet, depending on the quantity made.

In the steel bottles the compressed gas is now sold at from 2*d.* to 3*d.* per cubic foot, which is, of course, a high price for work on anything like a commercial scale; but if we keep a few small bottles of compressed oxygen ready for emergencies, their value may, in some cases, be more than a thousand times their cost, and the expense becomes, therefore, a minor consideration.

It may be well to mention, whilst dealing with this subject, that compressed liquid nitrous oxide has been used for small blowpipes for platinum working, but it is not only very much more costly than compressed oxygen, but it is also not so satisfactory. With the oxygen, repairs of platinum vessels in the laboratory become a very easy matter, and the ordinary forms of blowpipes can be used for this purpose, provided a small jet is used and the outer cap is kept about ¾ in. in advance of the jet. This is necessary to obtain a rough flame for general heating, a fine-pointed flame being liable to cause perforation of the vessel instead of producing a broad welding surface. If the compressed oxygen is to be at all freely or generally used, the price charged must be greatly reduced, and, judging further first cost of the gas, I certainly can see no reason why so high a price should be charged, as the bottles last practically for ever, and the cost of compressing must be very small.

DISCUSSION.

Dr. Campbell Brown said that Mr. Fletcher had not only given them an extremely pleasant and instructive entertainment, but had laid practical working chemists under an additional debt of gratitude to him for this very powerful means of performing operations requiring the highest temperatures in such a cleanly, simple, neat, and safe way that they might be performed even in a drawing room. In the present room, which was made of very combustible material, they had used the highest temperatures that had ever been employed with perfect ease and safety. He was sure they had all admired the manner in which oxygen had been utilised, and they could not but feel extremely thankful to Mr. Fletcher for all that he had done in supplying chemists with gas furnaces of all kinds. Without his apparatus they could not do that which they were now accustomed to do every day in the laboratory. He (Dr. Brown) would like to ask what the nozzles of the oxygen blowpipes were made of, and how they stood the high temperature?

Mr. W. P. Thompson said that as the author had referred to his failures with oxygen, he (Mr. Thompson) would like to explain one or two things in regard to them. Being in need of a continuous and equable bright yellow heat for about 36 hours, but having no engine or blast with which to sustain it, he laid on a small stream of oxygen from a bag which he estimated to hold enough for his purpose with occasional replenishing. The furnace used was one of Mr. Fletcher's, having a large number of tubes issuing from a plate above a mixing chamber of gas and air. He laid on the oxygen through one of the holes of the casing so that it might mix with and assist the air. This arrangement did accomplish his purpose in some considerable degree, giving a bright yellow heat for a long period, though not so long as he could have desired; but, unfortunately, it melted the tubes of the furnace and the bottoms of the crucibles. In one case, a platinum one was destroyed, presumably owing to accidental spirts of oxygen. He would ask Mr. Fletcher whether he had yet invented any arrangement by which they could attach one of those Brin's bottles to a gas furnace and so enrich the air for some time without a blast and without the necessity of constant supervision?

Mr. Fletcher, in reply, said he thought Mr. Thompson was rather in advance of the age. He (Mr. Fletcher) had only made his experiments on a small scale, and Mr. Thompson would have to wait a little time. No doubt it could be done. The first question was how to construct the burner; still, having got it on any scale at all, he could go on, but going on meant going on slowly, because, as they knew, experiments usually were not successfully completed in a short time. In reply to the Chairman's question, the nozzles were of brass and kept practically cold. The outer caps were also of brass. It was an easy matter to replace them with iron if necessary. The passage of the cold oxygen inside and the cold gas outside kept the blowpipe cool. The outer cap of the first he made was turned in; that burned away instantly, and he was obliged to leave them straight. He had not found these to give way at all, but if they did it was a very easy matter to replace them with iron, but just then the matter was only in an experimental stage. Many chemists did not understand workshop blowpipes, but a mechanic who needed a blowpipe for repairs wanted it in his hand.

PRELIMINARY NOTE ON A MODIFICATION OF KOETTSTOEFER'S AND REICHERT'S PROCESSES FOR THE ANALYSIS OF BUTTER AND OTHER FATS.

BY W. F. LOWE, F.C.S., F.I.C., ASSOCIATE OF THE ROYAL SCHOOL OF MINES.

The Act of Parliament, commonly called the Margarine Act, having just come into force, the following preliminary note on a modification of Koettstoefer's and Reichert's processes for the analysis of butter and other fats, which has yielded very satisfactory results in the hands of the writer, will probably be of interest to many of the members of the Society.

The method is a combination of Koettstoefer's and Reichert's methods, and is carried out in the following manner:—About 2 grams of the clarified fat is saponified with 10 cc. of normal alcoholic KHO in a flask tightly closed with a tied down cork. The alcohol is then boiled off on the water bath, and the soap dissolved in 50 cc. of hot water. The excess of KHO is then titrated with $\frac{N}{2}$ H_2SO_4 solution, using one small drop of phenol pthalein as indicator. This gives the amount of KHO required to saponify the total fatty acids, as in Koettstoefer's process; 25 cc. (altogether) of $\frac{N}{2}$ H_2SO_4 is then run in, two pieces of tobacco-pipe stem added, and the flask connected with a Liebig condenser and 50 cc. distilled over. The distillate is filtered and titrated with $\frac{N}{10}$ KHO solution, and phenol pthalein as indicator.

This gives the volatile fatty acids as in Reichert's method, and also gives a second data for the constitution of the fat. A third data may be obtained by washing the fixed acids remaining in the flask, and adding to them any that have passed over into the distillate and been separated by filtration, and also any remaining attached to the tube of the condenser, dissolving them in alcohol and titrating with $\frac{N}{2}$ KHO and phenol pthalein.

The same flask is used throughout the whole process, the fat being saponified, titrated, and distilled in the one flask (one of Cubley and Preston's conical flask of about 200 cc. capacity answers very well, and is sufficiently strong for the purpose). If the flask is tightly corked and heated on water bath and well shaken, the saponification takes place almost at once, and ten minutes heating is quite sufficient for this amount of fat. The whole process (without the titration of the fixed acids) does not occupy more than two hours, and can be carried out even in less.

The standard alcoholic KHO is prepared with rectified spirit, as purified methylated spirit does not seem to answer so well.

Blank experiments are made with each set of assays, two checks of 10 cc. of alcoholic KHO being boiled down and titrated with $\frac{N}{2}$ H_2SO_4. In measuring the alcoholic KHO it is very needful to allow the pipettes to drain for the same length of time. The writer allows them to drain for half a minute, and then touches the liquid with the point of the pipette. The whole of the volatile acids do not come over in 50 cc. of distillate, for if another 50 cc. of water be added to the flask and distilled a fresh quantity will come over, but is too small to be of importance. In an experiment tried in this way the second 50 cc. of distillate required only 0·15 cc. of $\frac{N}{10}$ KHO. An experiment was also made to see if any volatile acids (acetic, for instance) could be distilled over from the alcoholic KHO; 10 cc. well heated in a closed flask in the same manner and for the same length of time as the fats, the alcohol boiled off, the residue dissolved in 50 cc. of water, 25 cc. of $\frac{N}{2}$ H_2SO_4 added, and 50 cc. distilled over. The distillate required only one drop (·05 cc.) of $\frac{N}{10}$ KHO to produce a permanent colouration with phenol pthalein.

The following table gives some results obtained by the process. The results are expressed in milligrams of KHO required for 1 gram of fat.

—	Total Fatty Acids. Millegrams of KHO required for 1 Gram of Fat.	Volatile Fatty Acids. Millegrams of KHO required for 1 Gram of Fat.	Volatile Fatty Acids. Number of cc. of $\frac{N}{10}$ KHO required for 2·5 Grams of Fat.	Insoluble Fatty Acids. Millegrams of KHO required for 1 Gram of Fat.	Process.
Kiel butter	222	35·6	15·9	..	Combined Process.
Do.	227	36	16	..	Do.
Butterine	190·1	4·2	1·8	..	Do.
Do.	192·6	4	1·7	..	Do.
Do.	..	4·1	1·8	..	Reichert's.
Do.	..	4·2	1·8	..	Do.
Mutton suet	190·4	0·6	0·3	..	Combined Process.
Do.	189·9	0·6	0·3	..	Do.
Kiel butter with 10·5 per cent. butterine	221·9	28·5	12·7	199·9	Do.
Kiel butter with 20·7 per cent. butterine	224	26·8	11·9	197·6	Do.

DISCUSSION.

After thanking Mr. Lowe for his paper, the Chairman said that the process was a combination of two processes in ordinary use, omitting some of the details.

The determination of total fatty acids might very well be omitted and determination of insoluble fatty acids substituted, because it was far from reliable, and it was quite as useful to calculate the results per hundred parts of the original butter fat as per hundred parts of total fatty acids. In determining the total fatty acids, it was necessary to standardise the alcoholic solution of alkali very frequently and very carefully, as it altered rapidly, and introduced errors which were greater than ordinary experimental errors. The alkali also dissolved some of the glass, which reduced the free alkali, and thus gave an error in excess of total fatty acid. Accordingly in Mr. Lowe's table of results, a sample containing 10 per cent. of butterine gave almost the same figures as one containing 20 per cent. of butterine, and both gave figures intermediate between those yielded by two different samples of genuine Kiel butter.

Again, carbonic acid, not expelled by this method of carrying out the details, increased the apparent estimate of volatile fatty acids.

In distilling the volatile fatty acids in the presence of insoluble fatty acids, some of the latter came over with the steam and had to be removed by filtration. This was an inelegant and dirty mode of treatment, very commonly employed, but not very accurate.

The quantity of butter taken—2·0 grammes—was too small, since it gave only about ·1 gramme of volatile fatty acids. It was better to take a larger quantity of butter fat, and saponify with approximately standard alkali, decompose the soap with slight excess of sulphuric acid, and weigh the insoluble fatty acids as in Hehner's process; then distil half the filtrate until four-fifths had come over, and estimate the volatile soluble fatty acids. The figures obtained were then total butter fat, insoluble fatty acids, and volatile soluble fatty acids.

The two latter figures checked each other. That is to say, if both were high or both low there was probably an error, or, at least, something unusual that required further examination.

Manchester Section.

Chairman: Sir H. E. Roscoe, M.P.
Vice-Chairman: Edward Schunck.
Committee:

J. Angell.
G. H. Bailey.
C. A. Burghardt.
R. F. Carpenter.
H. Grimshaw.
Peter Hart.
I. Levinstein.
W. H. Perkin, jun.
Wm. Thomson.
T. Wardle.
P. Winser.

Hon. Local Secretary:
J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Tuesday, February 7th, 1888.

DR. SCHUNCK, F.R.S., IN THE CHAIR.

ON THE ADULTERATION OF TALLOW WITH COTTON-SEED OIL.

BY ROWLAND WILLIAMS, F.I.C., F.C.S.

Cotton-seed stearin is mentioned among the adulterants of tallow in Allen's Commercial Organic Analysis, but I have not been able to find any reference to the use of cotton-seed oil itself for the same purpose in other works which I have consulted on the subject. To those who have not had much practical experience in this matter it might, indeed, seem difficult, if not impossible, to introduce any considerable amount of cotton-seed oil into tallow without the risk of betraying its presence to the consumer, owing to the apparent probability of its reducing the consistency and altering the general appearance of the mixture to a greater or lesser degree. Such, however, is not the case, and I know for a fact that many unscrupulous dealers adulterate their tallow to a large extent with cotton-seed oil, as it is quite easy to add even as much as 40 per cent. of the latter without much fear of detection otherwise than by chemical analysis. When I mention that the price of cotton-seed oil is only about two-thirds that of tallow, it will be at once seen that there is plenty of scope for profitable adulteration.

My reason for bringing this subject before you is because I have, during the past year, received for analysis from different firms a great many samples of tallow, which my clients have had special reasons to suspect were adulterated with cotton-seed oil. Most of these samples, however, proved to be fairly good commercial tallow, but one or two were undoubtedly adulterated. One of the suspected samples had a melting point of 102° Fahrenheit, and it required 19·54 per cent. caustic potash for saponification. The melting point of genuine tallow varies considerably in different samples, according to the nature and part of the animal from which it is derived. It usually lies between 100° and 120° Fahrenheit, the melting point of the best classes of tallow being about 110° Fahrenheit. Genuine tallow requires from 19·3 per cent. to 19·8 per cent. caustic potash for saponification, whilst cotton-seed oil requires from 19·1 per cent. to 19·6 per cent. Consequently, judged by its melting point and saponification equivalent alone, the sample in question might have been allowed to pass as genuine tallow. I thought it would be interesting therefore to ascertain the effects produced by addition of definite proportions of cotton-seed oil to tallow which was beyond doubt free from adulteration. With this end in view, I prepared a series of mixtures of pure tallow and cotton-seed oil, respectively containing 5, 10, 15, 20, 25, 30, and 40 per cent. of the latter. If you will examine these, I think you will admit that no casual observer could detect much difference between the mixtures and the original tallow with which they were prepared. I determined the melting points and saponification equivalents of the original tallow, cotton-seed oil, and the above-mentioned mixtures of the two.

The results obtained are given in the annexed table, as are also the iodine absorptions, which will presently be referred to.

——	Cotton-seed Oil.	Pure Tallow.	Tallow + 5 per Cent. Cotton-seed Oil.	Tallow + 10 per Cent. Cotton-seed Oil.	Tallow + 15 per Cent. Cotton-seed Oil.	Tallow + 20 per Cent. Cotton-seed Oil.	Tallow + 25 per Cent. Cotton-seed Oil.	Tallow + 30 per Cent. Cotton-seed Oil.	Tallow + 40 per Cent. Cotton-seed Oil.
Melting point..........	—	110° F.	110° F.	108° F.	106° F.	105° F.	105° F.	103° F.	102° F.
Percentage of potash required for saponification	Per Cent. 19·4	Per Cent. 19·6	Per Cent. 19·6	Per Cent. 19·6	Per Cent. 19·6	Per Cent. 19·4	Per Cent. 19·4	Per Cent. 19·4	Per Cent. 19·5
Percentage of iodine absorbed..............	109·1	40·8	44·0	47·1	49·7	52·9	56·1	59·2	66·2

These figures conclusively prove that determinations of the melting point and saponification equivalent of tallow are worthless, unless taken in conjunction with other data, as it is evident that 40 per cent. of cotton-seed oil may be added without affecting the two estimations in question to any serious extent.

It is well known to those who have had much experience in the analysis of oils and fats that tallow has a very low iodine equivalent, whilst that of cotton-seed oil is comparatively high, being in fact about 2½ times as great as that of tallow. It seemed likely, therefore, that by finding the percentages of iodine absorbed by the various mixtures already mentioned, some idea of the relative proportions of tallow and cotton-seed oil contained therein might be obtained.

Upon investigation this proved to be the case. The estimations were made by placing very accurately weighed small quantities (usually from 5 to 10 grains) of the fatty matter in stoppered bottles, dissolving in chloroform, and adding excess of Hübl's reagent to each. (Hübl's reagent is prepared by dissolving separately 250 grains of iodine and 300 grains of mercuric chloride each in 5,000 grains of nearly absolute alcohol. The two solutions are then mixed and filtered, and after standing 12 hours the reagent is ready for use.)

In all of the experiments the reagent was allowed to act for three hours at the ordinary temperature, and, after adding potassium iodide and diluting with water, the excess of iodine was determined in each by titration with standard hyposulphite. A blank experiment was at the same time made with the same quantities of chloroform and Hübl's reagent, in order to arrive at the exact strength of the alcoholic iodine solution employed in the experiments.

On reference to the table of results, it will be seen that the percentages of iodine absorbed have, on the whole, a remarkably close connexion with the proportions of cotton-seed oil present in the various mixtures.

Indeed, for all practical purposes, it is quite accurate enough to assert that every percentage of iodine absorbed in excess of that required by genuine tallow indicates adulteration with one and a half per cent. of cotton-seed oil.

The iodine absorption of all pure tallows which I have examined varies only within very narrow limits, generally lying between 40 and 41 per cent. Consequently, if this test were always carefully applied in the examination of tallow, no genuine sample would be condemned, whilst on the other hand adulteration with even so small an amount as five per cent. of cotton-seed oil would certainly be detected.

Newcastle Section.

Chairman: P. P. Bedson.

Vice-Chairman: J. C. Stevenson, M.P.

Committee:

Alfred Allhusen.
G. T. France.
John Glover.
John Morrison.
John Pattinson.
J. B. Payne.
H. R. Procter.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
C. T. Richardson.
T. W. Stuart.

Hon. Local Secretary and Treasurer:

J. T. Dunn, The School, Gateshead.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

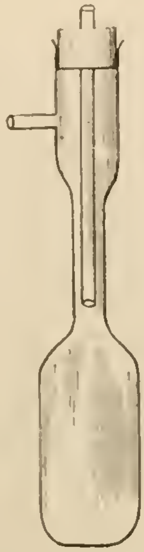
Meeting held in the Durham College of Science, March 7th, 1888.

DR. BEDSON IN THE CHAIR.

MISCELLANEOUS COMMUNICATIONS.

Mr. G. T. France gave a verbal account of Chance's process for the recovery of sulphur from alkali waste, as he had seen it in operation.

Mr. C. P. Laidler exhibited and described a gas-regulator, which he had devised for use by Mr. John Pattinson in his investigations on the loss of available chlorine from bleaching powder. The instrument was a modification of Page's regulator, the upper part of the mercury tube being expanded, and the side tube led away from the expanded part; by this means greater firmness in the tube for gas-entry is obtained, a much larger and stronger cork being admissible.



ON THE RATE AT WHICH BLEACHING POWDER LOSES ITS AVAILABLE CHLORINE WHEN KEPT AT DIFFERENT TEMPERATURES.

BY JOHN PATTINSON, F.I.C., F.C.S.

In a paper contributed by me to this Section in 1886 (*see* J. Soc. Chem. Ind., Vol. V., p. 587), I gave the results of various analyses showing the changes which had occurred in bleaching powder kept in casks as well as in bottles during a period of about twelve months. These casks and bottles had been stored in a cellar in which it was found that the temperature did not rise above about 60° Fahr. throughout the year. The results then obtained were of interest, as showing the changes which had taken place in bleaching powder kept at this and lower temperatures; but inasmuch as bleaching powder is often stored where it is subjected for a lengthened period to temperatures of 70° or 80° Fahr., it seemed desirable to ascertain the changes which would take place in its composition when kept at these higher temperatures, and I have therefore had a series of samples kept as nearly as possible at a temperature of 60°, a series kept at about 70°, and a third series kept at about 80° Fahr. over a period of about twelve months, and have made analyses of each series monthly, showing the changes which have occurred in the amounts of available chlorine and in the chlorine existing in other forms.

It has been shown by my experiments reported in 1886, in the paper above referred to, that bleaching powder loses available chlorine at much about the same rate when kept in bottles as it does when packed in 6-cwt. casks, and as it is much more convenient to keep bottles than casks at the required temperatures for a lengthened period, I have made the present investigation with bleaching powder kept in bottles holding about 4 ozs. each and closed with unsealed corks.

The bleaching powder used was made by the ordinary manufacturing process from Buxton lime. After being well mixed it was put into 36 bottles. Eleven of these were placed on wooden shelves inside each of three tin-plate boxes, about 9 inches square and 9 inches deep, covered with felt to prevent radiation of heat. The boxes were placed on a flue made of sheet iron, into which the heat from a small jet of burning gas was made to enter. A nearly uniform temperature was maintained by using a slight modification of one of Page's automatic gas regulators (described in the Chem. Soc. Jour., 1876, I. 24). This was placed in the box on the flue nearest the gas jet in which a temperature of 80 Fahr. was required. The required temperatures were obtained in the other two boxes by placing them on the flue further away from the source of heat, and by interposing pieces of felt between the boxes and the flue. A maximum and minimum thermometer was placed in each box, and the registered temperatures were noted every day for about eleven months.

The following table (Table I.), taken from the daily record of the temperatures, gives the highest, lowest, and average temperatures to which the bleaching power was subjected during each month:—

TABLE I.

—	60° Box.			70° Box.			80° Box.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
January	63	55	60·6	72	67	69·9	82	78	80·0
February	64	54	59·7	72	67	69·6	82	78	79·8
March	64	55	59·8	71	67	69·1	82	78	80·3
April	64	54	59·7	72	65	69·0	83	78	80·3
May	64	56	60·7	73	66	69·5	82	78	79·8
June	74	54	63·8	75	61	69·6	83	76	79·2
July	80	52	64·6	80	62	71·1	85	77	80·1
August	70	52	59·6	77	61	71·9	84	76	79·6
September	62	52	58·5	74	62	69·3	80	76	78·7
October	63	52	58·2	75	65	69·1	82	76	79·4
November	62	53	58·4	73	65	69·2	82	76	79·8
December	62	52	58·0	73	65	69·2	82	78	80·5

The maximum and minimum temperatures given above, when they vary much from the required temperatures, did not continue long at these extremes, so that the average temperatures for the month were kept fairly close to the temperatures required. On some of the hot days of June, July, and August, however, it was found impossible to keep the 60° and 70° boxes sufficiently cool, as the temperature of the air was higher than these temperatures; and although no gas was burning in the flue excepting that which went through the bye-pass of the apparatus, yet on these days the temperature in the 80° box reached 84° and 85° on a few occasions.

At intervals of about a month a bottle was taken from each of the three boxes, and the bleaching powder they contained examined for available chlorine, chlorine existing as chloride, and chlorine existing as chlorate.

The available chlorine was ascertained by testing with a standard solution of arsenious acid (Penot's test). To determine chlorine existing as chloride a portion of bleaching powder in which the available chlorine was reduced by solution of arsenious acid was slightly acidified with nitric acid in the cold, the slight excess of acid used was then neutralised by carbonate of lime, and the solution titrated with standard nitrate of silver solution. The difference between the amounts of chlorine thus indicated and the amount of available chlorine gave the chlorine existing as chloride of calcium. To determine chlorine existing as chlorate, a solution of sulphurous acid was added to a portion of the bleaching powder diffused in water, and the solution heated to boiling to reduce the chlorate. After the excess of sulphurous acid was expelled by boiling, two or three drops of nitric acid were added to insure complete removal of sulphurous acid, carbonate of lime added to neutralise the excess of nitric acid, and the total chlorine then ascertained by titrating with standard nitrate of silver solution. The difference between the total chlorine thus ascertained and the chlorine existing as available chlorine and chloride of calcium gave the chlorine existing as chlorate.

The results of the monthly testings are given in Table II. The figures represent percentages.

TABLE II.

Date.	Samples kept at about 60°.				Samples kept at about 70°.				Samples kept at about 80°.			
	Available Chlorine.	Chlorine as Chloride.	Chlorine as Chlorate.	Total. Chlorine.	Available Chlorine.	Chlorine as Chloride.	Chlorine as Chlorate.	Total Chlorine.	Available Chlorine.	Chlorine as Chloride.	Chlorine as Chlorate.	Total Chlorine.
1887.												
Jan. 11	36·10	0·14	0·09	36·33	36·10	0·14	0·09	36·33	36·10	0·14	0·09	36·33
Feb. 11	35·30	0·94	0·09	36·33	35·10	1·14	0·09	36·33	34·60	1·64	0·09	36·33
March 11	34·60	1·21	0·09	35·90	34·20	2·04	0·09	36·33	33·20	3·04	0·09	36·33
April 13	34·80	1·53	Trace	36·33	33·70	2·63	None	36·33	30·70	5·88	Trace	36·58
May 12	34·40	1·93	None	36·33	33·25	3·08	None	36·33	30·00	6·75	Trace	36·75
June 13	33·60	2·21	None	35·81	31·60	4·21	None	35·81	26·00	9·90	0·60	36·50
July 15	33·20	2·78	None	35·98	30·90	4·91	None	35·81	26·10	9·88	0·60	36·58
Aug. 15	32·90	3·08	None	35·98	31·10	4·45	0·26	35·81	21·70	13·34	0·86	35·90
Sept. 14	31·70	3·77	None	35·47	29·90	4·80	0·34	35·04	20·30	14·40	1·20	35·90
Oct. 13	31·10	4·37	None	35·47	29·30	5·91	0·43	35·64	17·80	16·39	1·45	35·64
Nov. 14	31·00	4·47	None	35·47	29·00	5·61	0·43	35·04	20·60	14·01	1·29	35·90
Dec. 13	30·10	5·37	None	35·47	23·30	6·91	0·43	35·64	19·10	15·17	1·37	35·64

It will be seen that, on the whole, there has been a gradual and regular loss of available chlorine the longer the samples have been kept, the only notable exception to this being in the case of the sample kept at 80° Fahr. tested in October, which seems to have lost more than the two bottles tested afterwards in November and December, which had been kept at the same temperature. Possibly this discrepancy, and the minor discrepancies observable in some of the other samples, may be owing to the bottles having been stopped with more or less porous corks, admitting of more or less rapid diffusion of air, and consequent decomposition. The bleaching powder kept at 60° has lost 6·0 per cent. of available chlorine during the 11 months, or at the rate of 0·55 per cent. chlorine per month; that kept at 70° has lost 7·8 per cent. of available chlorine during the same period of time, or at the rate of 0·71 per cent. per month; and that kept at 80° has lost 17·0 per cent. of available chlorine during the same time, equal to 1·64 per cent. per month.

There has occurred a regular and corresponding increase of chlorine existing as chloride of calcium in all the samples during the time the experiments lasted. Beginning with only 0·14 per cent. of chlorine in this form, the samples kept at 60° increased to 5·37 per cent. at the end of the 11 months, or an average monthly increase of 0·48 per cent.; the samples kept at 70° increased to 6·77 per cent. of chlorine, or equal to 0·62 per cent. increase per month; the samples kept at 80° increased to 15·03 per cent., chlorine existing in this form equal to an average monthly increase of 1·37 per cent.

As in the experiments made in 1886, the small quantity of chlorine existing at first in the form of chlorate, or at any rate, in some form of combination which the tests for available chlorine and chlorine as chloride failed to indicate, and which could be decomposed by heating with sulphurous acid, ceased to exist in this state of combination in each of the sets of samples at the end of the third month, excepting a mere trace in the sample kept at 80°. I have satisfied myself by repeated analyses that freshly-made bleaching powder frequently contains small quantities of chlorine in this form of combination, and that, in the course of a few months, it ceases to exist in this condition. That it should thus disappear is most unexpected, for chlorates are considered the most stable of all the compounds of chlorine and oxygen. In the samples kept at a temperature of 60° no furthur chlorate was formed after the disappearance of the small quantity existing in this form at the beginning. This was also the case in all the samples tested in 1886 which had also been kept at temperatures seldom exceeding 60°. But in the bleaching powder kept at 70° and 80°, notable quantities of chlorate were formed, especially in that kept at the latter temperature. In the samples kept at 70°, after the disappearance of the first formed chlorate in April, no chlorine was found in this form until August, when the sample then tested was found to contain 0·26 per cent. This, it may be observed, was after the hot weather of July, when these samples had been exposed for parts of some days to a temperature varying from 78° to 80°. This amount was increased to 0·43 per cent. of chlorine as chlorate in October, and the latter amount was not exceeded in the future tests. It is probable, therefore, that had the temperature of 70° been maintained, little or no chlorate would have been formed. In the samples kept at 80°, as in the other samples, the small quantity of chlorate found at first had nearly disappeared at the end of the third month, but at the end of the fifth month—in June—a notable quantity of chlorine as chlorate—0·60 per cent.—had made its appearance in this sample, and an increasing quantity of chlorine in this form was found afterwards, so that at the end of the eleventh month 1·37 per cent. of chlorine was present as chlorate.

The percentage of total chlorine—chlorine in all forms of combination—was but little diminished during the year. Taking the samples as they were then found, the sample kept at about 60° had 0·86 per cent. less total chlorine than at first, and the samples kept at about 70° and 80° had each 0·69 per cent. less than at first.

The following table (Table III.) gives more completely the percentages of the constituents of the various samples at the beginning and at the end of the period of eleven months:—

TABLE III.

——	Jan. 11, 1887.	December 13, 1887.		
		60°	70°	80°
Available chlorine	36·10	30·10	28·30	19·10
Chlorine as chloride	0·14	5·37	6·91	15·17
Chlorine as chlorate	0·09	None	0·43	1·37
Total chlorine	36·33	35·47	35·64	35·64
Calcium in all forms, reckoned as lime	45·11	44·58	45·14	45·78
Magnesia	0·31	0·29	0·29	0·29
Peroxide of iron	0·07	0·07	0·07	0·07
Alumina	0·33	0·33	0·28	0·28
Protosesquioxide of manganese	Trace	Trace	Trace	Trace
Carbonic acid	1·39	1·35	1·35	1·37
Siliceous matter	0·50	0·45	0·45	0·45

From these data has been calculated the composition of the various samples as follows:—

TABLE IV.

——	Jan. 11, 1887.	December 13, 1887.		
		60°	70°	80°
Calcium chloroxide—$CaOCl_2$	64·57	53·84	50·62	34·16
Calcium chloride	0·22	8·40	10·80	23·72
Calcium chlorate	0·26	0·00	1·25	3·99
Calcium carbonate	3·16	3·07	3·07	3·11
Calcium hydrate	19·41	19·71	20·30	21·05
Magnesia	0·31	0·29	0·29	0·29
Ferric oxide	0·07	0·07	0·07	0·07
Alumina	0·33	0·33	0·28	0·28
Manganese oxide	Trace	Trace	Trace	Trace
Siliceous matter	0·50	0·45	0·45	0·45
Water (by difference)	11·17	13·84	12·87	12·98
	100·00	100·00	100·00	100·00

It is obvious that in the samples kept at 60° Fahr. the decomposition represented by the equation $6\ CaOCl_2 = Ca(ClO_3)_2 + 5\ CaCl_2$ cannot have taken place, seeing that no calcium chlorate existed in the samples at the end of the experiment. This formula will account for the formation of the calcium chlorate and some of the calcium chloride found in the samples kept at 70° and 80°, but not the whole of the latter compound. There has evidently been much oxygen evolved as such from the lime converted into calcium chloride, according to the reaction $CaOCl_2 = CaCl_2 + O$, in the case of all the samples; and, as accounting also for loss of chlorine, it is possible that the decomposition mentioned by Lunge and Opl as sometimes occurring when air is passed over bleaching powder, represented by the equation $CaOCl_2 = CaO + Cl_2$, may to some extent have taken place whereby chlorine has been evolved and lime or its hydrate has been formed. The above analyses would seem to bear out this supposition, for the amounts of calcium hydrate are somewhat higher in the samples at the end of the 11 months than in the samples at first, and there has been some loss of chlorine.

As indicating the evolution of oxygen, it may be interesting to mention that the cork of a bottle of the same kind of bleaching powder as that used in all the experiments, which had been hermetically sealed with sealing-wax and kept in the box in which a temperature of 60° was maintained, was forced out with explosive violence, and about one-third of the contents of the bottle scattered about, on the night of the 28th of April. The remainder of the bleaching powder in the bottle was examined at the time, and found to contain:—

	Per Cent.
Available chlorine	34·80
Chlorine as chloride	1·53
Chlorine as chlorate	None
Total chlorine	36·33

This explosion must have been caused by the evolution of oxygen almost entirely, for there was as much chlorine found in the bleaching powder after the explosion as was found in it in January.

The various changes which the samples have undergone—the loss of oxygen and some chlorine, and gain of water by absorption of moisture from diffused air—probably account for the differences in the amounts of total lime reckoned from calcium in all forms, and also for the increase in water. If the proportion of total chlorine in relation to the total lime be calculated, it will, perhaps, afford a more correct measure of the loss of total chlorine during the period than by any other mode of calculation. In the original bleaching powder it is seen that 36·33 of chlorine is associated with 45·11 of lime. In the sample kept for 11 months at a temperature of 60°, had the 44·58 per cent of lime it contains been associated with the same proportion of chlorine, it ought to have contained 35·90 of chlorine. It was found to contain only 35·47 per cent. of chlorine, showing a loss of 0·43 of chlorine in relation to the lime. In like manner, if the sample kept at 70° had had the same proportion of chlorine to its lime as at first, it should have had 36·38 per cent. of chlorine at the end. The analysis shows only 35·64 per cent. —a loss of 0·74 of chlorine. In the case of the sample kept at 80° the loss is still greater. Had it had the original proportion of chlorine to lime it should have contained 36·87 per cent. of chlorine. It had only 35·64 per cent., showing a loss of 1·23 of chlorine.

From the results of these experiments, as well as from those previously reported in 1886, it will be seen that although the available chlorine of bleaching powder disappears in proportion to the length of time it is kept and to the temperature to which it is subjected, yet within a comparatively small amount the whole of the chlorine it originally contained is still retained in some form or other in combination with the calcium of the compound. This at any rate is true of bleaching powder when kept in casks or bottles for about twelve months at temperatures varying from 60° to 80° Fahr.

To answer the question, then, sometimes submitted to chemists, whether a certain sample of bleaching powder containing a deficiency of available chlorine has ever been up to the required commercial standard of 35 per cent. available chlorine, it will in most cases be sufficient to determine the chlorine existing in all forms in the sample, and to assume that this all existed originally as available chlorine. It is seldom that the freshly-made bleaching powder of commerce contains much chlorine in any other form.

In cases where the bleaching powder under examination has got wetted, and in some other circumstances, it may be desirable to ascertain the ratio between the lime and the total chlorine in order to learn if the bleaching powder has ever been of the proper strength. It may be assumed that in good bleaching powder 45 of lime will always be associated with at least 35 of chlorine. If the ratio falls much below this—say if 45 of lime is found associated with 30 of total chlorine, it may be safely assumed that the bleaching powder has never contained 35 per cent. of available chlorine.

My thanks are due to my assistant, Mr. C. P. Laidler, who has greatly aided me in this investigation.

The Chairman, in inviting members present to express their opinions on points in the paper, which would be formally discussed next month, said the presence of carbon dioxide did not seem to be the cause of the loss of chlorine, which seemed to take place both directly and by resolution into calcium chloride with escape of oxygen, and by conversion into chlorate.

Mr. France said that the temperature of manufacture had much to do with the question. At too low a temperature the chlorine was not absorbed by the lime, and when made at a high temperature the bleach lost its chlorine more readily than when made at a lower temperature.

Discussion on Mr. Ridsdale's papers was postponed till next meeting on April 11th, when Mr. Pattinson's paper will be discussed, and Mr. John Watson will read a paper on a "Volumetric method for the determination of sulphur in burnt pyrites."

Glasgow and Scottish Section.

Chairman: J. J. Coleman.
Vice-Chairman: R. R. Tatlock.
Hon. Vice-Chairmen: E. C. C. Stanford. Sir J. Neilson Cuthbertson.

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T. L. Patterson.
J. Pattison.
R. Pullar.
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Ernest Smith.
D. R. Steuart.
A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:
G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Fourth Meeting for this Session was held in the Rooms, 14, St. Andrew Street, Edinburgh, on Tuesday, February 7th, 1888.

PROFESSOR CRUM BROWN IN THE CHAIR.

A NEW ANTISEPTIC SOAP.

BY JOHN THOMSON.

It is now over eighteen months since I commenced a series of experiments with antiseptics such as have become known within recent years as most powerful in retarding the growth of, or destroying absolutely, bacteria, especially those associated with malignant or infective diseases.

My object was to discover some convenient and suitable vehicle for the antiseptic which would hold it in such proportion that the work of the antiseptic should be done effectually, the vehicle used in no way restraining or diminishing the efficiency of the reagent as a germicide.

A number of so-called antiseptics were tried, with results more conspicuous for the extreme limitation of antiseptic power, or rather for the utter uselessness of such substances in retarding decomposition, or in any way acting as germicides.

At length the mercury compounds were tried, and it soon became evident that I was working in a right direction.

I made myself as fully acquainted as I possibly could with the properties of these compounds, and especially with what had been discovered quite recently as to their valuable antiseptic powers.

Bichloride of mercury has been used successfully in solution as an antiseptic. There were connected with its use, however, several disadvantages, to some of which I shall have to refer later. The greater germicidal potency of biniodide of mercury, though strongly advocated by Sattler and others, was not so well known.

Vehicle.

I may here confess that the difficulty of securing a suitable vehicle remained for a time insurmountable, and it was only after considerable deliberation that I at length concluded that the salt, whatever it might be, would be most safely and most easily and conveniently combined with some soap.

Now, however, cropped up the difficulty of combining a mercuric salt with an alkaline soap which would yield a good lather.

In all my experiments I met with defeat, as the salts employed invariably struck work in the presence of an alkali. Immediate or gradual precipitation of the antiseptic and its complete destruction as an antiseptic was the nett result of months of labour and numerous experiments.

At last I thought of biniodide of mercury as the salt from which I might expect better things, and my confidence was not misplaced, as the salt combined freely and at once with soap of almost any kind, without in any degree losing its antiseptic properties. I had now advanced so far on the road to success, in obtaining a handy vehicle for a most powerful antiseptic. The combination was such as might be used by a physician or nurse in the hospital or sick room in disinfecting operations. But the crucial part of the work had now to be set agoing, viz., that of discovering or proving the potency of the salt when in combination with the soap. In this I was greatly assisted by Dr. Archibald and other friends in instituting tests; but I still found considerable difficulties presenting themselves at every turn, such as that of obtaining properly sterilised material with which to conduct my experiments. Crude and unsatisfactory as the tests were, they proved sufficient to justify my most sanguine expectations, and to arrest the attention of professional friends. In order that Dr. Archibald might test the matter thoroughly, Dr. Woodhead devised a method which gave promise of good results, and, after some preliminary control experiments, the task was completed.

He gives the following report:—

"The mercuric salts are amongst the most powerful, if not the most powerful, of all antiseptics and germicides at our command, especially the bichloride and the biniodide. The advantages of the former are, that it is freely soluble, is cheap, and is a powerful antiseptic. Its disadvantages are, its extremely poisonous properties, the readiness with which the salt is reduced and with which it combines with albuminoid matter, so being rendered inert. It is also very difficult to get it to form a soap, the oleate of mercury being formed, a compound which has little or no germicidal action. The biniodide of mercury is a much more powerful antiseptic; it is not so poisonous, and combines with soap in certain proportions.

"A long series of experiments have been carried on with this soap in order to determine its antiseptic value. It contains a certain proportion of the biniodide of mercury (in a solution of iodide of potassium or other solvent), which is easily incorporated in this condition with the soap stock, from which it has no tendency to separate.

"A series of comparative experiments has also been made with this and other antiseptic soaps, and it is found to have much more germicidal properties than any other antiseptic soap I have been able to procure. The soaps in question appear tabulated under numerals. The organisms on which the properties of the soaps have been tested are the following: — (1) Streptococcus scarlatinæ (Klein), (2) Bacillus subtilis, (3) orange sarcina, (4) white bacillus from Tweed water, (5) mixture of organisms from putrid urine, (6) the micrococcus of Osteo myelitis (acute inflammation of bone), (7) Aspergillus nigrescens, (8) a mixture of spores from various fungi, (9) yellow micrococcus from pus, (10) mixed putrefactive organisms, (11) Bacterium termo, and (12) Bacillus scarlatinæ (Edington). Solutions of the biniodide soap (1 gramme of soap in 120 cc. of water, and 1 gramme in 60 cc., or 1 in 1,000 and 1 in 2,000 of the salt) acting for 10 minutes on silk threads saturated with the above micro-organism, prevented their germination most effectually. In every case the soap was removed after 10 minutes by carefully washing the threads in two distilled waters, after which the threads were plunged into peptonised gelatine in the usual manner.

"The other antiseptic and ordinary soaps used in similar proportions failed in most instances to prevent the growth of the micro-organism.

"(*See* tables for exact results.) Numbers have been used in place of the names of the soaps.

"We have also had submitted for biological test a cheaper form of soap, 'Carbolate of Mercury Soap,' in which a compound of carbolic acid and oxide of mercury takes the place of biniodide of mercury. This is not such a powerful disinfectant as the above, and its germicidal action is considerably slower; but we find that silk threads steeped in micro-organisms or infected clothes steeped in a solution of one part of this soap in 120 of water are rendered perfectly aseptic, even when organisms are used which resist the action of other so-called antiseptic soaps. We think that these experiments have a most important bearing on sanitation and disinfection, and we consider that Mr. Thomson has solved a most difficult problem, that of killing, and not merely enfeebling, micro-organisms."

"In the following tables the word '*Treatment*' with the numbers at the head of each column, refers to the organism used in the experiment. Thus, in the first series, *Treatment* 7 means that the organism numbered 7 in the list was used as the test organism, *i.e.*, the thread was saturated with that organism (in this instance Aspergillus nigrescens) before being placed in the antiseptic solution; 9 = yellow micrococcus from pus and so on."

"'*Control*' refers to the fact that a sterilised thread, one of the batch to be used, was plunged into the nutrient gelatine; if no growth occurred the threads were looked upon as being fit for use, and the series of experiments was accepted. It will be seen that there is always a minus mark (—) opposite the word control, showing that no growth ever occurred and that the whole of the threads were germ free to begin with."

"'*None*' refers to the fact that no antiseptic was used in the experiments referred to in the line opposite. The needle was simply plunged into the mass of micro-organisms and then into nutrient gelatine. It will be seen that there was invariably in such cases a profuse growth, indicated by the two plus marks (++)."

"'1 *distilled water*' means that after the thread had been soaked in the micro-organisms, it was thoroughly washed *once* with distilled water for 10 minutes and then plunged into the nutrient gelatine."

"'2 *and* 3 *distilled waters*' should be read in the same way. It will be seen on referring to the tables that these washings do not interfere with the growth of the organisms, as '++' appears in every instance."

"In the use of the soap or of an antiseptic solution the method of procedure was as follows:—"

"Threads were sterilised, then plunged into one or other of the organisms, afterwards soaked in the solution of soap, &c. for the time marked in the column, 5 minutes, 15 minutes, &c. They were then washed in two distilled waters, 10 minutes each, after which they were plunged into the sterilised gelatine."

"'*a*' after soap refers to stronger solution = 1 of soap to 60 of water."

"'*b*' after soap refers to stronger solution = 1 of soap to 120 of water.

"'+' means that growth has not been prevented.

"'++' that growth is luxuriant.

"'+?' that growth is very scanty indeed.

"'—' that there is no growth on the fourth day.

"'—?' that slight growth made its appearance after the fourth day."

"No. 3. Orange sarcina is somewhat uncertain in its growth."

FIRST SERIES.

Treatment	7	7	9	6	10
	5 minutes.	15 minutes.	5 minutes.	5 minutes.	24 hours.
Control	—	—	—	—	—
None	++	++	++	++	++
1 Distilled Water	++	++	++	++	++
2 " Waters	++	++	++	++	++
3 " "	++	++	++	++	++
Yellow Soap $\frac{1}{60}$	++	++	++	++	++
" $\frac{1}{120}$	++	++	++	++	++
Biniodide Soap $\frac{1}{60}=\frac{1}{2400}$	+	—	+	+?	—
" " $\frac{1}{120}=\frac{1}{4320}$	—?	—	+?	—	—
Biniodide Solution $\frac{1}{2000}$	—?	—	—?	+?	—

FIRST SERIES—*cont.*

Treatment	10	10	10	12	12
	3 hours.	15 minutes.			
Control	—	—	—	—	—
None	++	++	++	++	++
1 Distilled Water	++	++	++	++	++
2 " Waters	++	++	++	++	+++
3 " "	++	++	++	++	++
Yellow Soap $\frac{1}{60}$	++	++	++	++	+++
" $\frac{1}{120}$	++	++	++	++	++
Biniodide Soap $\frac{1}{60}=\frac{1}{2400}$	—	—	+?	—	—
" " $\frac{1}{120}=\frac{1}{4320}$	—	+?	—	—	—
Biniodide Solution $\frac{1}{2000}$	—	—	—	—	—

SECOND SERIES.

Treatment	5	5	5	6
	5 minutes.	10 minutes.	15 minutes.	10 minutes.
Control	—	—	—	—
None	++	++	++	++
1 Distilled Water	+	++	++	++
2 " Waters	++	++	++	++
3 " "	++	++	++	++
Thomson's Biniodide in Hypo*	+	—?	+	+
" Bromide of Hg	+	+	+	+
Biniodide Soap. *a.*	—	—	—	—
" " *b.*	—	—?	—	—?
Carbolate of Hg Soap. *a.*	+	—	—?	—
" " *b.*	+	+	+	—

When time is written in a column, it refers to all in that column.

* Hypo = Hyposulphite of soda.

THIRD SERIES.

Threads left in Antiseptic Solution for Ten Minutes.

Treatment	1	2	3	4
Control	–	–	–	–
None	+ + +	+ + +	+ + +	+ + +
1 Distilled Water	+ + +	+ + +	+ + +	+ + +
2 „ Waters	+ + +	+ + +	+ + +	+ + +
3 „ „	+ + +	+ + +	+ + +	+ + +
Carbolate of Hg Soap *a*	–?	–	–	+?
„ „ „ *b*	–?	–	–	+
Old Biniodide of Hg Soap *a*	–?	–	–	–
„ „ „ „ *b*	–?	–	–	–
New „ „ „ *a*	–?	–	–	–
„ „ „ „ *b*	–?	–	–	–
I. *a*	+	+	–?	–
I. *b*	+	+	–?	+
II. *a*	+	+	+ +	+
II. *b*	+ +	+ +	+ +	+
III. *a*	+	+	+	+
III. *b*	+ +	+ +	+	+
IV. *a*	+	+	–?	+ +
IV. *b*	+	+	+ +	+
V. *a*	+	+ +	+	+
V. *b*	+ +	+ +	–?	+ +
VI. *a*	+	–?	–?	+ +
VI. *b*	+	–?	–?	+ +
VII. *a*	+	–?	+	+ +
VII. *b*	+ +	–?	–?	+ +
VIII. *a*	+ +	+ +	+ +	+ +
VIII. *b*	+	+?	+	+ +
IX. *a*	+ +	+	+	+ +
IX. *b*	+	+	+ +	+ +

FOURTH SERIES.

Threads. Ten Minutes of Antiseptic treatment.

Treatment		1	2	3	4
Control		–	–	–	–
None		+ +	+ +	+ +	+ +
1 Distilled Water		+ +	+ +	+ +	+ +
2 „ Waters		+ +	+ +	+ +	+ +
3 „ „		+ +	+ +	+ +	+ +
Biniodide Soap	$\frac{1}{2000}$ ($\frac{1}{60}$)	–	–	+?	–
	$\frac{1}{4000}$ ($\frac{1}{120}$)	–	–	–?	+
X.	$\frac{1}{60}$	+	+ +	+	+ +
	$\frac{1}{120}$	+	+ +	+	+ +
XI.	$\frac{1}{60}$	+ +	+ +	+	+ +
	$\frac{1}{120}$	+ +	+ +	+	+ +
$HgCl_2$ Sol.	$\frac{1}{2000}$	–	–	–	–
	$\frac{1}{4000}$	–?	–?	–	+
	$\frac{1}{5000}$	–?	–	–?	–?
	$\frac{1}{6000}$	+ +	+?	–	+?
	$\frac{1}{7000}$	+ +	–	+	+?
	$\frac{1}{8000}$	+ +	–?	–	–
HgI_2 Sol.	$\frac{1}{6000}$	–	–	–?	–?
	$\frac{1}{7000}$	–	–	–	–?
	$\frac{1}{8000}$	–	–	–	–?

FIFTH SERIES.

Threads. Thirty Minutes of Antiseptic treatment.

Treatment		1	2	3	4
Control		–	–	–	–
None		+ +	+ +	+ +	+ +
1 Distilled Water		+ +	+ +	+ +	+ +
2 „ Waters		+ +	+ +	+ +	+ +
3 „ „		+ +	+ +	+ +	+ +
Biniodide Soap	$\frac{1}{2000}$ ($\frac{1}{60}$)	–	–	–	–
	$\frac{1}{4000}$ ($\frac{1}{120}$)	–	–	–?	+

"The biniodide soap also has been tried in the treatment of cases of eczema with most marked success, especially where the irritation has been produced by the fermentation of accumulated secretions (the fermentation being set up by micro-organisms).

"It has also been used in parasitic skin diseases, such as favus and ringworm, also with marked success, the results proving that the activity of the biniodide as a parasiticide is not in any way lost when it is combined with soap. The importance of this in connexion with the washing of scarlet fever patients during the period of desquamation and the prevention of infection is very evident."

DISCUSSION.

Mr. Dott, referring to Dr. Woodhead's statement that bichloride of mercury precipitates with albumen, said that there was no doubt that this was the case, but the precipitate dissolves in an excess of the albumen, and in Lister's process for preparing "serosublimated" gauze, that property is made use of.

Mr. Aikman said that the property which bichloride of mercury possessed of precipitating albumen was what doubtless made it valuable as an antiseptic in preserving timber. Corrosive sublimate was for long one of the most widely used of antiseptics for this purpose. It was now of course almost entirely superseded by the use of "creosote," which like the bichloride of mercury possessed the property of coagulating the albuminous compounds in the wood.

Dr. Woodhead said that, as regards strength, the soap contained from 1 to 3 per cent. of biniodide of mercury dissolved in iodide of potassium (1 to 3 parts of the salt in 100 parts of the soap). The watery solution of soap was always made up as far as possible so that it might be 2 or 1 in 4,000—that is that there might be one part of the salt in 2,000 of water, or one part in 4,000 (by taking one part of the 3 per cent. soap in 60 or 120 parts of water). Touching on the re-solution by albumen the difficulty, he said, in preserving tissues was the limited quantity of albumen in a piece of tissue. In large pieces there was no flow through the tissues, and consequently at the surface the albumen was precipated, the bichloride having lost its antiseptic powers, the centre of the tissue became putrid from the presence of organisms not affected by the mercuric salt. If a small piece of tissue and a large proportion of bichloride was used, its great value was that it practically fixed everything in exactly the condition in which it came in contact with the mercuric salt, and therefore it was used with delicate tissues for fixing or coagulating the protoplasm in the exact condition in which it was found at death.

* * *

DISCUSSION ON MR. MACADAM'S PAPER ON MANURES, NATURAL AND ARTIFICIAL.

(Journal VII., 79.)

Mr. Stanford considered the subject a very large and very interesting one, but he would like to ask Mr. Macadam whether he did not think that the making of soluble phosphate or superphosphate was likely to become a thing of the past? The balance of evidence was, he thought, in favour of the fact that any phosphate was available for agricultural purposes, however insoluble, provided it was sufficiently finely ground. It appeared to him that the very troublesome and offensive process of making superphosphates was simply a roundabout way of getting the phosphate into a fine state of division, as it was known that when superphosphate was added to the soil it assumed the insoluble form, and became a precipitated phosphate, which, curiously enough, in the analysis was not valued at such a high figure as the soluble. When the extraordinary rapid development of this basic phosphate was considered, and the enormous quantity which was being poured into the market (and, he believed, being used as fast as it was produced), it certainly did look as if the manufacture of superphosphates would become a thing of the past.

He believed that all chemists would warmly welcome any general standard method of analysis for manures, provided it was put forward, as in America, by a sufficiently standard authority.

Mr. Dott admitted the advantage of a standard method of analysis, but there was, in his opinion, one disadvantage, and that was the tendency to perpetuate methods of analysis which might subsequently be improved upon.

Mr. Irvine asked if the agricultural value of "dissolved bones," and a manure "so called," but prepared from mineral phosphate, with the addition of nitrogenous matter, and only sufficient crushed bone to give it the appearance of dissolved bones, was the same, because, if not so, the sale of such a sophisticated compound looked like a fraud.

Dr. Milne quite agreed with Mr. Stanford as to the probable non-existence of artificial manures by-and-bye. The adoption of a uniform method of analysis would certainly be a step in the right direction. It was certainly very aggravating for a chemist, who was using what he believed to be the most accurate process for the determination of, say, phosphates, to have his results compared with another chemist who was using an obsolete process. The chemists of America were certainly to be congratulated on having united in the endeavour to adopt a uniform method, which everyone should follow, as, except that was done, there would be no end, in his opinion, to discrepancies in the analysis of manures.

Mr. Macadam, replying to Mr. Stanford, admitted the possibility of superphosphates becoming a thing of the past. He had no doubt whatever that if phosphates could be sufficiently finely ground there would be very little necessity for treatment with sulphuric acid. Many would recollect Morfitt's process, in which raw phosphates were dissolved in hydrochloric acid, and the resulting solution precipitated by lime. The process had never come into use to any great extent. By this process the phosphates were obtained in an extremely fine state of division, but the cost of manipulation was too great, at least with the present low rates at which soluble phosphate could be purchased. Why "precipitated" or "reverted" phosphate should not have a greater value attached commercially to it than "soluble" phosphate he did not pretend to say, and he could not, within the limits of the time devoted to this discussion, fairly lay before the meeting the opinions expressed by the advocates on either side of the controversy. In his own opinion a greater value should be allowed for these "precipitated" phosphates than for "insoluble" phosphate, as the first would be more readily taken up by the plant than the latter. He did not quite agree with a previous speaker that if a "*recognised*" series of processes were established, erroneous methods would be perpetuated, as such would be guarded against, provided the committee appointed to arrange the processes was sufficiently large and representative. He agreed with Mr. Irvine's contention, that to call a dissolved mixture containing mineral phosphates mixed with bones "bone manure," was not descriptive of the article, and that the use of such titles should not be encouraged. In fact, this was a case which the Trade Marks Act would probably rectify.

The Fifth Meeting for this Session was held in the Rooms, 207, *Bath Street, Glasgow, on Tuesday, March 6th*, 1888.

MR. J. J. COLEMAN IN THE CHAIR.

ON THE ESTIMATION OF THE CALORIFIC VALUE OF SOLID AND LIQUID FUELS.

BY FREDK. J. ROWAN, C.E.

The estimation of the calorific value of fuel has been for a considerable time known to be a matter of much difficulty, and it is being recognised that the methods which have been employed in such estimations can at best afford only approximations to the full value.

The methods referred to are (1) the *experimental* method, which is carried out by submitting specimens of fuel to combustion in a calorimeter; and (2), the *theoretical* method, which consists in calculating the calorific value of the different elementary bodies existing in the fuel, as set forth in the result of an ordinary chemical analysis, and assuming the calorific value of the fuel to be the sum of these, with certain unimportant corrections.

As long as the means employed for the use of fuel in the arts and manufactures remained in a crude or imperfect state, there was no occasion to question the sufficiency of these estimates of calorific value, since they yielded, in general, higher results than were attained in practice. With the improvement of appliances for the combustion of fuel on the large scale and for the application and utilisation of its heat, which have followed enlightenment as to the true nature and value of heat, discordant results have, however, appeared; and there is, moreover, an increasing desire in such matters to know what is the maximum result attainable, in order that practice may be compared with it and improved in view of it.

Recent results observed in engineering practice with coal used in steam-boiler furnaces have led to the conclusion that coal has a greater evaporating power as so used than its thermal equivalent as usually ascertained shows to be possible. In addition to this, results repeatedly obtained of late years with liquid fuels, have completely upset all thermal calculations founded upon their ultimate chemical composition. It is of course easy to dismiss such results as mythical, or to endeavour to explain them away by suggesting priming of steam boilers or some other abnormal action which would vitiate the result, but it is surely much wiser to accept them as an incentive to fresh inquiry as to the direction in which it may be possible to improve our methods of estimation.

One writer[*] some time ago suggested that the temperature of ignition must be added in estimating the heating value of fuels, but it is impossible that this element can enter into estimates of the *quantity* of heat available from the combustion of fuel. Combustion is chemical combination which is possible only under certain conditions, and these include the physical state of the substances and a given minimum temperature which is a *static* condition essential to the production of the phenomena.

Another writer[†] endeavours to find in the degree in which the effect of *radiant* heat is utilised the solution of all questions as to difference in heating effects. This, however, although it may influence the methods of applying fuel, cannot help us in estimating the quantity of heat which may be obtained from its combustion. The amount of radiant heat produced varies with the intensity or temperature of combustion, and not with the calorific value of the fuel.

A glance at the defects of existing methods of estimation may enable us to see more clearly what is required in the way of improvement.

(1.) The calorimetric method is objectionable because it operates upon very minute quantities of the substance which is being tested;[‡] the gaseous products of combustion, when allowed to rise in bubbles through the water in the calorimeter, have been found to be not completely cooled, thus causing a "not unimportant" loss of heat;[§] and the dense fumes generally given off "indicate that the combustion itself is incomplete."[‖] The combustion is usually conducted rapidly in a confined space, in presence of the resulting products, so that it might well be incomplete, besides being thus conducted at a low temperature. The oxygen is frequently derived from the decomposition of some solid substance, and the carbonic oxide which passes off is necessarily formed by decomposition of the carbonic acid in presence of the glowing carbon, both of these actions absorbing heat. Even in the results obtained with Favre and Silbermann's calorimeter, carbonic oxide was found, and it is well known that this gas is not formed as the result of a primary combustion, although the amount of heat absorbed in producing it from carbonic acid is not fully known. For in addition to the absorption of heat due to change of volume, it is to be observed that as oxygen combines as O_2, work must be expended in separating that duplex molecule when CO results from the action

$$CO_2 + C = 2\,CO.$$

(2.) The untrustworthiness of the method of calculating theoretical calorific power is due to a variety of causes. First of all, there is the uncertainty as to the value to be ascribed to the elements themselves.

Favre and Silbermann found considerable difference between the calorific powers of five varieties of pure carbon, as follows:—[*]

—	Calorific Power.	Specific Heat (Regnault).
Wood charcoal	8080	0·24150
Gas retort carbon	8047·3	0·20360
Artificial graphite	7762·3	0·19702
Native graphite	7796·6	0·20187
Diamond	7770·1	0·14687

so that they concluded that "there is no exact relation between the calorific power and the specific heat of carbon in the different allotropic states." It appears also from these results that "the heat of combustion of an elementary substance depends not only upon its chemical constitution but also upon its physical state before combustion."[†]

Favre and Silbermann noticed that the density of both simple and compound bodies exerts an influence upon their calorific value, and showed that "the fuel value of polymeric bodies varies with the state of condensation of their molecules, with which it is in inverse ratio." They applied the same observation to simple bodies in different allotropic conditions, for while carbon vapour is valued at 11,214 calories, natural graphite is only 7796·6, and diamond 7770.

All calculations of the calorific value of fuels proceed upon the assumption that the carbon of the fuel exists in it as solid carbon, in which state it is to be taken as of the value of wood charcoal burning to carbonic acid, although it is certain that this is wide of the mark for both solid and liquid fuel—even apart from the fact that a large portion of the carbon must burn in the state of gas.

In addition to this uncertainty about carbon, there is the fact that all estimations of the calorific power of hydrogen have been made with that substance in the state of gas. Little is known about it in other states, but it is certain that neither in coal nor in liquid fuel does it exist as a gas, although it may be gasified before either fuel is ignited. In assuming therefore, that the calorific power of solid or liquid hydrogen is the same as that of gaseous hydrogen "we commit an error," as Professor Rücker remarks,[‡] "of the existence of which we are certain, while we are totally ignorant of its magnitude."

All ordinary analyses of fuels give simply their ultimate chemical composition or the proportions of the several elementary bodies into which they are resolved. In analyses of coal we have usually the percentage proportions of carbon and hydrogen into which the coal has been resolved by the action of heat.

Of the proximate composition of coal but little is known, but it is recognised that it consists for the most part of *solid hydrocarbons* and is not a mere mixture of carbon and hydrogen. Extremely little progress has been made in isolating any of these hydrocarbons in their natural state by chemical methods, and it is very doubtful if they can be successfully separated from one another. When heat is applied to coal it is well known that gaseous hydrocarbons, probably of different composition, are formed by reactions taking place within the substance of the coal, and finally a certain quantity of so-called "fixed carbon," or, more properly, deposited carbon, remains after all the gaseous hydrocarbons have been driven off.

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[*] "Engineering," 28th July 1882.

[†] The "Engineer," 21st October, and 11th November, 1887.

[‡] *See* W. Anderson in Inst. C. E. lectures on "Heat in its mechanical applications." (1883.)

[§] Percy. Metallurgy, Vol. Fuel, p. 511.

[‖] J. Goodman in the "Engineer," 4th November 1887.

[*] *See* Percy. Fuel, p. 163.

[†] "Coal, its history and uses," p. 215. London, Macmillan, 1878.

[‡] *Ibid.*, p. 216.

The fact is often overlooked that the composition of the hydrocarbons formed by the action of heat on coal, as well as the physical state of the resultant carbon, depends upon the temperature to which the coal has been exposed during distillation or decomposition, and since the calorific value of the different hydrocarbons varies with their constitution and that of solid carbon with its physical state, it is evidently not easy at present to trace any exact relation between the results yielded by any given coal on analysis and those found in practical use.

We thus do not know what coal is proximately composed of—in what way the elements are combined in its substance—or what is the calorific value of its various ingredients or of the compounds which may be produced by treating it at different temperatures.

In the face of such elements of uncertainty it is not surprising that Messrs. Scheurer-Kestner* and Meunier-Dollfus found wide variations between the experimental and calculated calorific values of different varieties of coal, and also between those of different specimens of coal which yielded practically the same results on analysis.

Several of the most striking of their results were published by Dr. Percy† in the following table, which, however, contains only instances in which the experimental result exceeded considerably the theoretical or calculated calorific power:—

No.	Locality.	Description of Coal.	Percentage Composition of the Coal, exclusive of Ash and Water.			Calorific Power calculated on the dry Coal free from Ash.		Coke per Cent. calculated on the dry Coal, free from Ash.
			Carbon.	Hydrogen.	Oxygen and Nitrogen.	Experimental.	Theoretical.	
1	Manosque, Basses Alpes ...	Lignite	66·31	4·85	28·84	6,991	5,782	46·76
2	" " " ...	Lignite.	70·57	5·44	23·99	7,363	6,533	47·55
3	Louisenthal, Saarbrück....	Not stated ...	76·87	4·68	18·45	8,215	7,056	59·49
4	Duttweiler, Saarbrück.....	Not stated ...	83·82	4·60	11·58	8,724	7,871	63·53
5	Ronchamp.................	....	88·38	4·42	7·20	9,117	..	71·53
6	Creusot	Caking.......	88·48	4·41	7·11	9,622	8,784	80·42
7		Non-caking..	90·79	4·24	4·97	9,293	8,585	84·12
8		Anthracite...	92·36	3·66	3·98	9,456	8,553	88·15

Nos. 5 and 6 illustrate the case of two specimens of coal which show practically the same percentage composition on analysis, but have more than 5 per cent. difference in calorific power; whilst 6 shows a smaller proportion of carbon combined with a greater calorific power than 7 exhibits, although the available hydrogen is practically the same in both. The difference between experimental and calculated calorific powers amounted in some instances to 15 per cent.

In the case of two specimens of coal from England (not given in the table), the calculated heat was also too small; but in the case of some kinds of brown coal from France and Germany it was larger than the experimental result, while there was not much difference between the experimental and calculated results in the case of several kinds of coal from Russia.

The correctness of some of these results was assailed by Bunté, Stohmann, and Fischer, but Scheurer-Kestner* succeeded in maintaining their accuracy against the objections of his critics.

Dr. Percy remarks that Scheurer-Kestner endeavoured to explain the difference in calorific power between Nos. 5 and 6 "by attaching a higher calorific value to the carbon which remains in the coke formed than to that which is evolved during the process of coking," but that this hypothesis will not explain the discrepancy in the cases of 6 and 7.

Grüner† inclined, it is said, to Scheurer-Kestner's view, whilst Von Hauer‡ ascribed an increase of calorific power to increased age of geological formation. The conclusion which is, however, expressed by Dr. Percy is undoubtedly the most weighty which has been announced. "It is the author's opinion," he said,‡ "that a thorough investigation by competent analysts into the proximate chemical constitution of coal, which is at present wholly unknown, is a necessary prelude to any trustworthy explanation of the differences in question."

Until that most desirable goal is reached, it is worth consideration whether we cannot approximate our method of estimating calorific power more closely to the actual conditions under which fuel is used.

If specimens of coal, for instance, were resolved into volatile hydrocarbons and fixed carbon at a series of ascending temperatures, or at a minimum and a maximum temperature, the volume and composition of the gases given off at each temperature respectively could be observed, as well as the quantity and physical state of the "fixed carbon" in each case. The quantity of sulphur, nitrogen, and ash contained in the coal would also be estimated, and the influence, if any, of the nitrogen on the combustion of the carbon might be investigated.

If now to the calorific value of the solid carbon thus obtained we were to add that of the hydrocarbon gases evolved, it is probable that we should have in result a tolerably close approximation to the quantity of heat yielded by the coal on combustion at any temperature within the limits used in this process. Moreover, on knowing the temperature at which any sample of coal had been thus resolved or analysed (which temperature should always be stated in the report of analysis), and comparing its yield and quality of gas and carbon with standard observations on representative kinds of coal at different

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[*] Ann. de Chim. et de Phys., s. 4. 1870, xvi. p. 436, s. 4. 1872, xxvi. p. 80.

[†] Metallurgy. Vol. Fuel, p. 539.

[‡] Fuel, p. 539.

[*] *See* Ann. de Chim., &c., Vol. VIII., pp. 267, 281. Bull. Soc. Chem.

[†] Jahresbericht Chem. 1187 (1874).

[‡] Jahrbuch fur Min. Geol. 727 (1863).

temperatures, it would probably be a simple matter to estimate the value of that particular coal for use at any given temperature.

This method would probably in some cases yield results similar to those obtained by the one proposed by M. Cornut, chief engineer to the Northern (of France) Steam Users' Association, which he expressed by the formula :-

$$Q = 8080\ C' + 11{,}214\ C'' + 34{,}462\ H.$$

where Q = the total quantity of heat,
C' = the fixed carbon, and
C'' = the volatile carbon, contained in the coal.

This latter method, however, takes no account of the variation in thermic value according to the temperature at which coal is decomposed, and consequently does not distinguish the calorific values of the hydrocarbons produced according to the temperature of their formation. It must thus fail under certain circumstances, although it is a decided improvement upon existing formulæ.

In dealing with liquid fuel, we are upon similar ground. The calorific value of this form of fuel has hitherto been calculated in the same way as that of coal, and hence it appears that too low an estimate has been formed of its value. The point aimed at, consequently, in most of the trials with this fuel, has been the realisation merely of a close approximation to the calorific value of the carbon and hydrogen estimated by analysis *as if existing separately in the fuel*. Such estimates have rarely credited liquid fuels with double the calorific value of good coal, but evaporative results, which could not but be considered startling in that view of the value of the fuel, have been obtained by Admiral Selwyn and others, and, although they have frequently been received with incredulity, there is no doubt that they go far towards showing that the method of estimation must be defective.

There has no doubt been a wide variety in the results obtained by different methods of using liquid fuel, and even with the same method under different circumstances, but this has been due to imperfections in the apparatus used and to want of experience in the best method of treating the fuel.

There has also been difficulty in understanding how such high results as four times the evaporative rate of coal could be legitimately obtained with a fuel which was stamped by recognised methods with a definite calorific value very far below this.

Admiral Selwyn explained the high evaporative rates obtained by him by assuming that the hydrogen of the steam used in his injectors was burned ; and Mr. Henwood, following in his steps, has claimed for his apparatus that the oil and steam are so proportioned that the hydrogen is fully utilised in the same way in his furnaces. But inasmuch as, in the dissociation of the hydrogen and oxygen composing steam, an amount of heat is absorbed and becomes latent, which is the same as that developed when the hydrogen is burnt and again combines with oxygen to form water, it is very improbable that this view affords an explanation of the results obtained. On the other hand, those who have rejected Admiral Selwyn's view have not given proper weight to several considerations which are intimately connected with our present subject.

The estimates which are usually made of the calorific value of liquid fuels from their elementary chemical analyses, are based upon the suppositions that the carbon contained in them *exists as solid carbon*, and *is to be burned as such*.

We have seen that even in estimating the calorific power of coal this is very insecure ground upon which to build, because it is not certain that any carbon exists as such in the solid state in coal.

In liquid fuels it is certain that none of it exists in that state, and hence we must give due weight to the fact that we are dealing with carbon in another physical state, which represents a certain store of energy in the form of latent heat.

The late Harrison Aydon, who was a pioneer in the practical application of liquid fuel, made reference to this fact some years ago. He said of liquid fuel that it was "naturally prepared the first stage towards gasification, because to effect the same result artificially 6,000 or more (Fahr.) heat units would have to be expended, which heat would become latent and so be lost as useful work. Now, these 6,000 heat units added to 15,000 heat units derived from converting or burning carbon into carbonic acid, would give 21,000 heat units, which the late Prof. Rankine stated to be the amount due to gaseous carbon."

Aydon then applied this method of estimation to the case of American petroleum, and to the creosote or dead oil which he had used at Woolwich. Taking petroleum of the composition, carbon 86, hydrogen 14 per cent., if the value for gaseous carbon were employed it would give this a calorific value of 26·887 lbs. of water per lb. of oil.

The dead oil, as analysed by Prof. Church, contained :—

Carbon	86·48
Hydrogen	7·06
Oxygen, &c.	6·46
	100·00

Estimating its calorific power as if the carbon were solid, it would give an evaporative power of 17·50 lbs. water per lb. of oil, while on the basis of gaseous carbon it would give 22·18 lbs.

We must, however, go even farther than Aydon did, for it is not merely the physical state of the carbon which represents so much latent heat, but also that of the hydrogen. Moreover, we have not to deal with hydrogen *separately* in the liquid state, but with hydrogen already combined with carbon in the form of hydrocarbons of some kind.

If in our methods of estimating the calorific value of this kind of fuel we are to approach as closely as possible to the conditions of its practical use, we must consider what takes place in burning the various oils fed into the furnaces, as they usually are, by means of steam jets.

These compounds of carbon and hydrogen are very readily dissociated by heat,[*] especially in presence of steam of high temperature, no doubt because of mutual decompositions taking place, and the result of this action is the formation of gaseous hydrocarbons which have a comparatively high calorific power. There is reason to believe that this result is accomplished with the expenditure of only a moderate amount of "work" in the form of heat.

The temperature at which steam is dissociated *in the presence of gaseous carbon* must be less than that which is required with steam and solid carbon, by at least the equivalent of the quantity of heat which becomes latent in gasifying the carbon, in order that it may unite with the oxygen of the steam to complete the reaction

$$H_2O + C = H_2 + CO.$$

When steam is thus decomposed there is present nascent hydrogen in contact with carbon in the gaseous form in some of the heavier hydrocarbons, and the circumstances are thus favourable to the formation of gaseous hydrocarbons of higher calorific power.

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[*] *See* Mr. Jas. B. Macarthur "On the Analysis of some Mineral Oil Gases." This Soc.'s Jour., VI., 810.

The oxygen of the decomposed steam may unite with part of the carbon to form carbonic oxide, or, if left uncombined in the primary reactions, it is ready to support combustion subsequently, and this it does, as is well known, with vigour.

This account of the reactions taking place, when liquid fuel is introduced into furnaces by a suitable method, is confirmed by the evidence of the results of ordinary oil-gas manufacture.

In one important particular—namely, the *quantity* of gas produced from oil—there is great difference between the processes which we compare. Gas which is to be used for lighting must be cooled and purified from condensable matters before being stored and conveyed, or distributed in pipes. Consequently we find that when it is produced by the apparatus of Pintsch, Keith, Rogers, or others of a similar kind, some of them employing steam, but others distillation alone, whilst it is said that from 90 to about 150 cubic feet of gas per gallon of oil used are stored for illuminating purposes, there is a liquid residue from the manufacture amounting to about 6 gallons per 1,000 cubic feet of gas made. These figures are given by Prof. Armstrong[*] in his paper "On the Manufacture of Gas from Oil." This liquid residue is quite suitable for gas making, and in some cases has been, with success, used exclusively as the raw material, so that it is practically of the same value for heating purposes as the original oil which has been employed.

In making use of liquid fuel for heating operations it will readily be understood that all the original oil is completely gasified, and therefore the quantity of gas produced per gallon of oil is in that case, according to the figures quoted above, probably from 250 to 300 cubic feet.

The *quality* of the gas made by the two methods may, however, be fairly considered as comparable, since the conditions can certainly be made very nearly identical in both. We may therefore take as an example the following analysis of the gas ordinarily produced by the apparatus made by Messrs. Rogers, of Watford, in which the oil is injected into red-hot retorts by steam. The oil which was used in producing this gas was a heavy hydrocarbon, having a flashing point of 250° Fahr.

ANALYSIS OF GAS.

Oxygen	0·73
Nitrogen	5·06
Luminiferous hydrocarbons	16·29
Marsh gas	46·17
Hydrogen	31·61
Carbonic oxide	0·14
	100·00

This gas is stated to be of 56-candle power, and the quantity which is produced and stored in the gasholder of the apparatus is from 110 to 120 cubic feet per gallon of oil.

The following figures give the thermic value of this gas, on the assumption that the "luminiferous hydrocarbons" mentioned are ethylene of the composition C_2H_4. If the composition C_3H_6 had been assumed for these hydrocarbons, the heating power would have been considerably higher.

Evaporative power of gas, per lb.	= 40·75 lbs.
" " " cub. ft.	= 1·622 "
Fahr. heat, units per lb.	21,843
" " cub. ft.	869·3
Calculated sp. gr. of gas	·4941

On the supposition that 25 to 27 cubic feet of such gas are produced per lb. of oil, these figures result in giving a theoretical evaporating power of *from* 40·5 *to* 43·79 *lbs. of water per lb. of oil* when completely turned into gas with steam. That gas of even higher heating power may be obtained from crude and heavy oils is shown by the following table, composed of results announced by Mr. W. Ivison Macadam,[†] with some by Dr. Wallace, and with comparative figures about gas from coal, which appeared in the "Glasgow Herald," 10th December 1886:—

No.	Description of Oil.	Specific Gravity.	Gas per Gallon.	Gas per Ton.	Candle Power.	Value per Ton in lbs. Sperm.
			Cub. ft.	Cub. ft.		
1	Crude paraffin oil	·850	98·76	26,026	50·36	4494
2	Green " "	·884	102·52	25,977	53·24	4741
3	Blue " "	·878	127·42	32,492	54·28	6947
4	" " "	·868	129·93	33,529	54·76	6295
5	Rectified coal oil	·844	95·26	25,282	42·56	3689
6	Twice run crude paraffin oil	·802	106·00	29,605	70·02	7105
7	No. 1 burning oil	·815	100·00	27,484	63·14	5950
8	Crystal oil	·798	106·62	29,928	54·00	5538
9	American petroleum	·799	86·00	24,110	66·66	5506
10	No. 2 burning oil	·830	100·68	27,171	49·76	4635
11	West Lothian oil	·840	94·15	24,922	60·15	5139
12	" "	·870	94·56	24,383	56·26	4702
13	" "	·870	94·85	24,396	57·65	4822
14	" "	·890	..	23,573	55·29	4469
15	Westfield oil (crude)	..	..	16,755	49·03	2815
16	Walkinshaw oil	·653	..	19,464	40·23	2683
17	Boghead coal	..	..	14,900	42·19	2157
18	Cairntable coal (1872)	..	..	11,294	35·75	1384
19	Haywood coal (1884)	..	..	11,360	32·12	1251
20	Lesmahagow, Auchenheath, coal (1882)	..	..	13,201	34·52	1562

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[*] This Soc.'s Jour., III., 462.

[†] This Soc.'s Jour., VI., 199.

The quantities of gas yielded, and the comparative values in lbs. of sperm are, of course, given in this table on the basis of gas being made and stored for use in lighting.

On the basis of the previously considered 56-candle power oil gas, however, these figures reveal a store of heat-producing energy in oils of low quality which has not yet been utilised, if recognised.

It is thus evident that it is on its ability to yield gas of high calorific power that the value of any fuel, and specially of the liquid form of fuel, rests, and that in order to use fuel successfully efforts must be directed to the complete production and utilisation of this gas.

In the case of liquid fuel we see that it may be possible with suitable apparatus employing steam to obtain, continuously, results equivalent to an evaporation of from 40 to 50 lbs. of water per lb. of oil. Such results have been obtained at rare intervals in trials already made, although in general they have been considered abnormal, and possibly incapable of a reasonable explanation.

These considerations throw the needed light on our present subject, and show that what is required in estimating the calorific power of fuel is, to imitate as closely as possible the conditions of actual use; turning the fuel into gas—with or without steam—estimating the quantity and quality of the gas produced, and of course allowing for the steam where it is used; and determining the calorific value of the fuel from that of the gas which is invariably present and is the immediate cause of combustion when fuel is used.

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Meeting held at Mason College, Birmingham, on the 8th February 1888.

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NOTE ON THE COMPOSITION OF STRONG CAST IRON.

BY THOMAS TURNER, ASSOC., R.S.M., F.S.C., F.I.C., LECTURER ON METALLURGY, MASON COLLEGE, BIRMINGHAM.

The author has in several previous papers referred to the chemical composition of cast iron with special strength (both tensile, transverse, and crushing), and has endeavoured to show the connexion which exists between chemical composition and mechanical properties. Several other specimens having recently been brought under his notice, there appears to be sufficient new material to deserve a brief notice.

In a paper read before the Iron and Steel Institute (May 1886), the author has attempted to deduce the composition of a typical foundry iron from the elaborate series of experiments conducted at Woolwich in 1858. In these experiments 53 representative specimens of cast iron from England and Wales were examined, both chemically and mechanically, and, on selecting the four specimens which stood highest in order of quality in the various tests applied, the average chemical composition was found to be as follows:—

	Per Cent.
Graphitic carbon	2·59
Silicon	1·42
Phosphorus	0·39
Sulphur	0·08
Manganese	0·55

This composition may therefore be taken to represent a typical foundry iron, as far as the mechanical tests adopted could serve to distinguish such a metal. In addition to being specially strong metal, these four selected specimens were all good working irons, which is a point to be specially noted in connexion with practical use.

In the author's experiments on the influence of silicon on the properties of cast iron the specimen with the maximum tensile strength (15·7 tons per sq. inch), had the following composition:—*

	Per Cent.
Graphitic carbon	1·62
Combined	0·50
Silicon	1·96
Phosphorus	0·28
Manganese	0·60
Sulphur	0·03

This was a soft, sound, good-working iron.

In subsequent experiments conducted at Rosebank Foundry, Edinburgh, four specimens of unusually high tensile strength were obtained. In fact, so far as the author is aware, these values for tensile strength are higher than any previously recorded for British iron.† The tensile strength and composition were as follows:—

Tensile Strength—Tons per Sq. Inch.	18·2	17·1	16·8	16·4
	Per Cent.	Per Cent	Per Cent	Per Cent.
Combined carbon	0·36	0·58	0·52	0·40
Silicon	1·29	1·50	1·13	1·38
Phosphorus	0·53	0·47	0·41	0·70
Sulphur	0·06	0·07	0·06	0·05
Manganese	1·00	1·00	1·33	0·65

Shortly after the Rosebank experiments Mr. Robert Buchanan, of the Star Foundry, Dumbarton, consulted the author in connexion with the use of silicious iron in the foundry. Mr. Buchanan himself conducted some experiments subsequently, and obtained some unusually high results with test bars though using a comparatively cheap iron. After being mechanically tested these bars were analysed by the author, and the results are now published for the first time. The tensile strength and chemical composition were as follows:—

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* J. Chem. Soc. XLVII., p. 577.

† Paper read by the author before S. Staff. Institute Iron and Steel Works Managers, March 1887.

—	I.	II.
Tensile Strength—Per Sq. Inch ..	16·68	15·2
	Per Cent.	Per Cent.
Graphitic carbon	2·90	2·60
Combined carbon	0·32	0·30
Silicon	1·34	1·63
Phosphorus	1·09	1·10
Sulphur	0·14	0·12
Manganese	1·38	1·29

The mechanical tests of these specimens were performed by Mr. Leslie S. Robinson, of Dumbarton (Industries II., p. 461).

In the first sample Mr. Robinson mentions that the test piece had the skin removed, and the first test gave a breaking stress of 16·68 tons per sq. inch. One of the broken halves was turned down to a smaller diameter and tested again, in order to obtain the modulus of elasticity, which was found to be 12,590,000, giving a specific extension of ·794 in. and a second breaking stress of 16·18 tons per sq. inch.

Professor Unwin has recently called the author's attention to some very unusually high tensile strengths observed in American cast iron run from the Wassiac blast furnace, Duchess County, N.Y. The maximum tensile strength observed was 21·2 tons per sq. inch, while the average of 13 tests was 18·46 tons. The tests appear to have been made with considerable care, by different persons, and with various testing machines, so the results, though higher than anything as yet recorded in this country, must be accepted as correct. Other exceptional tensile strengths have occasionally been recorded in America and on the Continent, but hitherto, so far as the author is aware, none have been so well verified. These tests show that, even in the highest recorded British tests, the maximum which may be expected has not yet been reached. The Wassiac cast iron had the following composition (Inst. C. E. LXXIV., p. 373).

	Per Cent.
Graphitic carbon	2·310
Combined carbon	0·780
Silicon	1·307
Phosphorus	0·294
Sulphur	0·086
Manganese	1·512

In the above cases the author has referred only to tensile tests, partly because it has been shown by other experimenters that tensile strength usually affords an accurate indication of the mechanical value of the material, and secondly, because the author has elsewhere shown the general principles by which it is easy to produce at will, in a given sample, either the maximum crushing, transverse, or tensile strength when the general chemical and mechanical characters of the metal are known.

On collecting and arranging the foregoing results we have the following table:—

—	Woolwich Experiments, 1858, Average.	Silicon Experiments, 1885.	Rosebank Irons, 1886.				Dumbarton Irons.		Wassiac Iron (Average).
Tensile Strength—Tons per Sq. Inch.	..	15·7	18·2	17·1	16·8	16·4	16·68	15·2	18·46
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Graphitic carbon	2·59	1·62	..	..	..	..	2·90	2·60	2·31
Combined carbon	..	0·56	0·36	0·58	0·52	0·40	0·32	0·30	0·78
Silicon	1·42	1·96	1·29	1·50	1·13	1·33	1·34	1·63	1·31
Phosphorus	0·39	0·28	0·56	0·47	0·41	0·70	1·09	1·10	0·29
Sulphur	0·06	0·03	0·06	0·07	0·06	0·05	0·14	0·12	0·08
Manganese	0·58	0·60	1·00	1·00	1·33	0·65	1·38	1·29	1·51

There were formerly two ideas held, which are quite negatived by the above experiments. In the first place it was believed that the best iron for foundry purposes would be an iron containing as nearly as possible only carbon and iron, *i.e.*, "pure cast iron." But in every case the above specially good irons contained between 1 and 2 per cent. of silicon and several tenths per cent. of phosphorus. In the second place many founders have held that it is possible "to get any strength, provided the metal is hard enough," and hence often do not care to aim at strength for fear of getting the metal too hard. As a matter of fact, however, the irons with maximum tensile strength are always good, soft, close irons, just such metal as is preferred for general purposes in the foundry.

From the above table the following maximum, minimum, and average composition is deduced.

—	Maximum.	Minimum.	Mean.
	Per Cent.	Per Cent.	Per Cent.
Combined carbon	0·78	0·30	0·475
Silicon	1·96	1·13	1·434
Phosphorus	0·10	0·28	0·587
Sulphur	0·14	0·03	0·074
Manganese	1·51	0·58	1·037

The mean result thus deduced agrees very fairly with the values obtained previously from a more limited number of experiments, viz.:—*

	Per Cent.
Combined carbon	0·46
Silicon	1·31
Phosphorus	0·53
Sulphur	0·06
Manganese	0·99

Such an iron may be regarded as the best base upon which to work for *special quality* foundry purposes. It may, of course, as the author has previously shown, be softened by increasing the amount of silicon, or it may be hardened by reducing the silicon present. It is interesting to observe that cold blast pig iron, made from clay ironstone (such as South Staffordshire All Mine pig iron), approximates very closely in composition to what has been given above, while long experience has shown the practical man the great value of such irons for use in the foundry when special quality is desired. In cases where fluidity or other characters are of more importance than strength, of course a cheaper iron would be recommended, which would contain more phosphorus and silicon than that given above.

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* Paper read before S. Staff. Inst. 1887.

Journal and Patent† Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Corrosion in Steam-boilers. Böhm. Zeit. f. Zuckerind., 1887, 35.

Schnirch attributes the corrosion of boilers in sugar factories to the presence of sugar or fat in the water, which give rise to the formation of free acids, and these attack the iron. The presence of ammonia, on the other hand, so far from being injurious, acts frequently as a protection, by neutralising the free acids. Copper compounds may prove destructive galvanically.—D. A. L.

II.—FUEL, GAS, AND LIGHT.

German Petroleum. G. Krämer and W. Böttcher. Verhandlung. d. Ver. z. beförd. d. gewerbfl., 1887, 549.

The principal fractions of German petroleum consist of hydrocarbons unattacked either by nitric or by sulphuric acid, but all contain a small proportion of hydrocarbons, absorbed or acted upon by these reagents. The lower boiling fractions of the latter consist mainly of aromatic hydrocarbons, toluene, *m.* and *p.* xylene, pseudo-cumene, and mesitylene. The authors consider that by removing the "heavy" hydrocarbons (those absorbed by concentrated sulphuric acid) the crude petroleum could be made to yield a valuable illuminating oil, and propose to test the oils in this respect by absorbing them with sulphuric acid of sp. gr. 1·84 at 15°, a process which gives concordant results with one and the same oil, provided they do not contain more than 13 per cent. of the heavy hydrocarbons, and boil below 300°. They are also of opinion that Germany possesses a supply, sufficient for its own consumption, of crude petroleum, which can be worked up for illuminating oils.—C. A. K.

German Petroleum. Engler. Verhand. d. Ver. z. beförd. d. Gewerbfl. 1887, 637.

German petroleum oils consist of hydrocarbons of the paraffin series (C_nH_{2n+2}) which form by far the greater portion of the lower boiling fractions of the oil and of hydrocarbons, C_nH_{2n}, in part belonging to the ethylene series, and in part hydrides of benzene and its homologues; further, they contain varying quantities of the so-called "paraffin," a wax-like substance differing from that obtained by distillation, and of benzene and its homologues and naphthalene. Phenols and organic acids also occur, the latter including isomers of the oleïc acid series and fatty acids. The quantity of these acids varies, as does that of the asphalt-like substances found in the oil, both being oxidation products of the original constituents of the petroleum. All the oils contain a little sulphur, and some of them nitrogen. They have a very small percentage of low boiling constituents. Oelheimer and Wietzer crude petroleum gives nothing below 150°, and hardly anything below 200°, so that they are of very little value as illuminants; they are, however, specially valuable as lubricants. Pechelbronn and Tegernsee oils contain a greater proportion of illuminating constituents, the latter being almost equal to Pennsylvanian oil; in fact, by employing lamps with a sufficiently good draught, all the German petroleum oils serve as good illuminating oils. The German petroleum oils free from paraffin are admirably adapted for lubrication; the others must be freed from this ingredient before being applied for this purpose. The author suggests that the residues from the distillation might be profitably worked up as illuminating oils by distilling them under diminished pressure, according to Krey's or Riebeck's method.

—C. A. K.

Amyl-acetate Standard Lamp. F. v. Hefner. Jour. f. Gasbel. **30**, 489.

Amyl-acetate recommends itself for use as a standard illuminant, being an inexpensive commercial product which can be prepared without difficulty, and giving a light very similar in colour to that of gas and electric incandescent lamps. The following are the conditions for obtaining the unit of luminosity (one normal candle) with an amyl-acetate lamp. The lamp is fitted with a solid wick completely filling a round nickel silver wick-tube 8 mm. internal and 8·3 mm. external diameter, and standing out free 25 mm.; when the wick is saturated with amyl-acetate, it is lit, and after burning 10 minutes, a perfectly steady flame 40 mm. high above the upper edge of the wick-tube, and burning in pure air, gives an illumination equal to one standard candle.—D. A. L.

A New Occurrence of Petroleum and Sulphur. Chem. Zeit. **11**, 1620.

Near the small fortress of Wosdwischinski, in the northern Caucasus, two mountain rivers join, the greater and the lesser Argun. The natives state that the black sand of these rivers contains gold. The lesser Argun, about 5 versts (1 verst = 1,066 metres) before joining the greater Argun, winds between rocks, 2,000 metres high on each side, which rocks consist of slate. The mass of rock on the right bank of the river contains a seam of coal, which is

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† Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d.*	½*d.*
Above 8*d.*, and not exceeding 1*s.* 6*d.*	1*d.*
„ 1*s.* 6*d.*, „ „ 2*s.* 4*d.*	1½*d.*
„ 2*s.* 4*d.*, „ „ 3*s.* 4*d.*	2*d.*

so saturated with naphtha as to burn like a torch. Naphtha also springs in several places from the soil. The mountain contains a large cave, in which there are large deposits of sulphur. The sides of this cave are composed of a light grey clay, which contains from 48·5 per cent. to 70 per cent. S, and the ground is covered with a yellow layer of flowers of sulphur.—S. H.

PATENTS.

The Manufacture of Inflammable Gas from Oil and from Oil and Coal. F. A. McMinn, London. Eng. Pat. 1297, January 27, 1887. 8*d*.

The lid or mouthpiece of an ordinary gas retort is fitted with a socket, through which an injector nozzle can be thrust at will, and oil be forced into the hot retort at any moment without interfering with the distillation of the coal. A plug closes the hole in the socket when the nozzle is withdrawn.—A. R. D.

Improvements in the Manufacture of Gas, and in Apparatus therefor. J. Howard and E. T. Bousfield, Bedford. Eng. Pat. 3291, March 3, 1887. 8*d*.

A decomposing retort is set in a vertical or inclined position over a furnace, and is filled with asbestos, perforated discs, or other contact surfaces. Oil is introduced into the upper portion of the retort, and the vapours produced are fixed by passing through the lower and hotter portion towards the exit. A rise-and-fall pipe connects the lower end of the retort with the hydraulic main, and after this latter comes a condenser. If it be required to mix the gas with air or some other gas of different quality, this is effected by the use of two or more revolving bucket-drums of such relative proportions or so geared or driven that the two gases are delivered in the required ratio into one main. If steam is to be introduced into the decomposing retort, it is first superheated by being passed through a pipe suitably placed in the retort setting.—A. R. D.

An Improved continuous Process and Apparatus for the Purification of Coal Gas from Sulphur Compounds by which Sulphur is recovered. C. Estcourt, Manchester; H. Veevers, Dukinfield; and M. Schwab, Manchester. Eng. Pat. 15,007, amended Specification, November 18, 1886. 8*d*.

This specification, of which an abstract appeared in this Journal, Vol. VI., page 719, has been amended by the addition of the words "and apparatus" to the title, and by three other verbal alterations which do not impair the value of the original abstract. The claims remain unchanged.—A. R. D.

Improvements in Incombustible Wicks. A. E. Webb, H. R. Johnstone, and H. W. Paul, London. Eng. Pat. 3834, March 14, 1887. 6*d*.

A mixture of—

Pulverised wood	4	parts	by weight.
Pulverised glass	1	"	"
Pulverised fireclay	2	"	"
Cotton or cotton dust	1	"	"
Pulverised sea sand	6	"	"

is placed in open moulds and fired at a full red heat for from 15 to 30 minutes. It is preferable to damp the mixture before placing it in the moulds, taking care to dry at a moderate temperature before firing. The ignition causes a partial volatilisation of the carbonaceous ingredients, so that the mass is left porous, and oil or spirit will rise through the same as in the case of an ordinary wick.
—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Gas Generator for Rich Coals. By Feraris. Oest. Zeits. f. Berg-u-Hüttenw. **35**, 407.

The author has altered his gas generator for non-coking coal, so that it may be used equally for bituminous coals, a higher temperature being required for the former and a lower for the latter. The average consumption of coal is 2,000 kilograms per day. The author's experience confirms the correctness of Siemens' view, that the most advantageous and rational method of heating consists in unrestricted radiation.—V. H. V.

IV.—COLOURING MATTERS AND DYES.

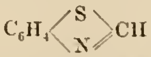
Constitution of Mixed Azo-compounds. V. Meyer. Ber. **21**, 11.

The author brings forward arguments in support of the view (which has already been put forward by Japp and Klingemann (Chem. Soc. Proc. Dec. 15th, 1887)) that all the mixed azo-compounds obtained by the action of diazo salts upon compounds of the acetoacetic ether type, are really ketone hydrazides.—A. G. G.

Action of Sulphur upon Dimethylaniline. R. Möhlau and C. W. Krohn. Ber. **21**, 59—67.

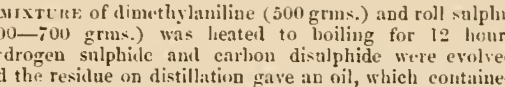
A mixture of dimethylaniline (500 grms.) and roll sulphur (600—700 grms.) was heated to boiling for 12 hours. Hydrogen sulphide and carbon disulphide were evolved, and the residue on distillation gave an oil, which contained, in addition to some aniline and methylaniline, a liquid C_7H_5NS and a solid $C_8H_7NS_2$.

The liquid compound was separated from the solid by solution in dilute HCl, which leaves the latter undissolved, and was obtained pure by means of its sparingly soluble ferrocyanide. It proved to be identical with Hofmann's methenylamidophenylmercaptan—

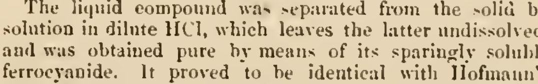


The solid compound $C_8H_7NS_2$, which remained insoluble on treating the product of the reaction with HCl, was crystallised from alcohol or acetic acid. It forms colourless prisms of melting-point 88°—89°, and boiling-point above 360° but below 440°. It is easily soluble in hot, sparingly in cold alcohol or acetic acid, sparingly in ether and carbon disulphide, insoluble in water. It has neither acid nor basic properties. By heating with sulphur it is converted into methenylamidophenylmercaptan with evolution of CS_2 and H_2S.

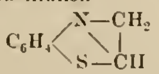
Hence it appears that the compound $C_8H_7NS_2$ is the primary product of the reaction of sulphur upon dimethylaniline, and its formation may be represented by the equation:—



This would then give rise to methenylamidophenylmercaptan by further action of sulphur:—



If the compound $C_8H_7NS_2$ is oxidised with nitric acid (15 pts. of acid of sp. gr. 1.4 and 10 pts. of water) it is converted into the nitrate of a base C_8H_7NS. This probably has the constitution



—A. G. G.

α-Hydroxynaphthylmethylketone (α-acetonaphthol). O. N. Witt. Ber. 21, 321—325.

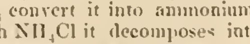
α-ACETONAPHTHOL $C_{10}H_6(OH).CO.CH_3$ is formed as a by-product in sulphonating α-naphthol in acetic acid solution. It can also be prepared by heating a mixture of equal parts of α-naphthol, acetic acid, and zinc chloride. After removing most of the acetic acid by distillation the residue is poured into hot water and extracted with aqueous caustic soda. The alkaline solution is precipitated with acid, and the crude acetonaphthol purified by repeated crystallisation from alcohol.

It crystallises from benzene in greenish six-sided plates, of melting-point 103 . It is easily soluble in hot, sparingly in cold, alcohol. It dissolves in alkalis with a yellow colour, and on cooling the alkaline salt crystallises out in lemon-yellow needles. By combination with diazo-compounds it yields azo colours, which are yellower in shade than the corresponding α-naphthol compounds. It does not form indophenols. Its alkaline solution gives a deep reddish-brown colour on warming with o-nitrobenzaldehyde. By the action of hydroxylamine it yields a ketoxim which crystallises from dilute alcohol in long yellowish white needles, of melting-point 168°—170°. On heating acetonaphthol with alcoholic ammonia at 180°—200 it is converted into the ketimide $C_{10}H_6(OH)C:(NH)''CH_3$, which forms long yellow needles, melting at 203°.—A. G. G.

Reactions of Thiocarbonyl Chloride ($CSCl_2$). H. Bergreen. Ber. 21, 337—352.

THIOCARBONYL chloride is decomposed by water, though not readily, with formation of CO_2, H_2S, and HCl. On exposure to light it changes in a few days into the crystalline polymeric compound, of melting-point 112·5°. Aqueous or ethereal NH_3 convert it into ammonium sulphocyanide. On heating with NH_4Cl it decomposes into CS_2 and CCl_4, the ammonium chloride apparently acting catalytically. It reacts with diphenylamine with formation of *tetraphenylthio-urea* $SC\{N(C_6H_5)_2\}_2$, of melting-point 196 . Thiocarbonyl chloride acts upon benzene in presence of Al_2Cl_6 with formation of the true *thiobenzophenone* $C_6H_5.CS.C_6H_5$. This appears to be a liquid, though it has not been isolated in a pure state. It reacts with hydroxylamine, yielding a body of melting-point 138°, identical with diphenyl-ketoxim, and with phenylhydrazine forming benzophenonephenylhydrazide of melting-point 137°.

The so-called "thiobenzophenone" of Engler differs from the foregoing in being a crystalline solid, of melting-point 146°.5 ; as it does not react either with hydroxylamine or with phenylhydrazine it is not the true thioketone, but is probably the duplo-compound



$$(C_6H_5)_2C<\genfrac{}{}{0pt}{}{S}{S}>C(C_6H_5)_2.$$

Thiocarbonyl chloride (1 mol.) reacts with 1 mol. of sodium ethylate with formation of ethyl chlorothioformate $Cl.CS.OC_2H_5$; with 2 mols. of sodium ethylate it yields diethylthiocarbonate $CS(OC_2H_5)_2$. With an alkaline solution of phenol it gives rise to diphenylthiocarbonate $CS(OC_6H_5)_2$, which separates from alcohol in glistening white crystals, melting at 97°. With sodium or cupric acetoacetic ether thiocarbonyl chloride produces the so-called "*Thiocarbonylacetacetic ether*" $(C_7H_8O_3S)_x$ of Norton and Oppenheim. This body forms yellowish needles which melt at 156°—162°.

In a similar manner $CSCl_2$ acts upon sodium malonic ether, sodium-benzoylacetic ether, and sodium-desoxybenzoin, yielding similarly constituted "thiocarbonyl" compounds, which have not the character of ketones since they do not react with phenylhydrazine or hydroxylamine.

"*Thiocarbonylmalonic ether*" $C_8H_{10}O_4S$ forms small needles of melting-point 177°—178°.

"*Thiocarbonylbenzoylacetic ether*" $C_{12}H_{10}O_3S$ crystallises in yellowish needles, which melt at 162°—164°.

"*Thiocarbonyldesoxybenzoin*" $C_{15}H_{10}OS$ forms small golden-yellow needles, of melting-point 286°; it dissolves in conc. sulphuric acid with a very intense bluish-violet colour.—A. G. G.

Preparation of Substantive Azo-colours for Cotton. H. Müller. Soc. Ind. Mulhouse. Chem. Zeit. 12, 181.

IF the hydrogen of the hydroxyl group in the azo-colours obtained by the action of phenols and naphthols on diazo-compounds be replaced by an alkyl radicle, and the resulting compound reduced by stannous chloride and hydrochloric acid, an assymetric diamidodiphenyl derivative results. The same change is produced by reducing in an alkaline solution to a hydrazo-compound and then treating with hydrochloric acid, *e.g.* :—

$$C_6H_5.N=N.C_6H_3(OC_2H_5)(CH_3)(1:4)+H_2=$$
$$NH_2.C_6H_4.C_6H_2(NH_2)(OC_2H_5)(CH_3).$$

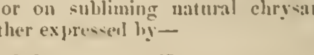
Similarly a whole series of diamidodiphenyl derivatives may be prepared, which, when converted into tetrazo-compounds, combine with amines, phenols, naphthols, or with their respective sulphonic acids, or with mixtures of one molecule of each, to produce yellow, red, or blue colours which dye cotton the corresponding colour substantively. Certain sulphonic acids of hydroxyazo-compounds are also similarly reduced to diamidodiphenyl derivatives. By treating diazobenzene chloride with paraphenol sulphonic acid, and then methylating or ethylating the hydroxyl group, a body of the following constitution results on reduction with stannous chloride and hydrochloric acid : $NH_2.C_6H_4-C_6H_2(NH_2)(OCH_3)(SO_3H)$. This possesses both basic and acid properties. The sulphate is slightly soluble in water, the hydrochloride more so. When diazotized and treated with the following substances the resulting colours are:—with naphthoic acid, red; with β-naphthylamine sulphonic acid (Brönner), yellowish red; with β-naphthol disulphonic acid R., red; with α-naphtol α-sulphonic acid, violet; with β-naphthol sulphonic acid (Schäffer), violet-red; with β-naphthol disulphonic acid R., violet-red; with salicylic acid, yellow. All these colours dye cotton without the use of a mordant.

—C. A. K.

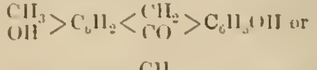
Leuco-Derivatives of some Anthraquinone Dyes. C. Liebermann. Ber. 21, 435.

LIKE anthraquinone itself, a number of dyes derived from it give, on reduction, various interesting leuco-derivatives. The following general rules may be observed :—The dyes are not all similarly acted upon by the same reducing agent; one and the same reducing agent acting on a certain dye may give rise to the formation of various successive reduction stages. The first reduction product, probably containing the group HO.C ⋮ C.OH, cannot generally be obtained in the pure state, owing to its being remarkably oxidisable, whereas the leuco-compound which corresponds to anthranole, and contains the group HO.C ⋮ CH, is most readily obtained pure. The hydroanthrone stage OC : CH_2 is also occasionally met with. If at the same time that the reduction takes place acetyl groups are introduced, it is sometimes possible to prepare, at least, the acetyl-derivates of the very unstable compounds containing the group HO.C.⋮ C.OH.

Reduction of Chrysophanic Acid : Chrysophanehydranthrone.—Chrysophanic acid (from rhubarb) is reduced by boiling with tin and glacial acetic acid and gradually adding fuming hydrochloric acid until the solution becomes almost colourless. The product crystallises from benzene in light yellow leaflets, and bears a striking resemblance to chrysarobin. It is with difficulty soluble in alkali, and the solution is coloured yellow with green fluorescence. On shaking with air the solution assumes the red colour of alkaline chrysophanic acid. Melting point 202-206 . Probably the body is identical with one previously obtained by the author on subliming natural chrysarobin. The formula is either expressed by—



$$\genfrac{}{}{0pt}{}{CH_3}{OH}>C_6H_2<\genfrac{}{}{0pt}{}{CH_2}{CO}>C_6H_3OH \text{ or}$$



Acetylchrysophanehydroanthrone, $C_{30}H_{20}O_7(C_2H_3O)_6$ melts at 230—231°. Its formula shows that it is not simply an acetyl-derivative of chrysophanehydranthrone; it may be regarded as an additive compound of the acetyl-derivative with one molecule of acetic anhydride. Chrysophanehydranthrone is also obtained on reducing chrysophanic acid with zinc powder and ammonia, until the solution, on shaking, is no longer coloured a deep yellow. The product of the reaction is mixed with the zinc powder, and may be separated by treating with HCl and extracting with alcohol.

The Reduction of Flavopurpurin is carried out in the same manner as that of chrysophanic acid with tin and glacial acetic acid. The resulting product is best dissolved in chloroform with addition of alcohol and precipitated with petroleum-ether. It dissolves in alkali with a yellowish-brown colour and greenish fluorescence, and this colour readily changes to that characteristic of alkaline flavopurpurin solutions. With mordants, colours similar to Persian berries are observed, but the colour is, of course, not fast to soap, for even this weak alkali causes oxidation. The acetyl-derivative was analysed, but the composition could not be ascertained with sufficient accuracy. The author, therefore, turned to the reduction of the anthranole and hydroanthrone of flavopurpurin. The reduction was accompanied by an introduction of an acetyl group. This was effected by boiling the colouring matters with acetic anhydride and sodium acetate in presence of zinc powder. (This method is worthy of note, as it allows of the separation of well crystallised acetyl leuco-derivatives of various colouring matters, whose leuco-derivatives are very readily oxidised.) Flavopurpurin, reduced in the above manner, gives two bodies, distinguished by their different solubility in glacial acetic acid. The less soluble crystallises in almost white leaflets, melting at 239—240°. Its colourless alcoholic solution shows a fine blue fluorescence. The more soluble body is identical with the one obtained by reduction of flavopurpurin with tin and glacial acetic acid.

The Reduction of Anthrapurpurin was effected, as in the previous case, with an accompanying introduction of acetyl groups. The body obtained is very similar to and probably isomeric with the acetyl-derivative of flavopurpurin. On reducing anthrapurpurin with zinc powder and ammonia, the anthranole or hydroanthrone of anthrapurpurin is formed.

Reduction of Anthragallol.—The method employed is that given under the reduction of chrysophanic acid. The product is finally crystallised from glacial acetic acid. It is the anthranole or hydroanthrone of anthragallol, and is soluble in alkalis with a yellowish-brown colour, which, in presence of air, changes immediately to violet. This colour is not due to the formation of anthragallol, but may be accounted for by assuming an intermediate product between the anthranole and the anthragallol, viz., the hydroxyanthranole.

Reduction of Anthraflavic Acid.—With zinc powder and ammonia small white needles of the anthranole or hydroanthrone of this acid are obtained. Tha triacetyl-derivative melts at 165°. Its alcoholic solution shows a blue fluorescence.

The Reduction of Rufigallic Acid, with accompanying introduction of acetyl, led to the corresponding anthranole containing seven acetyl groups.—A. R.

Therapeutic Substitutes for Chrysarobin. C. Liebermann. Ber. 21, 447.

The quinone group in chrysarobin is partially reduced. This accounts for its great affinity for oxygen, alkaline solutions absorbing the oxygen of the air as perfectly as those of pyrogallol. The author is of opinion that to this alone is due the therapeutic action of chrysarobin. It has been successfully employed in the treatment of various skin diseases, such as ptoriasis, eczema marginatum, &c. Now, as regards the great affinity for oxygen, various leuco-compounds of dyes derived from anthraquinone bear a great resemblance to chrysarobin, and the author has given his attention to this matter, in order to ascertain whether these bodies have a similar therapeutic value, particularly as they could—given a good method of reduction—be more readily and cheaply obtained on a large scale than chrysarobin.

The dyes are best reduced by boiling with ammonia and zinc powder, the latter separated from the ammoniacal solution which is allowed to flow at once into HCl. The precipitate thus formed, after washing and drying, is ready for use. The dyes which it is most profitable to employ are manifestly alizarin and the purpurins. The leuco-derivative of the former has already been described as desoxyalizarin, but the author proposes to replace this term as well as the name given to this stage of the reduction products of anthraquinone derivatives, viz., anthranoles, by the general term "Anthrarobin." Thus he denotes the reduction product of commercial alizarin B as anthrarobin, and the products from the purpurins as anthrarobin P or F. Commercial anthrarobin is a yellowish-white body which when dry is not oxidised by exposure to the air. It is insoluble in water and dilute acids, soluble in dilute alkalis and alkaline carbonates with a brownish-yellow colour, which by oxidation (in contact with air) changes through green to blue and finally to an alizarin-violet. Anthrarobin is also readily soluble in alcohol, but prolonged boiling with this solvent must be avoided.

Dr. Behrend (Berlin) has studied the therapeutic properties and finds that the same diseases are cured by anthrarobin as by chrysorobin, but the action of the former is not quite so intense. On the other hand, anthrarobin has the advantage of avoiding inflammation of the skin, and stains can be readily removed with soap and soda. The skin is coloured faintly brown by it.—A. R.

PATENTS.

Improvements in the Production of Alkylised Diamidobenzophenonamine Chlorides and Conversion of the same into Alkylised Diamidobenzophenones and Yellow Colouring Matters of the Class of the "Auramines." O. Imray, 28, Southampton Buildings. From the "Farbwerke vorm. Meister, Lucius, and Brüning," of Hoechst-on-the-Maine, Germany. Eng. Pat. 1691, February 3, 1887. 6*d*.

In this process chlorides of acid radicles are first produced by the action of phosgene on tertiary monamines:—

$$C_6H_5N(CH_3)_2 + COCl_2 = ClOC.C_6H_4.N(CH_3)_2 + HCl.$$

The acid chlorides are then combined with secondary monamines and thus give substituted benzamides. Thus with diphenylamine and the above acid chloride the product is dimethylamidobenzodiphenylamine:—

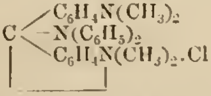
$$(C_6H_5)_2N.OC.C_6H_4.N(CH_3)_2.$$

By the action of haloid phosphorus compounds, phosgene, or thiophosgene, the benzamides are converted into haloid derivatives:—

$$(C_6H_5)_2N.CCl_2.C_6H_4N(CH_3)_2.$$

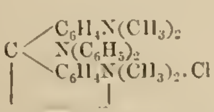
The latter compounds can be again condensed with tertiary aromatic monamines:—

$$(CH_3)_2NC_6H_5 + (C_6H_5)_2N.CCl_2.C_6H_4N(CH_3)_2 =$$



$$C\begin{cases} C_6H_4N(CH_3)_2 \\ N(C_6H_5)_2 \\ C_6H_4N(CH_3)_2.Cl \end{cases} + HCl.$$

The condensation products thus formed when heated with water are converted into tetramethyldiamidobenzophenone:—



$$C\begin{cases} C_6H_4N(CH_3)_2 \\ N(C_6H_5)_2 \\ C_6H_4N(CH_3)_2.Cl \end{cases} + H_2O =$$

$$(CH_3)_2NC_6H_4.CO.C_6H_4N(CH_3)_2 + HCl + (C_6H_5)_2NH.$$

Heated with ammonia the condensation product similarly yields "auramine" and diphenylamine. The following examples are given in illustration of the process :—(1.) Four parts of phosgene are mixed with 20 parts of dimethylaniline, kept cold, and six parts of diphenylamine are then added, the mixture being afterwards heated for 15—30 minutes to 90 C. The melt is then mixed with 15 parts of hydrochloric acid diluted with 200 parts of water and soda lye added till dimethylaniline just begins to separate. After filtration and washing, dimethylamidobenzodiphenylamine is left as a white crystalline powder, melting when pure at 178 C. In order to form the condensation product 10 parts of the last-named substance are heated with five parts of phosphorus oxychloride, and when cool 10 parts of dimethylaniline are added. After the first spontaneous rise of temperature the melt is allowed to cool, and is then heated on a water bath for two hours, when tetramethyldiamidobenzophenone-diphenylamine chloride is formed as a viscous mass with a slight metallic lustre, becoming nearly solid on cooling. In order to convert the condensation product into tetramethyldiamidobenzophenone, the melt is digested with about five times its volume of dilute hydrochloric acid at 70° C., until the intense red colour at first formed has changed into green, brown, or yellow. Decomposition takes place with the separation of diphenylamine, which is removed from the ketone base by washing with alcohol or by extracting with hydrochloric acid. In order to convert the condensation product into auramine, the melt is digested with 50 parts of 20 per cent. aqueous ammonia at about 50° C., and kept at this temperature for one or two hours. The purification of the auramine from the diphenylamine and excess of dimethylaniline is effected by the usual methods. (2.) In the second example 120 parts of dimethylaniline are mixed with 25 parts of phosgene and 23 parts of aniline afterwards added. The operation is conducted as before, the product being dimethylamidobenzanilide, a white crystalline substance melting when pure at 184°. The condensation product is formed from 10 parts of the dimethylamidobenzanilide, 18 of dimethylaniline, and 8½ of phosphorus oxychloride in the same manner as before. By acids the condensation product is decomposed into tetramethyldiamidobenzophenone and aniline; by alkalis the free base is thrown out, and this by treatment with acids also furnishes the ketone and aniline.—R. M.

Improved Manufacture of a Methylene Blue specially adapted for Printing on Textile Fabrics. Oliver Imray, Southampton Buildings. From the "Farbwerke vorm. Meister, Lucius, and Brüning," of Hoechst-on-Maine, Germany. Eng. Pat. 2985, February 25, 1887. 4*d.*

The object of the process described is to prepare a methylene blue free from zinc chloride, this latter salt having a prejudicial effect on the fibre of the goods on long steaming, and also leading to a partial destruction of the colouring matter itself. The commercial product, which is a zincochloride, is dissolved in water (ten parts) and the zinc precipitated from the hot solution by any suitable precipitant, such as an alkaline carbonate, sulphide, oxalate, phosphate, &c. On filtering off the zinc compound the solution deposits the colouring-matter on cooling in a crystalline form.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

An Artificial Textile Fibre resembling Silk. Compt. Rend. 1887, 898.

To prepare this substance a solution of 3 grms. of nitrocellulose in 100 or 150 cc. of a mixture of equal parts of alcohol and ether is mixed with 2·5 cc. of a filtered solution (1:10) of dry iron (or zinc) chloride in alcohol, then 1·5 cc. of an alcoholic solution of tannin is added. The whole is filtered in a closed apparatus, to prevent evaporation, and the liquid transferred to a raised reservoir fitted below with a glass or platinum conical nozzle having an opening of 0·1 to 0·2 mm., and the edge not thicker than 0·1 mm. This tube discharges into a receiver filled with a half per cent. aqueous solution of nitric acid. The liquid thread becomes consistent directly it enters the acidified water, and can be removed from it at once. It is dried quickly in a current of dry, but not warm, air, and then reeled. Prepared in this manner it is grey or black, but it can be made any colour by dissolving dyes in the ether-alcohol mixture. The new fibre is transparent, pliant, cylindrical or flat, and both in appearance and to the touch is silky. Its diameter is 12 to 20 u., and it required 20—25 kilos. per square millimetre to break it. (One sample took 30 kilos.) It burns without favouring an extension of fire. When heated in a closed vessel it decomposes slowly. It is not attacked either by cold or hot water or by moderately strong acids and alkalis. It is insoluble in alcohol and ether alone, but dissolves in a mixture of the two, and in acetic acid. Many threads may be united to form one thread, either by adhesion direct from the nozzle, or by a suitable arrangement in the acid vessel. This strengthens the threads and lessens the liability to accident in spinning.—D. A. L.

PATENTS.

Improvements in Treating Wool. D. Mason, Glasgow, From A. Schlamm and F. à Brassard, both of Aachen, Germany. Eng. Pat. 15,364, November 10, 1887. 4*d.*

The inventors dispense with the preliminary treatment with an alkali before carbonising, and they use a much weaker acid than is usual.—E. J. B.

Improvements in the Treatment of Exogenous Fibrous Plants, Flax, Jute, Rhea, and the like. J. Longmore and W. L. Watson, London. Eng. Pat. 3715, March 11, 1887.

The process consists in treating the green stems with a hot solution of caustic soda.

Or the dried stems may be dipped into concentrated sulphuric acid for a few minutes.—E. J. B.

Improvements in and in Apparatus for Cleansing or Scouring Wool. C. Robeson, Philadelphia, U.S.A. Eng. Pat. 15,178, November 8, 1887. 8*d.*

The object of this patent is to cleanse or scour wool without the use of alkaline or other chemical substances, and to leave the fibre thus treated in such a condition that it is ready to be spun. To effect this, the fleece is first moistened with water, next subjected, in a heated chamber, to a temperature of from 110° to 150° F., for the purpose of softening or "starting" the grease and wax, and finally, these substances are removed by pressure between squeezing rollers. The wool, after rinsing and drying, is in a condition to be carded or spun, without requiring to be oiled, since, by regulating the pressure of the squeezing, sufficient oil may be left in the wool to dispense with the usual oiling. A form of apparatus suitable for carrying out these operations is described in the specification.—W. E. K.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Fixing Tannin by Means of the Double Salt of Antimony Fluoride and Ammonium Sulphate. E. Dollfus. Soc. Ind. Mulhouse. Chem. Zeit. **12**, 184.

The double salt of antimony fluoride and ammonium sulphate, $SbF_3.(NH_4)_2SO_4$ (this Journal 1887, 728) fixes tannin completely, but it has a prejudicial action on certain yellow colours obtained by means of chromium oxide and tin. This action takes place especially above 50° C., and its extent depends upon the duration of the steeping in the bath.
—C. A. K.

A New Antimony Mordant. A. Frey. Soc. Ind. Mulhouse. Chem. Zeit. 12, 55.

This salt has the formula $SbF_3(NH_4)_2SO_4$, and when mixed with half its weight of soda crystals, is a fixing agent of better quality than tartar emetic, and is much cheaper.
—J. W. L.

Bleaching of Wool by Hydrogen Peroxide. P. Ebell. Chem. Zeit. 12, 2.

Although raw wool can be well bleached by hydrogen peroxide, it is not economical to do so, as wool is a crude article, and the cost of the peroxide in addition to the loss of weight of the wool would make the operation a very expensive one. The bleaching of wool should rather commence at a stage when the wool has been worked up to fabrics which are not sold by weight, and have a high value in the market. In order to get at the cost of this bleaching operation, the author made some experiments with some fine woollen cloth of a dirty yellow colour and some lace of a delicate pattern. The former measured 20 by 22 cm. = 0·44 sq. m., and weighed 62 grms.; whereas the latter, 10 by 14 cm. = 0·14 sq. m., and weighed 24 grms. Both were bleached by the following three methods: 1. They were steeped in 3 per cent. hydrogen peroxide, well saturated with the liquor, wrung out, and allowed to dry at 12° to 17° C. 2. They were steeped in an ammoniacal bath of peroxide at 15° to 17° C. until bleached. 3. They were steeped in an ammoniacal bath of peroxide at 30° C. until bleached. The bleaching liquor in the latter two cases consisted of 1,000 parts of 3 per cent. hydrogen peroxide and 20 parts of ammonia of 0·910 sp. gr. The first method required the treatment to be repeated before the stuff was bleached.

1 sq. m. of woollen cloth consumed 446 grms H_2O_2.
1 sq. m. of woollen lace consumed 956 grms. H_2O_2.

For the second and third method (bleaching in the ammoniacal bath), the loss in peroxide amounted to:

1 sq. m. of woollen cloth consumed 455 grms. H_2O_2.
1 sq. m. of woollen lace consumed 1,070 grms. H_2O_2.

At ordinary temperatures 27 hours are required for bleaching; at 30° C. the process is finished in 8 to 10 hours. A temperature of 17° to 20° C. is probably the most favourable temperature to use on the large scale. The loss of actual hydrogen peroxide is about equal by all the three methods. Loose bulky goods consume more of the bleaching agent than dense fabrics. As may be supposed, the bleaching vat gets gradually poorer in peroxide, and on the large scale this fact may be made use of by employing weak solutions for a preparatory bleaching, and passing the goods systematically from weak to strong solutions. In this manner the expenses for peroxide may probably be lessened by one-third.—S. H.

PATENTS.

Producing Basic Sulphocyanides of Aluminium, Iron, and Chromium for Dyeing and Printing Purposes. J. Hauff, Stuttgart, Germany. Eng. Pat. 5109, April 6, 1887. 4*d.*

This invention consists in warming neutral aluminium sulphocyanide or sulphocyanic acid with freshly-precipitated aluminium hydrate, precipated at a temperature not above 60° C. Aluminium hydrate readily dissolves in a neutral aluminium sulphocyanide solution, and takes up as much as eight times the quantity of aluminium already contained therein. In this manner easily-soluble basic aluminium sulphocyanide compounds are formed which do not decompose so readily as the neutral salts when exposed to heat. The neutral solution evaporated to dryness on the water bath, quickly decomposes, whereas "the four times basic salt" can be boiled and evaporated to dryness without decomposing, and will be easily soluble again in water. These basic aluminium salts form an excellent mordant for dyeing and printing. In the same manner basic iron and chromium sulphocyanide salts can be produced.—S. H.

Improvements in Dyeing Yarns and Fabrics Black, Blue, and other Colours. R. Chadwick and J. W. C. Chadwick, Kidderminster. Eng. Pat. 4547, March 26, 1887. 6*d.*

The fabric is dyed in a single bath consisting of a solution of the dyestuff described in Eng. Pat. 3280, 1887, acidified by a mineral acid. For modified shades, other substances, such as are well known to dyers for obtaining such modifications in the case of logwood dyes, are also added to the dye bath.—W. E. K.

Improvements in the Process and Apparatus for the Bleaching of Vegetable and Animal Matter, and Washing and Scouring of Wool. A. J. Boult, London. From H. K. de Pawlowski, Paris, France. Eng. Pat. 2354, February 15, 1887. 8*d.*

The object of this invention is to avoid all manipulations in the decoloration or bleaching of wool, flax, hemp, jute, esparto grass, &c., and in the washing and scouring of wool; the usual agitation of these materials in the decolorising or bleaching liquors being replaced by an automatic circulation of the liquors themselves.

The apparatus consists of a series of open or closed vats on one level, and connected by pipes. The two end vessels of the series are also connected with two hermetically closed receptacles placed on a higher level than the vats themselves. In the vats, the material to be treated is placed either on false perforated bottoms or suspended on hooks or bars, and the vats are filled with the liquors to the action of which the material is to be subjected. From the top of each of the closed upper receptacles a pipe passes connecting it with an "hydraulic balance." This latter is connected with a vacuum chamber, and is a form of apparatus so arranged as automatically to produce a vacuum alternately in the two receptacles. When the one receptacle in communication with the vacuum chamber is filled with the liquor from the end vat with which it is in connexion, the hydraulic balance comes into operation, and the vacuum acts on the other receptacle whilst the former one becomes emptied by the return of the liquor to the vat. In this way an alternate circulation of the liquors in the vats is brought about through the entire series, the quantity displaced being dependent on the size of the receptacles. By a modification of the apparatus a circulation of gaseous decolorising or bleaching agents may be effected.—W. E. K.

Improvements in Dyeing. J. Grunbut, South Shields. Eng. Pat. 15,432, November 11, 1887. 6*d.*

An Improved Process and Means of Dyeing Cotton and other Fibrous Substances in Aniline Black. J. Grunbut, South Shields. Eng. Pat. 17,106, December 12, 1887. 4*d.*

For the purpose of dyeing fibres aniline black, the first of these specifications describes a preliminary mordanting with Congo red, azurine blue, chrysamine, Hessian purple, or other analogous substantive cotton colour. The fibre is dyed in the usual alkaline solution, as is well known for these colours, and subsequently is dyed in aniline black by means of a mixture of aniline oil, bichromate of potash, and sulphuric or hydrochloric acid, such as is usually employed in aniline black dyeing.

The second specification extends the process by the addition of a second dyeing in one of the substantive cotton colours after the yarn has been subjected to the aniline black dyeing process.—W. E. K.

VII.—ACIDS, ALKALIS, AND SALTS.

Manufacture of Barium Hydrate. Lucien. Bull. Ass. Chim. 6, 444.

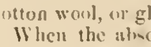
To prepare barium hydrate from the carbonate the latter is mixed with 50 per cent. of dry coal, containing a small percentage of ash and heated in puddle furnaces in charges of 600 kg. The decomposition requires four to five hours, and a temperature of about 1,100° C., and the difficulty of the operation arises from the fact that a high temperature is difficult to maintain, owing to the substance being a bad conductor; it is necessary, therefore, to have a good air supply and yet preserve a reducing atmosphere. Successfully effected, a yield of 85 to 90 per cent. of the oxide contained in the carbonate taken is obtained. Lately Radot's furnace has been used, 1,200 kg. of carbonate, containing 40 per cent. of moisture, being heated by hydrocarbons from coal tar. In this case the barium hydrate collects on the bed of the furnace, and is run off in the liquid state and allowed to solidify. The reduction is incomplete, and the product obtained contains only 30 per cent. of the hydrate; there is a great deal of carbonate which can be separated and worked up again, and also silicates, &c. The hydrate melt is ground up, exhausted with water by decantation in vessels provided with agitators, and the resulting liquid of 15° B. concentrated to 40° B. to obtain crystals for immediate use, and to 68° B. if a solid mass for keeping be required. Great care is necessary throughout the operation, and the exhaustion with water must be done quickly and in a fairly dilute solution in order to prevent crystallisation. The preparation of barium hydrate from the sulphate is easier, but there is also a considerable loss. The dried sulphate is mixed with 35 per cent. of coal, and heated for 4—5 hours to dull redness in a muffle, the charge being 915 kg. The melt, protected from moisture which might bring about decomposition with evolution of sulphuretted hydrogen, is subsequently exhausted with water, and the resulting liquid concentrated to 40° B. For further concentration it must be desulphurised, which is best effected by the addition of zinc oxide in slight excess, the zinc sulphide being recovered, burned to oxide, and the sulphur dioxide evolved absorbed.—C. A. K.

Action of Chlorine on Gold; Preparation of the Compound Au_2Cl_4. J. Thomsen. J. Prakt. Chem. **37**, 105—108.

The compound Au_2Cl_4 was prepared by the author 12 years ago (J. Prakt. Chem. **13**, 337). The experiments have been repeated. A rapid current of chlorine is passed through a tube containing a weighed quantity of gold, the latter being heated to start the reaction and then placed in a beaker packed with cotton wool, or glass wool, to prevent its cooling too much. When the absorption of chlorine is complete (50—70 gr. of gold may be chlorinated in half an hour) the excess of chlorine is displaced and the tube re-weighed. In three experiments the proportion of gold to the chlorine absorbed was 1:2.09, 1:2.12, and 1:2.05, whence the compound formed has the composition Au_2Cl_4. The excess of chlorine is due to a little $AuCl_3$ being formed. Krüss and Schmidt (Ber. **20**, 207) have obtained very different results in repeating Thomsen's experiment. These the author traces to their employing too high a temperature, whereby Au_2Cl_4 would yield metallic gold, and Au_2Cl_2, and also to their not taking sufficient precaution to check the cooling of tube during the chlorination.
—C. A. K.

Notes on the Theory of the Sulphuric Acid Process. G. Lunge. Ber. **21**, 67—87.

The author criticises Raschig's latest theory (Annalen **271**, 242) on the reactions going on in the vitriol chambers, which is based on the action of a new compound, the dihydroxyamine sulphuric acid:—



$$SO_2<^{OH}_{N(OH)_2}$$

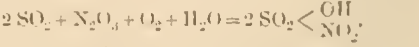
of which Raschig himself says, "of the existence of which nothing was previously known, and which will scarcely ever be prepared in a free state." This compound is said to be formed whenever sulphurous and nitrous acid meet, and is at once split up with an excess of nitrous acid into nitric oxide, sulphuric acid, and water. The following equations represent Raschig's theory:—

(*a.*) $N(OH)_3 + H.SO_2.OH = (OH)_2.N.SO_2.OH + H_2O$.

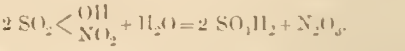
(*b.*) $(OH)_2N.SO_2.OH + N(OH)_3 = 2NO + SO_4H_2 + 2H_2O$.

(c.) $2NO + O + 3H_2O = 2N(OH)_3$.

The evidence brought forward in favour of this startling theory has nothing at all to do with the conditions actually prevailing in the vitriol chambers. Dilute solutions of nitrites and sulphates were made to act upon each other at a freezing temperature, whereby a basic salt of the dihydroxyaminesulphuric acid was obtained. At a higher temperature and with concentrated solutions a copious evolution of nitrous oxide took place. These are the arguments for the new theory. But Lunge also shows in great detail that, apart from all other considerations, Raschig's three equations are altogether contrary to the known reactions of the gases and vapours existing in the vitriol chambers. It is also against all common sense that the principal reaction should be performed by a compound of avowedly problematic existence, while those bodies actually occurring in the atmosphere of the chambers in enormous quantities should only play a secondary part. In previously published investigations (this Journal **1884**, 258 and 633—639) Lunge explained the chamber process by the following equations:—

(1.)


$$2SO_2 + N_2O_3 + O_2 + H_2O = 2SO_2<^{OH}_{NO_2}.$$

(2.)


$$2SO_2<^{OH}_{NO_2} + H_2O = 2SO_4H_2 + N_2O_3.$$

He is still of opinion that nitrosulphuric acid is formed as an intermediary compound, while the nitrous acid acts as oxygen-carrier. And whereas these two equations express the principal reactions in the vitriol chambers, our present knowledge of the subject can now explain observations, apparently at variance with this theory. Lunge and Naef have previously shown, that in a normally working chamber system, the composition of the nitrous gases does not admit of the existence of nitrogen peroxide. In the first chamber nitrous acid is found along with some nitric oxide, in the last chamber nitrous acid only can be detected. It may be contended that although the composition of the gases corresponds empirically to nitrous acid, they may be a mixture of nitrogen peroxide and nitric oxide. But this supposition must be dismissed, because it is not likely that the nitric oxide could escape oxidation in the presence of a very large excess of oxygen and at a high temperature. Nor is it probable that one molecule of nitric oxide would be accompanied all through the chambers by exactly one molecule of nitrogen peroxide. Again, sulphuric acid forms with nitrogen peroxide a mixture of nitrosulphuric acid and nitric acid, and still more nitric acid would be produced from nitric oxide, steam, and oxygen. All this nitric acid would dissolve in the chamber acid, whereas, as a matter of fact, scarcely any nitric acid is found in the chamber acid of a first chamber well working. Both nitric oxide and sulphurous acid act very slowly on nitric acid dissolved in sulphuric acid, and a reduction of the nitric acid is therefore very unlikely. Nevertheless, we must not lose sight of the fact, that reactions may be different in different parts of a chamber system owing to local circumstances, such as a change of temperature, the presence of very large quantities of one compound, and so forth. If nitrous acid is admitted as the nitrous compound essential for the sulphuric acid process, Berzelius and Weber's theory, shown by the equations 3 and 4, should equally be admissible:—

(3.) $SO_2 + N_2O_3 + H_2O = SO_2(OH)_2 + 2NO$.

(4.) $2NO + O = N_2O_3$.

But this is not so. For everywhere, where the formation of sulphuric acid took place, a corresponding quantity of nitric oxide should be found, whereas the analysis of the greater part of a chamber system shows the presence of nitrous acid only. Besides, nitric oxide and oxygen do not form nitrous acid in an atmosphere of sulphuric acid mist, but nitrogen peroxide or nitric acid, according as water is absent or present. This fact upsets both equations or every theory which is based on the reduction of the nitrous gases to nitric oxide. However, the author's two equations do not explain the whole process. As previously mentioned, Lunge and Naef found nitric oxide in the first chamber of their system, and the author's theory must be modified for the first chamber. Here sulphurous acid, nitrous fumes, oxygen, and steam meet in the most concentrated state, and it is quite conceivable that sulphurous acid is directly oxidised by the nitrous gases, these being reduced to nitric oxide, thus:—

$$(5.)\ SO_2 + NO_2 + H_2O = SO_4H_2 + NO.$$

$$(6.)\ SO_2 + N_2O_3 + H_2O = SO_4H_2 + 2\ NO.$$

The nitric oxide is then immediately oxidised by oxygen, steam, and sulphurous acid to nitrosulphuric acid, thus:—

$$(7.)\ 2\ SO_2 + 2\ NO + 3\ O + H_2O = 2\ SO_2\ 2\ SO_2(OH)(NO_2).$$

Even if by a local action any nitric acid is formed, the latter is at the prevailing high temperature in the state of a vapour, that is to say, in the state most favourable for an immediate reduction by sulphurous acid, thus:—

$$(8.)\ SO_2 + NO_3H = SO_2\ (OH)(NO_2).$$

Under no circumstances can nitrogen peroxide be formed here, as the formation of nitrogen peroxide from nitric oxide and oxygen depends on the absolute exclusion of steam. The nitrosulphuric acid is then acted upon by sulphurous acid, thus:—

$$(9.)\ 2\ SO_2\ (OH)(NO_2) + SO_2 + 2\ H_2O = 3\ SO_4H_2 + NO.$$

Now, this is the very reaction which accounts for the occurrence of nitric oxide in the first chamber. It is the same reaction which goes on in the Glover tower, where the very same conditions are prevalent, viz., excess of sulphurous acid, steam, and a high temperature. The theory of the sulphuric acid process can be now summed up as follows: Equation 1. The intermediary formation of nitrosulphuric acid. Equation 2. The splitting up of nitrosulphuric acid into sulphuric acid and nitrous acid. Besides some secondary reactions take place in the first chamber of a system. Equation 9. A portion of the nitrosulphuric acid is denitrated by sulphurous acid. Equation 7. The nitric oxide produced by this reaction with oxygen, sulphurous acid, and steam forms nitrosulphuric acid. Equation 8. Sulphuric acid reduces any nitric acid present—either directly introduced into the chambers or formed there—to nitrosulphuric acid. Equations 5 and 6. A portion of the sulphurous acid is directly oxidised by the nitrous gases.

As regards the loss of nitre in the manufacture of sulphuric acid, Lunge divides it in a "chemical" and a "mechanical" loss. The latter can only be caused by insufficient absorption in the Gay-Lussac tower and incomplete denitration of the oil of vitriol leaving the process. The "chemical" loss is less easily defined. It is true, nitric oxide can be reduced to nitrous oxide and even to nitrogen, but the conditions of the chamber process are not favourable to this reduction, which is only caused by a large excess of steam. The formation of nitrogen peroxide in the last chamber of a system may lead to far more serious losses. This formation takes place, if too large a supply of nitrous gases is admitted to the chambers; the process of sulphuric acid making is then completely finished before the gases leave the last chamber. No sulphuric acid mist fills up the atmosphere of the chamber, nor are there any appreciable quantities of sulphurous acid present. The nitrous acid not being able to form, nitrosulphuric acid is oxidised by oxygen to nitrogen peroxide. Part of it along with the excess of other nitrous gases enters the Gay-Lussac tower, which is already unable to retain all the excess, and some nitrous gases must inevitably escape unabsorbed. Again, if the supply of nitrous gases is insufficient, the last chamber contains more than its fair share of sulphurous acid, which by denitrating the nitrosulphuric acid, causes the formation of nitric oxide. The abundance of steam in the last chamber reduces one portion of the nitric oxide to nitrous oxide, while another portion of nitric oxide simply leaves the Gay-Lussac tower unaltered and unabsorbed. The sulphurous acid entering the Gay-Lussac tower probably also denitrates the nitrous vitriol there formed, causing a further loss of nitrous gases. It may be argued, that (according to equation 7) nitric oxide, sulphurous acid, oxygen, and steam act on each other, and therefore nitric oxide cannot escape unaltered. But this need not be the case, if the circumstances are unfavourable. It is quite conceivable that these gases may exist side by side without acting on each other, if the temperature drops below that necessary for the reaction, and if comparatively small quantities of these gases are mixed up with very large quantities of nitrogen. In conclusion, Lunge does not think that the practice of this branch of chemical industry can now learn much from the theory. The utilisation of sulphur has been perfected to a very high degree, and the consumption of nitre brought down to a very low proportion, and an improvement therefore seems only likely in the apparatus. The process as now carried out requires a long time, and accordingly an enormous space. If by practicable means a thorough mixture of the gases were brought about, the reaction would proceed more speedily. Oxygen in place of air would have the same effect, and the operation might then be performed under pressure. It is also worth while to draw attention to the remarkable properties of electrical discharges in condensing vapours to liquids.—S. H.

Iodine Trichloride. B. Fischer. Pharm. Zeit. **32**, 694.

Iodine trichloride has lately gained importance for medicinal purposes. It is best prepared by passing chlorine into a three-necked Woulfs' bottle, in one neck of which a small retort is inserted, from which iodine is sublimed into the bottle. Thus produced, it forms orange crystals, easily soluble in water. A solution of iodine trichloride is quickly prepared by suspending 5·5 grms. of iodine in 22 grms. of water, and passing chlorine into the water, which must be kept well cooled, until no more chlorine is absorbed. The solution then contains 10 grms. of iodine trichloride. For testing it as to purity, an aqueous solution of the trichloride (1:20) is shaken with chloroform, which latter must not be coloured violet at once, but the colouration must appear immediately on the addition of a few drops of stannous chloride. The solution or the crystals must be kept protected from light, and in bottles, the glass-stoppers of which are covered with paraffin.—S. H.

PATENTS.

Improvements in Apparatus for the Manufacture of Monohydrated Sulphuric Acid. J. Brock, Widnes. Eng. Pat. 4430, March 24, 1887. 8*d.*

This invention relates to an improved apparatus for carrying out Lunge's process (Eng. Pat. 96, 1883) of obtaining monohydrated sulphuric acid (H_2SO_4) from rectified oil of vitriol by means of artificial cold. The concentrated acid, after having been cooled down in a refrigerator attached to the platinum or glass retort, is conveyed by air pressure to a store tank placed at a higher level than the "charging box" of the freezing machine. Instead of running the acid directly from the store tank to the charging box, it is allowed to descend to the ground level, passed there through a worm, cooled by cold water, and raised again in another pipe to a little above the top of the charging box, whence it descends by a short pipe into the top of the charging box. A tap is inserted in some suitable place, in order to shut off the communication between the store tank and the charging box during the time a charge is being blown out of the latter. The charging box is made of iron, and of such a shape that it stretches right across the tank containing the freezing cells. It is divided into the same number of compartments as that of the freezing cells, and the size of each compartment is such that it fills one of the freezing cells to a suitable height. The latter receive their charge by syphons, which are made to play simultaneously by air pressing on the surface of the acid. All the freezing cells belonging to a particular row are thus filled at the same time. They are then moved by means of a crane into the freezing tank, which contains a number of rows of freezing cells. Each time a fresh row of cells is ready to be put into the freezing tank, the row of cells which has been longest in the freezing tank is lifted out, while all the other rows are moved one step forward, so as to make room for the fresh row of cells. The cooled cells are dipped for a few seconds in warm water, whereby the frozen mass is detached from the sides, and the cells are then tilted into a shoot. Here an archimedian screw crushes up the frozen mass and conveys it to a centrifugal machine, which rapidly separates the white crystallised mass of monohydrated sulphuric acid from the mother liquor, consisting of less concentrated acid. The latter is either sold in that state, or concentrated to full strength in the usual manner. The solid monohydrate is scooped into an enamelled iron pan, wherein it is melted, and, by means of a tap, run into carboys for storing or carrying the product.—S. H.

Improvements in the Manufacture of Nitric Acid. J. Taylor, Cheltenham. Eng. Pat. 4201, March 21, 1887. 6*d.*

Ferrous sulphate in suitable proportion is mixed with sodium or potassium nitrate, and the mixture heated in a closed vessel. Nitrous fumes are evolved and passed into water, in which they become converted into nitric acid. The residue, consisting of ferric oxide and sodium or potassium sulphate, is separated by lixiviation, the former being made use of as a pigment, while the sulphate solution is concentrated and allowed to crystallise.—S. H.

Improvements in the Manufacture of Pyrosulphates. H. Baum, Mannheim, Germany. Eng. Pat. 4241, March 21, 1887. 6*d.*

This invention is based on the fact that the bisulphates of the alkalis and of ammonia, or molecular mixtures of neutral sulphates with sulphuric acid, heated in a vacuum, become converted at a comparatively low temperature (260° to 320° C.) into pyrosulphates, liberating water, without the formation of the slightest trace of sulphur trioxide. The operation is performed in a cast-iron retort, provided with a stirring arrangement and connected with an air-pump. The retort, while being exhausted, is heated to 260° C., and the temperature is gradually raised to 320° C. The water passes off at 260—280° C. It is desirable to introduce between the retort and the air-pump a condenser and receiver, connected by a glass tube, so that the point of completion of the reaction can be readily ascertained, the fusion being complete as soon as water is no longer detected in the glass tube. Pyrosulphates of the other alkalis are produced in the same manner.—S. H.

Improvements in treating Alkali Waste to obtain Sulphuretted Hydrogen, and in Apparatus employed therein. A. M. and J. F. Chance, Oldbury. Eng. Pat. 8666, June 16, 1887. 8*d.*

A mixture of alkali waste and water as a thin cream is introduced into a series of vessels connected by pipes and fitted with inlet and outlet ways. Gases from a closed limekiln, which consist almost entirely of carbon dioxide and nitrogen, are then pumped through the contents of the first vessel. The carbonic acid is absorbed by the free lime and by the calcium sulphide with the production of sulphuretted hydrogen. This gas is driven forward, and meeting with fresh quantities of free lime and calcium sulphide is by them absorbed with the formation of calcium sulphydrate. The gases issuing at first, therefore, contain neither carbonic acid nor sulphuretted hydrogen, and are allowed to escape into the atmosphere. After some time the issuing gases contain sulphuretted hydrogen, when the outlet from the last vessel is closed, and that from some one of the intermediate vessels is opened. The carbonic acid is now acting on the sulphydrate formed, and for each equivalent of carbonic acid two equivalents of sulphuretted hydrogen are evolved, thus: $Ca(SH)_2 + CO_2 + H_2O = CaCO_3 + 2\ H_2S$. This gas is collected in a gas-holder and applied in any convenient manner. When the alkali waste in the first vessel is completely decomposed, it is disconnected, and another vessel takes its place as the first of the series, thus making the process a continuous one. The apparatus employed consists of a number of vertical cylinders (Figs. 1 and 2) each being furnished with a perforated bottom, *b*; *f* is the carbonic acid gas supply main with the descending pipes *g*, leading from the main to the cylinders beneath the perforated bottoms; *h* is the connecting main; *i* is the return main; and *s* the exit main leading to the gas-holder. It will be understood that there must be at the very least three cylinders for one cycle of operations, viz.:—a last vessel from which the first gases are delivered into the atmosphere; an intermediate vessel from which the strong gases are taken; and a first vessel, the contents of which are carbonated while the two kinds of gases are passing away.—S. H.

A Process for the Production of Hydroxylamine. Fritz Raschig, Berlin. Eng. Pat. 3028, February 26, 1887. 6*d.*

In this process the hydroxylamine-disulphonates of potassium or sodium are first prepared by adding to a cold saturated solution of the nitrite the amount of acid sulphite indicated by the equation:—

$$NaNO_2 + 2\ HNaSO_3 = HO.N(NaSO_3)_2 + NaOH.$$

To the mixed solutions cooled down to 0° C. there is then added sufficient potassium chloride or acetate to convert the sodium disulphonate into the potassium salt which separates out in crystals having the formula:—

$$HO.N(SO_3K)_2 + 2\ H_2O.$$

Several modifications in this first step are described in the specification, amongst them being the formation of the disulphonates by the action of sulphur dioxide on a mixture of the nitrite with the hydroxide or carbonate:—

$$2\ KNO_2 + K_2CO_3 + 4\ SO_2 + H_2O = 2\ HO.N(SO_3K)_2 + CO_2.$$
$$KNO_2 + KOH + 2\ SO_2 = HO.N(SO_3K)_2.$$

The next step in the process is the decomposition of the disulphonates, which is effected by boiling with water for some hours under ordinary pressure or more rapidly by heating in a closed vessel to about 130° C.

$$2\ HO.N(SO_3K)_2 + 4\ H_2O =$$
$$(NH_3.OH)_2SO_4 + 2\ K_2SO_4 + H_2SO_4.$$

The following is the process preferred:—About 10 parts of the crystalline potassium disulphonate are added in small portions to about two parts of boiling water. After boiling for two hours the solution is evaporated to the crystallising point and then allowed to cool, when potassium sulphate crystallises out. The mother liquor on further evaporation yields a second crop of crystals, consisting chiefly of normal and acid potassium sulphate. By continuing the fractional crystallisation the crystals at last consist of almost pure hydroxylamine sulphate, the last portions being precipitated from the mother liquor mixed with potassium sulphate by means of alcohol. The last portions are then again purified by fractional crystallisation from water as before.—R. M.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Colouring Porcelain in a High Temperature Furnace. Chem. Zeit. **12**, 184.

The presence of small quantities of iron in kaolin used for the manufacture of porcelain has led to the idea that this impurity is the cause of the yellowish colour which sometimes results, at least in cases where an oxidising flame is used; with a reducing flame the porcelain would have a blue-green tinge due to the ferrous salts. This is not so; at the high temperatures employed in the furnace neither ferrous nor ferric oxide result; the magnetic oxide of iron (Fe_3O_4) is formed, and this colours the porcelain from grey to black according to the quantity present. The yellow colour of porcelain is not due to iron at all, but to the reduction of alkaline sulphates to sulphides by a smoky flame. In the manufacture of glass, iron behaves similarly, forming the magnetic oxide of iron; by adding a sufficient amount of ferric oxide to the melted glass and allowing it to cool slowly, crystals of the magnetic oxide separate in the mass.—C. A. K.

FIG I

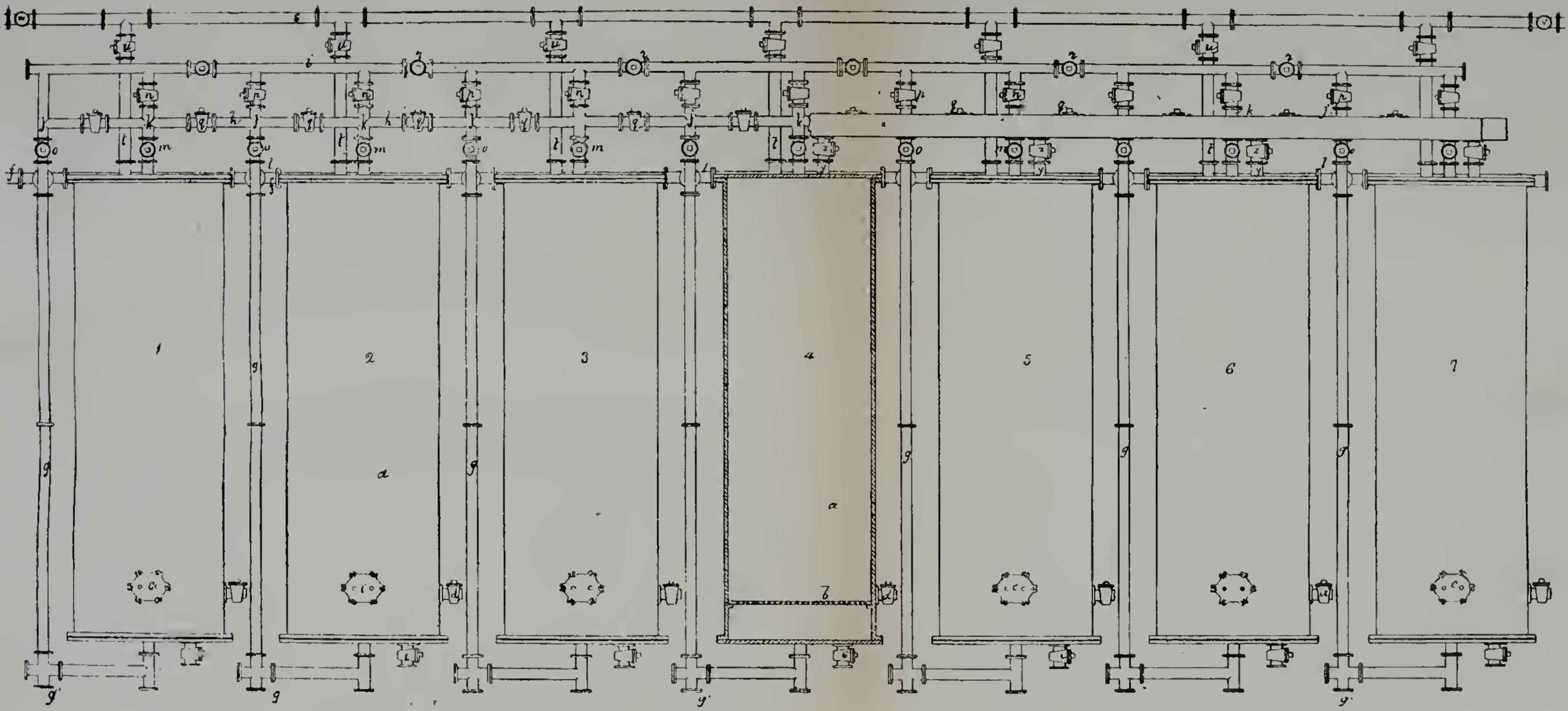
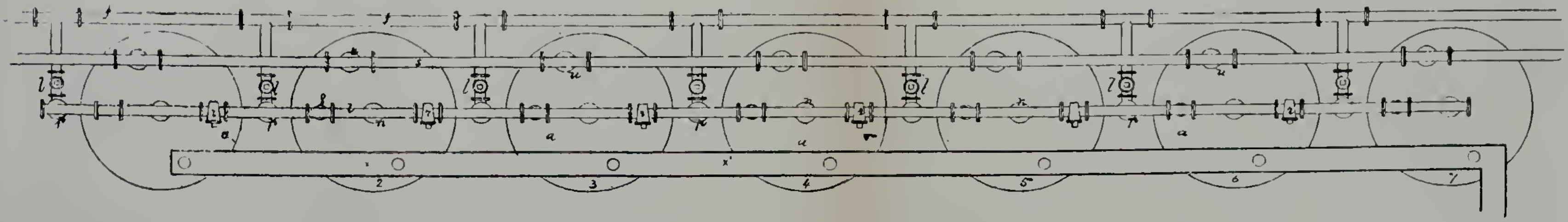


FIG 2.



IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENT.

Improvements in the Manufacture of what is known as "Iron Cement." G. G. M. Hardingham, London. From P. J. Grouvelle, Paris. Eng. Pat. 315, January 8, 1887. 6*d*.

For a cement which may be required to withstand high temperatures and act as a good conductor of heat, while making a sound joint; a better conductor of heat is substituted for a portion of the cast-iron filings in the usual mixtures. A suitable mixture might contain 62 parts of cast iron filings, 32 parts of gun-metal or copper filings, and six parts of a 4 per cent. solution of glacial acetic acid with sufficient water to render moist.—W. G. M.

X.—METALLURGY, MINING, Etc.

Manganese in its Application to Metallurgy, and some Novel Properties of Iron and Manganese. By Robert Abbott Hadfield. Proc. Inst. Civil Eng., Session 1887—1888, No. 8.

Hadfield's Steel Foundry Company, Sheffield, was, some time ago, in search of a material suitable for making castings which should possess hardness and toughness, as ordinary steel castings did not combine these qualities. Cast steel, unlike cast iron, could not be "chilled"; this was a great disadvantage, for although steel castings of ordinary temper might be exceedingly tough, as soon as hardness was reached, by an addition of carbon or other bodies, the toughness rapidly decreased, the material became brittle, and did not possess the intense hardness of chilled iron. Even cast steel with more than 2 per cent. of carbon was comparatively soft; and whilst chilled iron cylinders, 0·79 inch in diameter by 1 inch long, remained unaltered under a load of 100 tons per square inch, cast or forged steel cylinders, if unhardened, shortened from 15 to 40 per cent. according to temper. If molten steel of any temper, as hitherto made, was run into an iron mould used for making "chilled rolls," when cold the grain of the casting would be somewhat closer than if cast in sand, but still quite soft, easily indented, and the metal might be turned in ordinary lathes. The same article made from cast iron of suitable mixtures would be intensely hard on the surface. Here, then, was a drawback to cast steel, as, although it might be hardened when immersed in water or oil, this application was impracticable to the many irregular forms dealt with by steel-founders; besides the intense strains brought to bear by such hardening process would cause the articles to crack and break into pieces. Special attention was drawn to what essentially constituted the peculiarity of manganese steel. Whilst the belief hitherto held, that steel became brittle and comparatively worthless when the manganese exceeded 2·75 per cent. was correct, it had now been proved that by adding more of the same metal, so as to obtain in the material under treatment not less than about 7 per cent. manganese, the result was a new metal. Thus, whilst manganese alloyed with iron, if present in the proportion of not less than 2·75 and up to about 7 per cent., gave a very brittle product, when its proportion was increased to not less than 7 and up to about 20 per cent., the result was a material possessing peculiar and extraordinary strength and toughness. The brittleness of the cast material seemed to partake more of the nature of glass, or other similar substance, than of a metal such as steel. Cast bars, about 2$\frac{5}{8}$ inches square in cross section, 30 inches long, were supported upon bearings 2 feet apart, and broken under hydraulic pressure, the breaking load being carefully noticed in each case. One of these specimens, containing 0·37 per cent. carbon and 4·45 per cent. manganese, was fractured under a pressure of 3$\frac{3}{4}$ tons, whilst a bar of ordinary cast iron stood 12 tons, and the higher percentages of manganese, 17 and 20 per cent. respectively, stood 29$\frac{1}{2}$ and 38 tons. Another instance was afforded by a bar casting, containing 4·73 per cent. manganese, being dropped from a height of 3 to 4 feet on a floor paved with cast iron, when fracture occurred in two or three parts of the bar at the same time, showing its extraordinary fragility. Pieces from another specimen, containing 0·48 per cent. carbon and 4·9 per cent. manganese, though exceedingly ductile when hot, in the cast state when cold could be reduced by a hand-hammer to fine powder, no cohesion seeming to exist between the particles. On the other hand, a specimen of forged material, containing 13·75 per cent. manganese and 0·85 per cent. carbon, when water-toughened, had a tensile strength of 65 tons per square inch, with 50·7 per cent. elongation; and another specimen, 69 tons and 46 per cent. respectively. In the latter case, the tensile load, calculated on the area of the bar at the moment of fracture, was equal to 102 tons per square inch. The combination of hardness and toughness found in this material led to experiments as to whether edge-tools could be cast from it. These tools, whilst not equal to those made of forged, hardened, and tempered steel, had afforded some remarkable results. The author exhibited some castings as they left the moulds, the cutting-edges being merely ground up, and neither hardened nor tempered. These included a cast axe, which had chopped through cold iron, along with the pieces of iron cut through. Another axe of the same quality, which had been used for over two years, readily shaved off the hair on the back of the hand; and cast razors had been made which, whilst not equal to those of ordinary steel, had done fairly well. A cast adze and chisel for wood were also shown, both of which had been constantly in use for over two years, and had cut through the hardest knots and hard wood. Manganese steel possessed toughness to resist severe usage, and hardness to prevent permanent set without bending or buckling. Some of the tests showed that the material had these qualities in a most remarkable degree. The tests were made with an ordinary drop-tup sliding between steel rails fastened to strong timber supports, which was allowed to fall on Browning's coupler-castings. The tup weighed 2,324 lbs., and the drop could be varied from 1 foot to 27 feet. Each casting was placed vertically and the tup allowed to fall upon the jaws, the permanent set being carefully measured after each blow. Exact particulars of the remarkable results obtained from the manganese steel were given. The couplers tested were an American malleable-iron casting, a manganese steel casting, containing 9·37 per cent. manganese, tested just as cast, a tough mild-steel casting, containing 0·25 per cent. carbon, having a breaking-strength of 32 tons per square inch, with an elongation of 30 per cent. on 2 inches; also two manganese-steel castings, water-toughened, containing respectively 9·75 and 14·25 per cent. manganese, which were unbroken, notwithstanding that the latter had more than 300 foot-tons of energy expended upon it. The author directed attention to the peculiar hardness of this steel, both in its cast and in its forged condition. The specimens were so exceedingly hard that it was scarcely possible to machine any of them on a practical scale; the hardness was most intense in the cast material, containing 5 to 6 per cent. manganese, which no tool would face or touch. A gradual decrease then occurred, and when about 10 per cent. was reached the softest condition was attained. Then an increase again took place, and at 22 per cent. it was very hard, still not so much so as in the 5 per cent. specimens. After passing 22 per cent. the cause of hardness became more complicated, owing to the presence of more carbon, 2 per cent. and upwards; in fact, the material began to partake more of the nature of cast iron, but it had greater transverse strength. The peculiarly combined toughness, hardness, and stiffness of manganese steel, either cast or forged, were very clearly brought out in the tests. The material seemed well adapted to resist severe stress before fracture, and yet at the same time to show very slight alteration under stress.

The too general use of the term "steel" was objected to. Mr. R. Mushet wrote:—"Your material is really not steel, but an alloy in certain proportions of iron and metallic manganese containing also carbon, but as little of that as you can help. Your alloy possesses some of the properties of steel, and it is to a certain extent a substitute for steel, just as brass, which is not copper, is nevertheless a substitute for copper." Whilst there was much to be said for this view, it was open to consideration whether iron formed actual compounds or mere mixtures or alloys. Steel had been defined by Bresson as "a particular state of iron produced by its union with bodies, the nature of which can vary. There are three classes: First, steels composed of iron and carbon; second, those of iron, carbon, and a third body; third, those formed of iron and another body which is not carbon, such *e.g.* as manganese, chromium, silicon, or tungsten." It would be seen from the properties of manganese steel that this view was correct, and that bodies other than carbon could play a constituent part in the conversion of iron into steel; in fact Faraday, long ago, was reported to have made an alloy of iridium and iron which possessed steel-like properties, although no carbon was present. When plunged in water the behaviour of manganese steel was quite different to that of ordinary carbon-steel, no hardening action taking place. Water certainly caused the material to become stiffer, but in a different degree to hardened carbon steel; for a piece of manganese steel after such treatment was slightly more easily touched by a file; therefore the process was termed water-toughening. After a large number of tests on the action of heat and sudden cooling upon this material, it had been found, generally speaking, that the higher the heat of the piece treated, and the more sudden and rapid the cooling, the higher would be its breaking-load and the greater its toughness or elongation. The more rapid cooling of the other test-bars was evidently the cause of their superiority, the chemical composition of all being the same. It was also thought that sulphuric acid, being a rapid conductor of heat, might give good results as a cooling medium. The experiment was therefore made with a bath consisting of equal volumes of water and sulphuric acid, and on 8 inches the extraordinary elongation of 50·7 per cent. was reached with a breaking-load of 65 tons, the bar being thus drawn cold $4\frac{1}{16}$ inches before fracture. It was found that oil had a beneficial effect on the metal, but not equal to either water or sulphuric acid; this no doubt was due to its lower conductivity. It was also noticed that the operation of merely heating the forged test-bar to a yellow heat and cooling it in air had a very beneficial effect, the elongation in most instances being increased to 15 and 20 per cent., the tensile strength also rising 8 or 10 tons per square inch. It was not easy to understand the action of the water-quenching process. As explained by Chernoff, the effect of oil-tempering on ordinary steel was to produce a metal of fine grain, which possessed much greater strength than open, coarse-grained steel. If, however, forged manganese steel possessed any difference of structure after being heated and water-toughened, it was rather in the direction of a more open than a closer grain. An approximate idea of the amount of manganese contained in steel might be formed by passing a magnet over specimens; as the percentage of manganese increased, the effect of the magnet diminished. Upon reaching about 8 per cent., there was no attraction in the bulk, though fine drillings were influenced; but, when 20 per cent. was reached, a magnet capable of lifting 30 lbs. of ordinary steel or iron would only lift pieces weighing a few milligrams. No advantage was gained in ordinary steel by adding more than 1·5 to 1·75 per cent. of carbon, an amount above this not producing steel with any greater degree of hardness. No one could well mistake the difference of fracture in wrought iron and in mild steel, though both might give by analysis the same percentage of iron; in fact, wrought iron might even contain more carbon than mild steel, and yet the structure in no way resemble that of the latter. It was apparent, therefore, that iron did vary its form or structure. This was noticed by steel-casting manufacturers, who by judicious treatment could increase the elongation of steel as cast from 8 or 10 per cent. up to 30 per cent. Prof. Barrett had noticed another point of difference between this and carbon steel. Manganese steel, when cooling, did not give any "after-glow."—W. S.

The Valuation of Pig-iron. A. E. Tucker. Iron 1888, 139—141.

The author first points out that the appearance of pig-iron is no certain indication of its chemical composition or of its properties, as the following selected analyses of two pig-irons having the same appearance show:—

SIMILAR FRACTURE PIGS.

—	3 H.C.N.	2 B.R.
Graphitic carbon	3·07	3·06
Combined carbon	1·42	0·51
Silicon	0·96	1·96
Sulphur	0·04	0·08
Phosphorus	0·07	0·62
Manganese	0·24	0·62
Totals	5·80	6·85
Iron, by difference	94·20	93·15

Also that pig-irons of practically identical composition may possess different fractures. In 3 N. and 3 A.B. (Table I.) the difference in fracture is distinct, though not very decided, while in 6 I.B. and 2 L. it is very marked. In the samples O.K. (Table I.) the silicon, sulphur, phosphorus and manganese are very nearly constant, though the fracture is in each case different, showing that carbon has much influence in determining fracture, this element alone varying in the analyses.

The author observes, "that fractures are largely determined by physical conditions, and, it will be obvious, that as fractures are simply phases of crystallisation, this crystallisation must have scope, and the fluid metal must be allowed to cool slowly before the characteristics of the metalloids can establish themselves. It therefore follows that we can have white irons of identical appearance with a highly phosphoric pig and a hematite pig. On the other hand, as the metal, through slower cooling, becomes more open, the influence of phosphorus asserts itself, and with high phosphorus we get that sandy appearance so characteristic of cinder pig."

PART II.

Having seen that, although the fractures of pigs are not absolutely independent of the materials composing them, yet they are quite insufficient to serve as a guide in the valuation of iron with that degree of accuracy which the necessities of the matter would warrant, the assistance of analysis was considered. In endeavouring to put a money value to the losses occasioned by undue composition, it was thought convenient, first of all, to take the case of an acid Bessemer shop as representing the simplest form of the conversion of pig into malleable iron. Supposing the size of converters, engines, &c. determine that the operation can be satisfactorily conducted with—

$$\left.\begin{array}{ll}\text{Total carbon} \ldots\ldots\ldots\ldots & 3{\cdot}52 \\ \text{Silicon} \ldots\ldots\ldots\ldots & 1{\cdot}75\end{array}\right\} 5{\cdot}27.$$

and the other metalloids remaining the same, the manager was compelled to use a metal containing—

$$\left.\begin{array}{ll}\text{Total carbon} \ldots\ldots\ldots\ldots & 4 \\ \text{Silicon} \ldots\ldots\ldots\ldots & 3\end{array}\right\} 7.$$

The cost of the pig would be increased (7 − 5·27) = 1·73 per cent.; to this, say 50*s.*, must be added the cost of conversion. Putting it at 10*s.*, there is a waste of 1·73 per cent. of 60*s.* = 1·03*s.* per ton of steel ingots, a very serious amount in itself, to which, however, must be added the cost of the extra wear and tear of linings, and therefore waste of metal, due to the increase of temperature arising from the use of such pig, the restriction of output, and inferiority of product, the cost of which would certainly not be less than that due to waste of metal. These items, therefore, would, in an ordinary size converting house, if allowed to go on, imply a loss of at least 30*l.* per 24 hours.

Proceeding, then, from the simpler case of the Bessemer converter, the effect of various elements on the value of pig in the puddling furnace could be discussed. Experience had established the fact before mentioned, that malleable iron might be satisfactorily produced from a pig, or mixture of pigs, of the following composition, and the results obtained from this composition were so excellent that it might, for the purposes of calculation, be regarded as a standard mixture.

STANDARD PIG (PUDDLING).

Graphitic carbon	3·30
Combined carbon	0·30
Silicon	1·25
Phosphorus	1·00
Manganese	0·50
Total	6·35
Iron, by difference	93·65

Such pig would work into puddled bar with a waste of only 3¼ or 3½ per cent.

Now, experience in basic steel making, as well as analytical and theoretical considerations, had led to the conclusion that, in the removal of phosphorus and silicon from pig, something like seven times and five times their weight of iron were respectively absorbed when oxide of iron (fettling) was used for their removal. Taking, then, these figures, and assuming (1) that the carbon of the pig was replaced by an equivalent weight of iron reduced from the fettling, and (2) that best iron is produced, and therefore that the amount of fettling was not restricted—how did the money value of such a pig as was mentioned compare with that frequently used in a forge? An average analysis of pigs used largely in the Birmingham district for puddling would give the following result. This was called No. 2 pig, and the former No. 1.

No. 2 PIG.

Silicon	2·75
Phosphorus	1·75

It followed that No. 2 should cost (2·75 + 1·75) − (1·25 + 1) = 2·25 per cent. less from this result alone. Now, supposing fettling be priced at 15*s.* per ton, and that it contained 60 per cent. of iron, and the working of 100 cwt. of No. 1 and No. 2 pigs be compared.

No. 1 PIG.

	Cwt. of Fettling.
Silicon.	
1·25 × 5 = 6·25 cwt. of iron required for removal,—	
Fettling required at 60 per cent.	= 10·41
Phosphorus.	
1 × 7 = 7 cwt. of iron required for removal,—	
Fettling required at 60 per cent.	= 11·66
	22·07

Therefore 22·07 cwt. were required for the elimination of the phosphorus and silicon in 100 cwt. of No. 1 pig = 4·4 cwt. of fettling to the ton. Of course, this did not represent the total amount of fettling required; perhaps 50 per cent. should be added to this on account of silica in the fettling itself, manganese, sulphur, &c. in the pig; so that about 6·6 cwt. of fettling must be used with No. 1 pig.* Proceeding in the same way with the pig there were—

	Cwt. of Fettling.
2·75 × 5 = 13·75 cwt. iron,—	
Fettling at 60 per cent.	= 22·91
1·75 × 7 = 12·25 cwt. iron,—	
Fettling at 60 per cent.	= 20·41
	43·32

= 8·66 cwt. to the ton, or adding 50 per cent.
= 12·99 cwt. to the ton,

If the respective costs of Nos. 1 and 2 were put at 42*s.* and 40*s.* on 100 cwt., 210*s.* and 200*s.* worth of pigs are obtained. However, we have 2·25 per cent. less iron-producing material in the one case than in the other, and the same cycle of operations has to be gone through as if this deficiency did not exist; if, therefore, 15*s.* for fuel, labour, and establishment charges were added per ton, the cost is raised 75*s.* per 100 cwt. Now 2·25 cwt. at 200 + 75*s.* = 6·18*s.* The 5 tons of pigs should therefore be priced at 210*s.* and 206*s.*, 18*s.* when charged to the puddling furnace, and not at 210*s.* and 200*s.* But No. 2 pig would consume 64·98 − 33·10 = 31·88 cwt. of fettling more than No. 1; this at 15*s.* = 23*s.* 7*d.* This meant 4*s.* 7*d.* on the ton. Hence, instead of paying 42*s.* and 40*s.* respectively, 42*s.* + (40*s.* + 1*s.* 2*d.* + 4*s.* 7*d.*) = 45*s.* 9*d.*, are paid, although the extra 3*s.* 9*d.* was not paid to the pig maker. Nor did this 3*s.* 9*d.* represent the total loss, for it would be evident that there must be a smaller output than was possible with a purer pig; there would be more labour and more fuel to be paid for, none of them inconsiderable items. These figures, therefore, worked out to a very large amount.

Again, if the percentage of silicon and phosphorus was greater than that of No. 2 pig, it would not be practically possible to produce a first-class bar without bleeding the furnace, the latter not being capable of holding the cinder which would have to be produced to obtain a good bar. When the silica of the cinder exceeded 20 per cent., it rapidly ceased to be capable of absorbing phosphorus, and experiments had shown that at 30 per cent. of silica absorption entirely ceased, hence the enormous quantity of fettling necessary to get anything like a fair puddled bar from a charge of cinder pig.

As regarded composition and prices paid, taking the case of samples $\frac{5}{N}$ and $\frac{6}{N}$, analyses and prices of which were given in the tables, from the foregoing remarks it would be seen, if No. 5 was worth 53*s.*, No. 6 was worth 53*s.* 6*d.*

Again, in the series JB, as malleable iron producers, there was no comparison in price and composition. No. 1 pig would not make a bar, it would be too dry, yet if a pig were taken whose composition most nearly approximated to the standard pig, say No. 2 pig in the same series, a difference in cost of no less than 32*s.* 6*d.* per ton was found. In AC 1 and 2, 1*s.* 2*d.* had been paid for apparently no difference at all; this was also the case with AB 3 and 4. In pigs AN 2 and 4 the relative costs should have been reversed, but pig 2 cost 2*s.* more than 4. Finally, in JB 2 and 8, 2 should have been about 2*s.* more than 8, whereas it had been charged at 10*s.* more.

In conclusion, were pointed out—

1. The unreliability of fracture as an indication of composition.

2. How the approximate value of a pig for forge purposes might be estimated.

3. The extraordinary want of relation between some of the market prices of pigs and their real value.

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* On 100 cwt. the addition of 50 per cent. would raise the amount of fettling to 33·10 and 64·90 cwt. respectively.

TABLE I.

	A.B.				O.K.				A.C.			
Marks	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.
Graphitic carbon	2·6	2·65	2·1	1·72	2·1	2·05	2·96	2·78	2·85	2·7	2·57	2·0
Combined carbon	0·15	0·3	0·52	0·84	0·72	0·56	0·64	0·84	0·34	0·52	0·7	0·95
Silicon	4·1	3·6	3·4	3·2	1·91	1·85	2·82	1·98	4·6	4·5	3·7	3·4
Sulphur	0·04	0·05	0·07	0·08	0·04	0·05	0·06	0·06	0·04	0·04	0·06	0·08
Phosphorus	1·25	1·25	1·28	1·3	0·63	0·62	0·6	0·63	3·5	3·58	3·6	3·5
Manganese	1·1	0·9	0·8	0·71	1·68	1·6	1·92	1·56	1·2	1·1	0·92	0·78
Totals	9·24	8·75	8·17	7·85	7·08	6·72	8·2	7·85	12·53	12·44	11·55	10·71
Iron, by difference	90·76	91·25	91·83	92·15	92·92	93·28	91·86	92·15	87·47	87·56	88·45	89·29
Price at works	41*s.*	40*s.*	40*s.* 3*d.*	39*s.* 4*d.*	52*s.*	51*s.*	50*s.*	50*s.*	32*s.* 6*d.*	31*s.* 4*d.*	31*s.*	30*s.*

	A.N.				S.H.				N.			
Marks	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.
Graphitic carbon	2·75	2·65	2·1	1·6	2·72	2·64	2·32	1·84	1·55	1·75	2·05	2·15
Combined carbon	0·33	0·50	0·84	0·98	0·2	0·4	0·72	0·99	0·55	0·96	0·61	0·59
Silicon	3·70	3·00	2·7	2·0	3·1	2·67	2·27	1·8	3·02	2·79	2·09	2·4
Sulphur	0·04	0·06	0·07	0·08	0·05	0·04	0·06	0·07	0·08	0·15	0·03	0·05
Phosphorus	0·90	0·88	0·84	0·84	2·88	2·89	3·00	2·9	1·68	1·71	1·54	2·79
Manganese	1·10	0·9	0·8	0·7	1·3	0·95	1·00	0·9	0·03	0·24	1·06	0·57
Totals	8·82	7·99	7·35	6·2	10·25	9·59	9·37	8·5	7·23	7·6	7·38	8·55
Iron, by difference	91·18	92·01	92·65	93·8	89·75	90·41	90·63	91·5	92·77	92·4	92·62	91·45
Price at works	52*s.*	50*s.*	50*s.*	48*s.*	36*s.*	36*s.*	35*s.*	34*s.*	34*s.*	34*s.*	36*s.*	31*s.* 6*d.*

TABLE II.

	J.B.								L.		
Marks	1.	2.	3.	4.	5.	6.	7.	8.	1.	2.	3.
Graphitic carbon	2·15	2·75	2·85	2·65	2·6	2·9	2·7	2·5	3·1	3·3	2·44
Combined carbon	0·66	0·34	0·29	0·43	0·15	0·1	0·16	0·2	0·1	0·32	0·45
Silicon	0·46	1·88	2·63	2·18	3·09	2·88	3·0	2·4	3·0	2·28	2·14
Sulphur	0·11	0·1	0·02	0·06	0·01	0·04	0·04	0·05	0·04	0·06	0·08
Phosphorus	0·72	0·94	2·52	0·76	1·34	1·05	1·93	1·34	1·05	1·19	1·63
Manganese	0·52	0·82	0·68	0·93	0·33	1·08	0·94	0·35	1·0	0·51	0·25
Totals	4·62	6·83	8·99	7·01	7·52	8·05	8·77	6·84	8·29	7·66	6·99
Iron, by difference	95·38	93·17	91·01	92·99	92·48	91·95	91·23	93·16	91·71	92·34	93·01
Price at works	82*s.* 6*d.*	50*s.*	32*s.* 6*d.*	47*s.* 6*d.*	40*s.* 4*d.*	52*s.* 6*d.*	40*s.*	40*s.*	54*s.*	42*s.* 6*d.*	40*s.* 2*d.*

	M.R.					A.				N.	
Marks	1.	2.	3.	4.	5.	1.	2.	3.	4.	5.	6.
Graphitic carbon	1·7	0·94	3·3	2·05	1·24	3·42	3·06	3·32	2·52	2·3	2·4
Combined carbon	0·55	0·9	0·08	0·12	0·36	0·28	0·51	0·73	0·87	0·8	0·73
Silicon	1·11	2·0	3·0	2·97	2·13	2·41	1·96	1·7	1·49	1·86	1·39
Phosphorus	0·03	0·04	0·08	0·59	0·04	0·04	0·08	0·02	0·14	0·04	0·11
Sulphur	0·13	0·67	0·1	0·27	0·55	0·04	0·62	0·09	0·57	0·56	0·48
Manganese	1·21	1·39	0·52	0·43	1·2	1·2	0·62	0·15	0·34	0·86	1·1
Totals	4·73	5·94	7·08	5·93	5·52	7·39	6·85	5·91	5·93	6·42	6·21
Iron, by difference	95·27	94·56	92·92	94·07	94·48	92·61	93·15	94·09	94·07	93·58	93·79
Price at works	Unknown.					56*s.*	82*s.*	52*s.*	50*s.*	53*s.*	50*s.*

—O. H.

The Reduction of Gold Chloride by Wood Charcoal.

A. Görz. Zeitschr. f. angew. Chem. 1888, 63—65.

In reducing gold from the solution resulting from the treatment of ore by Plattner's or other wet processes, the precipitant used is either ferrous sulphate, hydrogen sulphide, or charcoal. The metal deposited by the first of these remains long suspended in the solution, a portion is always lost as float gold, and if chlorine, bromine, calcium hypochlorite, magnesia, soda, or nitric acid be present, the precipitation is incomplete; whilst, on the other hand, the presence of lime in the liquid causes a precipitate of calcium sulphate with the gold. The application of hydrogen sulphide is troublesome and costly, and is unsatisfactory in dealing with arsenical liquids. The charcoal method (*see* this Journal, 1887, 824), which is inexpensive, and yields a pure metal that may be deposited and melted without difficulty, is therefore rapidly superseding the others. Experiments were made by the author to determine the circumstances favourable to a combination of rapidity with completeness of precipitation. He found that at ordinary temperatures some 50 per cent. of the gold was deposited fairly quickly, but that the remainder was thrown down far more tardily, the precipitation being incomplete even after several days. By warming the solution to 67° C., the action was quite complete in a few hours. At a boiling temperature, however, the decomposition was very rapid and complete. The proportion of charcoal used to gold obtained was as 1000 : 106; by lowering the proportion to 750 or 500 : 100 the end of the reduction was delayed. The metal is deposited on the charcoal, never on the sides or bottom of the vessel, and none is found suspended in the liquid or floating on the surface; the presence of salt is immaterial. In regard to the theory of the action; König, of Pennsylvania, experimenting to find whether reduction is due to the alkaline carbonate of the charcoal ash, to gas condensed in the charcoal, to catalytic action, or to oxidation of the carbon, ascribes it to simultaneous physical and chemical action. Davis considers it solely chemical in nature:—That the carbon oxidises at the expense of the water, and the liberated hydrogen, then combining with the halogen of the chloride, sets free the gold as a precipitate. By effecting the reduction in a flask and passing the gases evolved, after careful drying, through a weighed CO_2 apparatus, and thence over heated copper oxide, and through weighed tubes for estimating the water and carbon dioxide thus produced, the author also is led to the conclusion that the reduction is due entirely to chemical action; and that besides gold, carbon dioxide, hydrogen, oxygen, and hydrochloric acid are finally obtained.—W. G. M.

Some Methods of recovering Tin from Tin-plate Scrap.

E. Donath and F. Müllner. Ber. d. öst. Ges. z. Förd. d. Chem. Ind. 1887, 130.

The methods hitherto used have been either physical and mechanical, chemical, or electrolytic. For very large works the last named is most economical, and possesses the advantage that, in addition to the tin, a saleable iron preparation is also obtained. But the comparative costliness of the plant hinders its adoption in smaller installations; and for these the chemical process of stripping with mixed hydrochloric and nitric acids and recovering with zinc scrap is in greater favour. The authors have experimented with a view to adopting the most economical process. For stripping in the cold, a mixture of 10 parts commercial HCl with 1 part HNO_3 and 10 parts H_2O is best suited: a larger proportion of nitric acid hastens the action, but dissolves more iron, which yields a basic salt during the precipitation, thus hindering the deposition of tin, and increasing the difficulty of dealing with the sponge. 100 kilos. of average scrap (with 5 per cent. tin) required 42 kilos. of such a mixture, containing 20 kilos. of HCl and 2 kilos. of HNO_3; the first portions of scrap treated being more rapidly attacked must be removed sooner from the bath. The solution was effected in earthen vessels, and was continued so long as solvent action was discernible. For the boiling process the concentration should not be lower than 10 parts of HCl with 1 of HNO_3 and 30—40 of H_2O, otherwise the action will be too feeble. Thus it is clear that the use of the more concentrated acid in the cold is more economical, directly in the quantities of acid needed, and indirectly in the lower cost of the stripping vessels and in the absence of expenditure for fuel. For the subsequent reduction of the tin by zinc scrap, the stronger solutions from the cold process must be diluted with three to four times their bulk of water, or the action will become too violent; the solution will heat and a white basic salt will deposit. The tin sponge filtered through sailcloth bag-filters must be washed most thoroughly free from iron and from acid, as very small quantities of basic salt act prejudicially in the melting of the metal. In drying the sponge, partial oxidation is inevitable, and it is better to work up the moist precipitate into tin salt. For fusion it should be well pressed, air dried, mixed with tar till a pasty mass is obtained, and melted with 10—15 per cent. of granulated tin in a Hessian crucible.

—W. G. M.

Transparency of Platinum.

By E. v. Aubel. Chem. Zeit. **13** (71, 21-29).

A transparent deposit of platinum can be obtained by covering the bottom of a glass dish with a mixture of platinic chloride and glycerol; this is evaporated to dryness and finally washed with alcohol to remove the product of decomposition of the glycerol. The metallic deposit is perfectly transparent, the transmitted light being of a dark blue-grey tint. The commercial method of producing platinum mirrors by reducing the chloride with essence of lavender and heating the containing vessel up to the temperature at which the glass softens, does not yield a sufficiently cohesive product. Transparent layers of platinum and mirror deposits of iron, nickel, and cobalt, can also be obtained by electrolytic methods. It is noted that the iron mirror rotates the plane of polarisation, the direction of which varies with the direction of the electric current.

—V. H. V.

The Non-homogenous Nature of Thomas Pig Iron.

C. Reinhardt. Rep. Anal. Chem. **7**, 742.

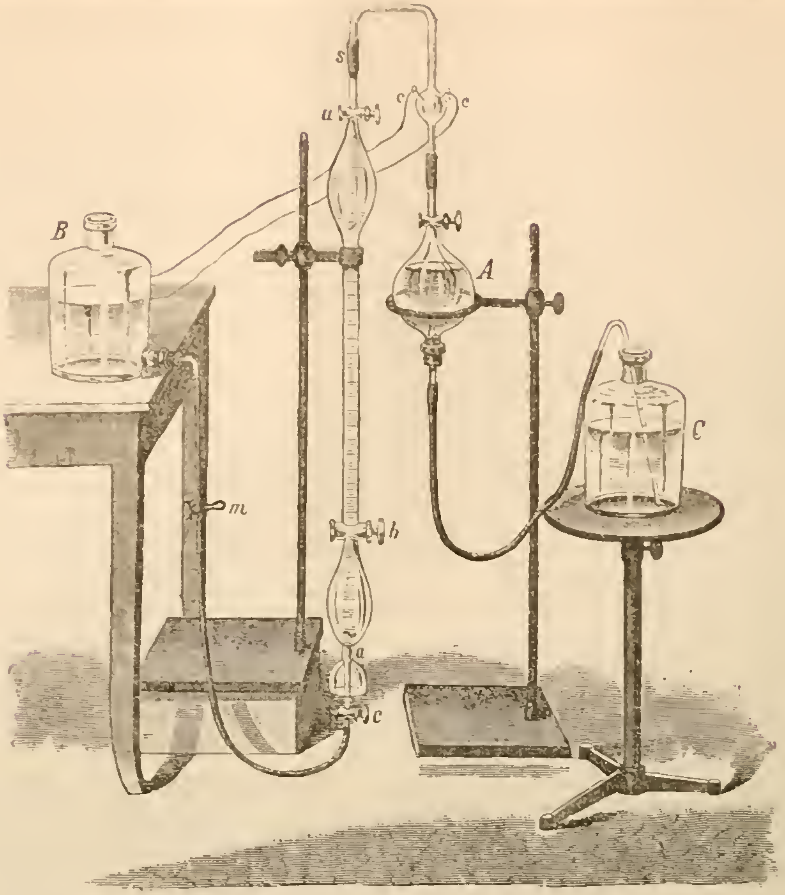
The proportion of phosphorus and manganese is almost invariably greater at the edges of a section of the melt than it is in the centre. In the case of slowly cooled grey cast iron the quantities of phosphorus and manganese vary throughout the mass, but appear to do so together. In a mass of the metal, phosphorus is very unevenly distributed in the various layers, and its amount appears to be greatest at the surface. The same may be said of manganese, and with a rapidly cooled melt both metals are found in the largest proportion, not only in the surface layer, but upon the whole exterior surface of the pig iron. Detailed directions for sampling, in accordance with the above observations, are given.—C. A. K.

Investigations on the Cause of Explosions in Coal Mines.

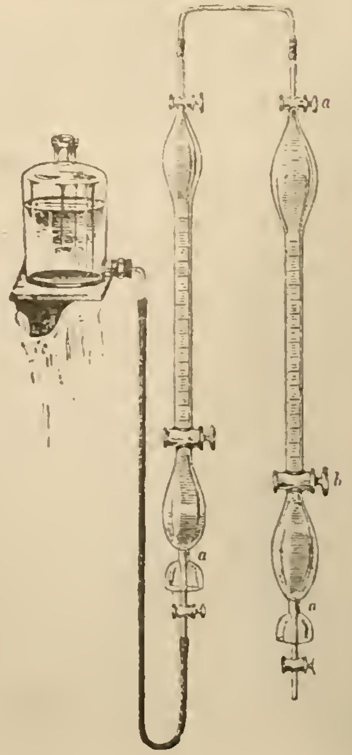
B. Franke. J. Prakt. Chem. **37**, 91—101.

The author comments upon the necessity of taking a series of regular observations, including the reading of the thermometer and barometer, and also the analysis of the fire-damp in one and the same part of the working, in order to obtain results which may aid in tracing the cause of explosions.

The fire-damp consists of carbon dioxide, oxygen, marsh gas, and nitrogen, and is free from hydrogen. For the analysis of the mixture the following apparatus is described:—The burette (as previously described by the author, J. Prakt. Chem. **35**, 259) is connected on the one side with the pressure flask B, on the other with the combustion vessel *cc*, and the pear-shaped vessel A, the last being connected with C; *cc* contains a piece of platinum foil which can be heated to a white heat by two Bunsen cells. The process of analysis is first to absorb the carbon dioxide with caustic potash solution, next the oxygen by means of an alkaline solution of pyrogallol, and then to determine the marsh gas by passing it through the combustion tube until it is completely burned; the nitrogen is taken by difference. To collect the sample the burette is filled with water, taken to the working, and the taps *a*, *b*, and *c* opened; as soon as the last drop of water has run out the taps are closed. The burette is then placed in a vessel of water which has attained the temperature of the room (the



burette being held in the reversed position to that in the figure) and the taps *b* and *c* opened, and *b* quickly closed again when the burette is filled with gas (100 cc.) at the temperature and pressure of the room. To determine the carbon dioxide the cap *ca* is removed, and the reservoir between *a* and *b* filled with caustic potash solution. The cap c is then introduced, and *b* is opened when the liquid enters the burette, where it is well mixed with the gas by shaking; by holding the burette in a horizontal position the alkali is allowed to flow into the reservoir, whence it is poured away and replaced by water in a similar manner to the above. After washing the gas the burette is again placed in a vessel of water, the tap *b* opened, and the volume of gas read off; the absorption represents the percentage of carbon dioxide. Similarly the oxygen is absorbed by an alkaline solution of pyrogallol. To burn the marsh gas the burette is fixed as shown in the figure. The water is replaced by air or oxygen, and thus exactly 100 cc. of the mixed gases obtained. By raising C, A and cc are filled with water; the burette is attached at *s* and the platinum foil heated by the battery. By alternately raising B and C the gas is syphoned backwards and forwards between the burette and the pear-shaped vessel A, *i.e.*, over the glowing platinum in cc. The marsh gas is completely burned (to ascertain this read off the volume of the gas in the burette, pass the gas through *cc* and read again) by 4—6 passages over the platinum, provided a large excess of oxygen be present. The gas is finally transferred to the burette, the carbon dioxide formed by the combustion absorbed by caustic potash, and, after washing, the volume of the gas read off as before. One-third of the contraction represents the percentage of marsh gas. As a check the residual oxygen may be determined, and knowing the quantity originally added, the difference gives the amount burned by the marsh gas, from which value the percentage of marsh gas may be caculated. The second figure shows the arrangement used by the author when the



mixture contains above 2 per cent. of Marsh gas, and the combustion is effected with air. The gas is then syphoned, after the absorption of the oxygen and the carbon dioxide, from the ordinary (100 cc.) burette to a second larger (200 cc.) burette, where it is mixed with air and burned, as already described. In cases where the percentages of carbon dioxide and of marsh gas are very small the author employs a 500 cc. burette, having 25 cc. of the scale graduated to 0·05 of a cc. (To be concluded.)—C. A. K.

PATENTS.

Improvements relating to the Extraction of Aluminium from Substances containing the same. C. Netto, Dresden, Germany. Eng. Pat. 4228, March 21, 1887. 11*d*.

A mixture of 100 parts by weight of cryolite with 30 to 100 of decrepitated common salt is fused in a covered fireclay crucible at a red heat, and when completely melted, 35 parts of metallic sodium are thrust down to the bottom of the pot. The sodium should be free from cavities and from hydrocarbons, and it is therefore preferred to remelt the metal into one mass, at a low temperature, immediately before use. It may be introduced into the aluminium bath by fixing it to the end of a long iron rod, which passes through a slot in a perforated iron cover-plate, also attached to an iron rod and introduced simultaneously with the sodium. Violent action immediately ensues, but the rise of the sodium to the surface is checked by the cover-plate, so that comparatively little escapes from the crucible; hence a great economy is effected as compared with the older processes, in which about 70 per cent. was wasted. The increase of temperature, consequent upon the reaction, promotes extreme fluidity, so that the aluminium unites for the most part into one mass, and the whole may be poured immediately into an ingot mould. The short duration of the process prevents the metal taking up large quantities of silicon or iron; the metal is therefore purer, and but little is wasted by solution in the bath, as occurs in the processes in which it is obtained in a state of finer subdivision. Other fluxes may be used instead of sodium chloride, and the method of introducing the sodium may be varied at pleasure.—W. G. M.

Improvements in the Manufacture of Alloys of Aluminium with other Metals. A. Mann, Twickenham. Eng. Pat. 9313, June 30, 1887. 6*d*.

An alkaline chloride mixed with aluminium sulphate is heated in a retort, and is afterwards mixed with calcium hydrate and left aside for some weeks, during which time a chloride of lime is formed. Aluminium sulphate is then mixed with a reducing agent, such as carbon or zinc. Equal portions of these two products are now to be fused with the required amount of the alloying metal. Zinc or brass is to be added to copper aluminium alloys when malleability or softness are required.—W. G. M.

Improvements in Apparatus for Extracting Metals from their Ores by Amalgamation. W. R. Lake, London. From A. Vogelmann, Magdeburg, Germany. Eng. Pat. 16,495, November 30, 1887. 8*d*.

In the bottom of a rotating conical pan is a concentric perforated plate, with a wooden box and central well, to retain amalgam beneath; communicating with the space beneath the perforated plate is a hollow shaft with hopper above for the introduction of ore. Within a short distance above the first vessel is a similar cone, with an inverted conical centre, through which a pipe for delivering the ore passes centrally. Mercury placed in the rotated vessel is driven over the bottom surface by centrifugal force, and the ore fed in beneath the perforated plate passes upwards through the apertures, and traversing the space between the two cones in contact with the mercury is finally passed into a circumferential overflow channel. Amalgam may be drawn out from the well when necessary, by means of a cock To prevent the sickening of the mercury a current of electricity is caused to flow constantly through the amalgamator from an electro-magnetic generator. This latter consists of permanent fixed horse-shoe magnets beneath the apparatus, and over them is constantly rotated a copper ring fixed to the underside of the pan. The pan is insulated from the central rotating shaft by a layer of felt, and the mercury by the wooden box above-mentioned. —W. G. M.

Improvements in the Treatment of Cupreous Pyrites to separate Gold, Silver, Copper, and Sulphur, and to obtain Oxide of Iron, and in Apparatus employed therein. Jas. and Jno. Hargreaves and T. Robinson, Widnes, Lancashire. Eng. Pat. 3704, March 11, 1887. 8*d*.

This is an improvement on Eng. Pat. 5681 of 1886, by which the copper, silver, and gold, and the sulphur in the pyrites are obtained separately, and the oxide of iron is useful as a pigment or in blast furnaces. After roasting in the kilns or pyrites burners fully described, the burnt pyrites are moistened with strong solutions of iron sulphate or chloride or sulphuric or hydrochloric acids, and heated in closed vessels in a current of air and steam to render the valuable metals soluble; the acids are subsequently recondensed. Sulphur is collected as such, and sulphur dioxide is absorbed in alkali waste. After their removal the iron oxide is heated to 400° F., after which it may be mixed with lime and pressed into blocks for use in the blast furnace. In the solution the addition of hot chloride of lead solution facilitates the deposition of gold and silver by means of iodides; and in precipitating the copper, ferric salts are first reduced to the ferrous condition by hydrogen sulphide or by sulphides, so that the iron used for precipitation shall not be unduly wasted. Or the copper may be entirely precipitated as sulphide with agitation, washed with alkaline sulphides to remove antimony and arsenic, dried centrifugally and exposed to air containing aqueous vapour at a temperature of 900° F., to yield oxide or sulphate.—W. G. M.

Solubility of Type-metal. R. Schütze. Ztschr. f. Chem. Ind. **1887**, 300.

Five grms. of coarse-grained type-metal, containing 90 per cent. of antimony, were treated with the following liquids (*a*) at ordinary temperatures for 20 hours, (*b*) at a boiling heat for two minutes. The liquids were: 1. Town's-water. 2. Nitric acid of 5 per cent. and 30 per cent. NO_3H. 3. Sulphuric acid of 16 per cent. and 98 per cent. SO_4H_2. 4. Hydrochloric acid of 4 per cent. and 30 per cent. HCl. 5. Glacial acetic acid. 6. Vinegar of 4 per cent. $C_2H_4O_2$, and 7. Sodium hydrate of 4 per cent. and 30 per cent. NaOH. The calcareous town's-water had no action at all. At ordinary temperatures the scale of attack was thus: Concentracted nitric, dilute nitric, concentrated hydrochloric, glacial acetic, dilute acetic, concentrated sulphuric, dilute hydrochloric, dilute sulphuric acid, dilute sodium hydrate, concentrated sodium hydrate. At boiling heat the scale of attack was thus: Concentrated nitric, dilute nitric, concentrated sulphuric, concentrated hydrochloric, glacial acetic, dilute hydrochloric, dilute acetic, dilute sodium hydrate, dilute sulphuric, and concentrated sodium hydrate.—S. H.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in the Electrolytical Treatment of Ores for Facilitating the Extraction and Recovery therefrom of Gold, Silver, or Copper, and in Apparatus therefor. H. Liepmann, London. Eng. Pat. 2390, February 15, 1887. 8*d*.

The ore to be treated is crushed, preferably rather finely, placed on a floor and mixed with a solution of common salt or other suitable chloride or mixture of chlorides. Into this are inserted carbon electrodes, or a vessel containing such and some of the above solution. The ore is sometimes mixed with crushed carbon to render it more porous so that air may permeate it, or sometimes it is placed in a closed vessel and air forced or drawn through. An electric current is passed through for two hours, an interval allowed for the liberated chlorine to act on the ore, and the current passed again, but reversed in direction; the same cycle of operations is gone through several times until the liquid that drains through shows no more sign of precious metal. The valuable metal is then extracted from the liquor by protosulphate of iron or any other suitable process.—E. T.

Improvements relating to the Manufacture of Plates or Electrodes for Primary or Secondary Electric Batteries, and to Apparatus therefor. C. L. R. E. Menges, the Hague, Netherlands. Eng. Pat. 11,923, February 19, 1887. 8*d.*

The improved plates have the appearance of trellis-work, for which form the inventor claims advantage in conducting power, a better circulation of the liquid and gas, and simplicity of manufacture of the electrode. Vertical sections through any hole show that the two sides that slant upwards have a V shape, and the two that slope downwards a V-groove shape. By this means it is claimed that the active material is more firmly held, and cannot readily fall out. The remaining part of the invention relates to means of enabling the upper part of the mould to be removed *obliquely* from the lower part without damaging the form of the perforations.—E. T.

Improvements in Electric Batteries. The Electrical Power Storage Company and H. W. Butler, London. Eng. Pat. 4781, March 30, 1887. 6*d.*

By this invention, perforated or reticulated sheets of celluloid, vulcanite, porcelain, prepared cardboard, or other suitable material, are placed between the plates of the battery to act as separators. Upon the separators, or on frames supporting them, are distance pieces in the form either of vertical ribs, or of pins or knobs, riveted or screwed in, and of course made of insulating material. In some cases more than one separating sheet is employed between each pair of plates.—E. T.

Improvements in Galvanic Batteries. H. H. Lake, London. From J. O. Whitten, Boston, U.S.A. Eng. Pat. 17,157, December 13, 1887. 6*d.*

The porous pot of the battery is made circular in inside section, but has a portion of its wall made double so as to form a second cell of crescent section, to act as a reinforcing cell. The zinc, in the form of a cylinder, nearly surrounds the porous pot, and rests in a gutter formed on the base of the latter, and containing mercury. The outer vessel (which is provided with a watertight cover) and the porous pot contain dilute sulphuric acid, and the reinforcing cell strong sulphuric acid. The porous cell also contains a carbon rod or plate, surrounded by crushed carbon and manganese. —E. T.

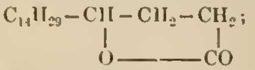
XII.—FATS, OILS, AND SOAP MANUFACTURE.

The action of Concentrated Sulphuric Acid upon Oleic Acid and upon its Triglyceride. A. C. Geitel. J. Prakt. Chem. **37**, 53—90.

The author reviews the work done on the subject by Müller-Jacobs, Liechti and Suida, and others, and calls attention to the increased yield of solid fatty acids obtained from tallow, when the saponification is effected by means of concentrated sulphuric acid. The oleic acid used in the following experiments was prepared by completely saponifying tallow with alkali, and decomposing the soap with hydrochloric acid; the separated fatty acids, after being well washed, were melted into a cake and the oleic acid removed by pressing. To further purify the latter the whole was crystallised by cooling to 3° C. several times, and the resulting paste pressed in a filter-press cooled by ice. Thus prepared, oleic acid forms a light brown liquid, solidifying at 4°·8., and melting at 13—14°. Its acid value is 200 (*i.e.* 1 gr. requires 200 m. gr. of caustic potash for neutralisation) and its iodine value 892 (*i.e.* 1 gr. absorbs 892 gr. of iodine). Trioleïn from olive oil was similarly purified by cooling and filtering through a cold filter-press. It remains clear at 0°; it has a saponification value of 192 (*i.e.* 1 gr. needs 192 gr. caustic potash for saponification) and an iodine value of 840.

Action of Concentrated Sulphuric Acid on Oleic Acid.—Oleic acid treated with sulphuric acid (sp. gr. 1·836) in molecular proportions, at 5° forms a thick, brown, very hygroscopic mass, in which, after cooling and allowing to stand for some time, needle-shaped crystals appear. On adding water a dark oil separates, and on diluting largely the whole dissolves to a clear yellow solution. In order to determine how much of the oleic acid had been changed into a sulphonic acid by this treatment, the "acid value" of the mixture was determined before and afterwards, and with due allowance being made for the "acid value" of the sulphonic acid formed. As a check on this, the amount of oleic acid (and other unsaturated compounds) remaining was also found by determining the iodine value. The dilution of the acid solution and the titration with alkali do not decompose the sulphonic acid formed, and thus the above method of determining the quantity of combined oleic acid is sound. By adding one equivalent of pure sulphuric acid (sp. gr. 1·841) to one of oleic acid, 70 per cent. to 84 per cent. of the latter is changed; this proportion and strength of acid yields the best result. Considerably higher results are obtained by determining the iodine value before and after treatment than when the acid value is employed, and the difference increases with the time the mixture has been allowed to stand.

The product of the reaction of sulphuric acid on oleic acid may be freed from the excess of sulphuric acid by treatment with a solution of sodium sulphate, and can be extracted with ether. On removing the latter by distillation, *stearic acid α-hydrogen sulphate* remains behind as a thick, brown mass, soluble in water, alcohol, and ether, insoluble in dilute acids and salt solutions. Its constitution is represented by the formula $C_{15}H_{31}-CH_2.CH\,(SO_4H).CO.OH$, and not by that proposed by Ssabanejew, $C_{15}H_{31}-CH\,(OH)-CH\,(SO_2.OH).CO.OH$—for on fusion with caustic potash or soda it is only partially decomposed into hydroxystearic acid, and no trace of a dihydroxy acid is formed. It could not be obtained free from water, and therefore was not analysed. Boiled with water, alkali, or dilute acid, an anhydride is formed, and on prolonged standing crystals of hydroxystearic acid separate. Of the salts of the stearic acid hydrogen sulphate, the sodium, potassium, and ammonium salts form soaps, which are neutral salts. The sodium salt is crystalline. The barium salt is a yellow powder, and the copper salt a pale green precipitate; on treatment with acetic acid, acid salts result. The silver salt is gelatinous, the zinc salt a yellow and the iron salt a brown oil. Analyses of some of these salts are given. By boiling stearic acid hydrogen sulphate, or its salts with dilute acid, the corresponding α-hydroxy-acid results, which may be purified by repeated crystallisation from ether. It forms white crystals melting at 81° to 81°·5, and has the formula $C_{15}H_{31}-CH_2.CH\,(OH).CO.OH$. The calcium, copper, and lead salts are characteristic. When heated to 200° C. hydroxystearic acid yields an anhydride; this is a brown syrup, which, in presence of aqueous solutions of the alkalis, readily forms salts again. A second anhydride crystallises in small plates, which melt at 47° to 48°. This appears to be an inner anhydride (lactone) of the formula:—



$$\begin{array}{l}C_{14}H_{29}-\underset{|}{CH}-CH_2-\underset{|}{CH_2};\\ \qquad\quad\;\; O\text{———}CO\end{array}$$

this readily takes up water to form the salts of γ-hydroxystearic acid. The calcium and lead salts have been prepared; when treated with an acid the anhydride, and not the free acid, again results.

Action of Concentrated Sulphuric Acid on Tri-oleïn.—Well-cooled olive oil treated with concentrated sulphuric acid also forms a thick, brown, hygroscopic mass. There is no evolution of sulphur dioxide. Mixed with ice-cold water, a slightly opalescent solution results, which is decomposed on warming, with the separation of a thick, white oil. This dissolves in a large excess of water, and is re-precipitated from its solution by acids and salts. Three molecules of sulphuric acid to one molecule of tri-oleïn give the best yield. The chief product of the reaction appears to be tri-oleïc sulphuric acid, which separates as a jelly, and is readily converted, either by water or by dilute acids, into an acid sulphuric ester of tri-oleïn. This could not be obtained free from tri-oleïn. A second acid, soluble in water, alcohol, and ether, is also formed. This is a yellow oil. The barium and copper salts are also oils. The author regards this acid as a tri-glyceride of oleic acid, stearic sulphuric acid, and hydroxystearic acid. Its acid value is 171·9—173·9 m. grm. KOH, and its iodine value 52·6 to 54·8. When decomposed by an alkali, the potassium salts of oleic, stearic-sulphuric, and hydroxystearic acids result, and also a further product, probably a distearic-sulphate of the following formula: $(C_{15}H_{31}-CH_2-CH.CO.OH)_2.SO_4$. This, however, could not be isolated in the pure state, and attempts to prepare its salts seem to show that the acid is decomposed by dissolving in water or by neutralisation. This last acid would be sure to yield α-hydroxystearic acid when heated with an acid; and the author considers that it must be regarded as the intermediate product to which the higher yield of fatty acids obtained by saponifying oleic acid and tri-oleïn with concentrated sulphuric acid is due. Hence a low temperature, excess of sulphuric acid, and good dry oils (or fats), which are conditions favourable to the production of the neutral distearic sulphate, and indirectly to that of the α-hydroxystearic acid, are consequently also the conditions which increase the yield of solid fatty acids formed by saponification.

—C. A. K.

Bone Fat. E. Valenta. Ztsch. f. Chem. Ind. 1887, 265.

The following conditions for the examination of bone fat are given by the author :—

Moisture.—Dry a sample at 110° C.

Ash.—Take the ash of 5—7 gr. of fat in a platinum dish, and determine the calcium in it.

Total Fatty Acids.—Saponify 5—10 gr. of fat with caustic soda of 38° B. diluted with twice its volume of alcohol. Distil off the alcohol, add water, and decompose the soap with dilute sulphuric acid. Heat on the water bath until the fatty acids become clear, add 5 gr. stearic acid, melt the whole, and allow it to solidify. Melt the resulting cake twice in pure water, dry with filter paper, transfer it to a platinum dish, again melt it, dry finally at 110°, and weigh. The stearic acid added is to be deducted.

Free Fatty Acids.—Boil 5—6 gr. of fat in a flask with absolute alcohol, allow the solution to cool, and titrate it with $\frac{1}{2}$ normal caustic alkali with phenol phthaleïn as the indicator. Knowing the saponification value of the fat the percentage of free fatty acids is reckoned from the amount of alkali used.

Saponification and Iodine Value.—Saponify 10 gr. of fat as above, precipitate the fatty acids, and melt them three or four times under water. The determinations may be made by the author's method or by that of Hübl (this *Journal*, 1884, p. 641).

Melting Point.—This is best determined by Pohl's method.

In most cases the determination of the total fatty acids, of the melting point, and of the free fatty acids is sufficient. The melting point, saponification, and iodine equivalent of the fatty acids extracted from commercial bone fat, either by benzine, carbon bisulphide, &c., or by boiling, show only comparatively slight differences, but they very often differ from those of the fatty acids sold by the bone boilers. Ten analyses of bone fat from different sources are given. The ash varies in these analyses from 0·11 to 2 per cent.; the water from 1·33 to 3·08 per cent. (in one very impure sample, almost black, it reaches 6·31 per cent.); the total fatty acids from 90·4 to 93·7 per cent. (in the above impure sample, 89·8 per cent.); the melting point of the fatty acids from 41°·5 to 42°·7; the free fatty acids from 14·8 to 26·5 per cent.; the saponification value from 200 to 207; the iodine value (by Hübl's method) from 48 to 55·8.

—C. A. K.

A new Vegetable Oil. T. F. Hanausek. Zeits. d. allgem. österr. Apotheker-Vereins, 1887, No. 30.

The seeds of Labiata Lallemantia iberica Fisch et M. yield a very cheap and generally useful oil; it is, however, little known in the commercial world, although it has been in use for a very long time in Persia, Syria, and Kurdistan, both for culinary purposes and as an illuminant. One plant will produce 2,500 seeds, they are black and resemble sunflower seeds in size and form. Analyses by Wildt, and more recently by L. Richter, show the following percentage composition of dry matter :—

——	Wildt.		L. Richter.
	Seeds.	Straw and Chaff.	
Crude albumenoids	26·87	14·06	23·79 (22·38 albumen)
Fat	29·56	2·78	33·52
Crude fibre	16·35	32·87	21·37
Non-nitrogenous extract	21·92	35·80	17·36
Ash	5·30	14·49	3·96

The relation of albumenoids to fat in other oil-seeds is as follows:—

—	Rape.	Linseed.	Hemp.	Lallemantia.
Albumenoids .	22·00	23·37	18·56	22·38
Fat	48·18	42·20	38·27	33·52

The oil keeps well, solidifies at – 34 to – 35°, and its sp. gr. is 0·9336 at 20—21°.—D. A. L.

Drying-unsaturated Acids in Fats and Oils. K. Hazura. Monatsh, 1887, 260—270.

From a series of experiments the author concludes :—that the drying-acids of fats and oils contain linolenic $C_{18}H_{30}O_2$ as well as linoleic acid $C_{18}H_{30}O_2$; when unsaturated fatty acids are oxidised with potassium permanganate OH groups are added, and saturated hydroxy-acids, containing the same number of carbon atoms in the molecule, are formed. The determination of the oxidation product affords a means for the qualitative analysis of fats and oils.—F. S. K.

Volatile Organic Acids in Suint. A. Buisine. Bull. Soc. Chim. 48, 639.

After a period of from 8—10 days the formation of volatile organic acids by micro-organism in suint reaches a maximum. To separate these acids, which are combined with potash, the solution is evaporated to dryness, and the residue extracted with alcohol. After removing the alcohol the aqueous solution of the potassium salts is treated with an excess of free phosphoric acid and distilled in steam. The free acids are now converted into the ethylethers, and these separated by fractional distillations as follow :—

37—40°	small quantity of ethyl ether formed during the process.
54°	a little ethyl formate.
75—77°	ethyl acetate.
96—99°	ethyl propionate.
124°	ethyl butyrate.
135°	ethyl valerianate.
166°	ethyl caproate.
210°	etcyl benzoate.

The author also prepared the barium salts of the acids by decomposition of the ethers with baryta water. The composition is stated below :—

Formic acid	Trace.
Acetic acid....................	60 per cent.
Propionic acid...............	25 „
Butyric acid	5 „
Valerianic acid	4 „
Caproic acid..................	3 „
Caprylic acid	Trace.
Benzoic acid	3 „
Phenol	Trace.

The formic acid was detected in the aqueous distillate by ammoniacal silver solution.

The caprylic acid separated in drops on the surface of the liquid, owing to its slight solubility in water.

Pure calcium acetate was prepared from the aqueous solution by Liebig's method—partial saturation of the acids with calcium carbonate and distillation of the uncombined acids—and the author hopes in this way to obtain acetic acid on the large scale from suint. In northern France alone, he calculates, 1,000,000 kilos could be prepared.

—O. H.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Improvements in Treating Leather. H. Golding, London. Eng. Pat. 3860, March 14, 1887. 6*d.*

The object of this invention is to increase the durability and water-repellent properties of leather by impregnating it with a hot solution of resinous gums, linseed oil, and turpentine.

For treating the soles of boots the following is suitable :—8 lbs. of gum animé or ordinary powdered resin are added to 3 gallons linseed oil and ¼ lb. each of litharge and sugar of lead as "driers." These materials are boiled together, and while still hot, but not boiling, 5½ gallons of hot turpentine are stirred in. The boots to be treated are warmed, and the hot solution applied with a brush. The boots are then left to dry for several days.—B. H.

Improvements in Leather Compositions, applicable to various Useful Purposes. E. Tuteur and J. Goulborne, both of London. Eng. Pat. 3027, February 26, 1887. 6*d.*

To make a composition suitable for soles and heels, cricket balls, writing desks, wall-decoration material, &c., leather flock is soaked in a solution of marine glue or india-rubber dissolved in mineral naphtha, and the pulp is pressed in suitable moulds. If hardness and inflexibility are desired the composition is vulcanised by adding sulphur and baking the product. The finished composition is oilproof and waterproof. For other objects where water-resisting property is of less importance the leather flock is compounded with Tuteur's belting glue dissolved in turpentine. Receipts for making compositions suitable for various purposes are given.—B. H.

XV.—AGRICULTURE, MANURES, Etc.

A New Manure Fraud. J. König, Allg. Brauer-w. Hopfenzeit., 1887, 1650—1651.

The author draws attention to the fact that a cheap mixture of basic slag and kainite is found in commerce under the name of ammonium phosphate, a more valuable and more expensive manure stuff.—D. A. L.

Kainite as a Protection against Wire-worm. Sächs. landw. Zeit., 1887, 685.

An oat field was in places left unmanured, whilst other parts received either Chili saltpetre and precipitated lime, or the same manures with kainite in addition, or Chili saltpetre, basic slag, and kainite. The crop on those parts receiving kainite was good, whilst where this constituent was omitted the plants were more or less severely attacked by wire-worm.—D. A. L.

Moss in Meadows. L. Dumas. Jour. d'agricult. prat., 1886, 86.

The growth of moss is favoured by the sterility, humidity, tenacity, and acidity of soil, and its presence indicates excessive moisture and insufficient aeration. Trenching and draining are recommended, especially when ranunculus, carex, colchicum, &c. are also prevalent; whilst alkaline manures are to be used to overcome the acidity.—D. A. L.

Injurious Action of Sulphurous Acid on Vegetation. L. Just. Bied. Centr., **16**, 790.

Certain roots were grown in the vicinity of a cellulose factory, and in the direction of the most prevalent winds blowing across the factory. The plants were all more or less charred, and analysis showed that the injury was due to sulphuric acid; some of the results are given below, the figures being sulphuric acid in 1,000 of dry matter.

Distance from Factory.	Healthy Leaves.	Sickly Leaves.
1. Immediately under factory .	9·35	16·89
2. 15 metres distant...........	15·72	14·05
3. 25 „ „	10·97	15·67
4. 50 „ „	9·58	11·03
5. 400 „ „	16·62	19·37

The figures in the second row show that although leaves are apparently healthy judging from the exterior, they may really be sickly. (Compare this Journal, 1887, 733.)

—D. A. L.

Manurial Experiments with Thomas Slag on Sugar Beet. E. v. Proskowitz. Bied. Centr. **16**, 739—742.

The experiments were conducted on a heavy humus swampy soil, poor in lime, which had during the three preceding years grown wheat top-dressed with Chili saltpetre, afterwards sugar-beet manured with dung, following a clover crop. All crops received Chili saltpetre, and in addition some received 6 kilos. of basic slag, some 8 kilos. per 100 sq. metres, applied either in the autumn or in spring, the remaining plots receiving 4·2 kilos. of superphosphate or no additional manure. The slag was of medium fineness, and contained 20·5 per cent. of phosphoric acid, and only 0·04 soluble in citrate. The superphosphate had 17·3 per cent. phosphoric acid, of which 12·44 was soluble. The results were irregular, but taking the average, under the prevailing conditions, superphosphate gave a greater increase than slag; whilst the period of sowing the latter made no material difference in the yield. The percentage of sugar was not affected by the variations in manuring.—D. A. L.

Experimental Cultivation of different Varieties of Potatoes. H. Schmidt, Landw. Centr. f. d. Provinz Posen, **15**, 273.

Seventeen different sorts of potatoes were grown for three successive years on a drained and cultivated loamy sand soil, with clay subsoil, in West Prussia. A table is given showing the yield of tubers and starch each year. At harvest 1887 the haulms of Gelbe Rose, Daberscbe, and Aurora were dead; of Warschauer, Odin, and Aurelie, ¾ dead; Kornblume and Andersen, ½ dead; Hermann, Juno, Amarant, and Charlotte, quite green. Attention is drawn to the speedy degeneration of the plant in some cases (the Odin potato for example), and to the great effect of the character of the season on the yield of some varieties. These experiments show that Warschauer and Hermann were the best yielding potatoes under all conditions, that Gelbe Rose, Aurora, and Daberscbe have good qualities for cultivation. Aurelie, Amarant, Charlotte, and Andersen require further trial before they can be recommended for cultivation on a large scale, whilst Odin and Kornblume proved of smallest value. Warschauer potatoes are only fit for fodder.—D. A. L.

Manuring Hops. C. Kraus. Bied. Centr. **16**, 785—78.

The best results are obtained with manures containing potash, phosphoric acid, and nitrogen, and, in addition, putrescible organic matter; the latter, by its steady decomposition, ensures a gradual supply of nutritive matter, which is observed to be favourable to the hop plant. Hence, guano is better as a hop manure than either potassium—ammonium—superphosphate, or mixtures of Chili saltpetre and superphosphate. Using rape-cake meal for feeding makes good hop manure. Excessive dressings of nitrogen are injurious to hop plants, although nitrogen itself is of the utmost importance. Dressings of nitrogenous manures on a poor soil deficient in potash and phosphoric acid are, however, followed by incomplete and unremunerative results (even on richer soils the disadvantage of such one-sided manuring becomes apparent after a time); similar remarks apply, to a certain extent, to manuring with potash and phosphoric acid alone. Nevertheless these two manures may be employed to advantage when experiment has shown that a soil already contains sufficient nitrogen, and that, therefore, any addition of nitrogen in manure would simply increase the yield at the expense of quality. Dung is an excellent manure for hops, but artificial manures may be mixed with it to advantage, especially where circumstances render dung comparatively dear.—D. A. L.

The Behaviour of different Plants when supplied with Nitrogen in the form of Nitrate in Experimental Sand Cultivations. E. Wolff and C. Kreuzhage. Bied. Centr. **16**, 793—808.

This communication furnishes the details of an important series of experiments, the conclusions from which have already appeared (this Journal, 1887, 667). The following numerical illustrations will be found of great interest. The experimental soil consisted of washed river sand, and the various plants were grown:—I. in the sand alone; II. in the sand with addition of dicalcium phosphate, calcium carbonate, magnesium sulphate, and potassium carbonate; III. same as II., with part of the potassium carbonate replaced by nitrate (= 33·3 kilos. nitrogen per hectare for all the plants except peas, where the smaller quantity of nitrogen = 83·2 kilos. per hectare). IV. same as II., with all the potassium carbonate replaced by nitrate (nitrogen = 133·2 kilos. per hectare, and for the peas 332·8 kilos.).

Tables showing yield in dry matter and nitrogen in the overground portions of the plants (exclusive of stubble and roots) in kilos. per hectare:—

Condition of Soil.	Oats.	Field-beans.	Lupins.	Red-clover.	Sand-pea.
Dried Substance.					
I. Unmanured	1,482	4,677	4,384	4,297	6,152
II. Salts alone	1,542	9,568	12,468	9,233	33,184
III. Salts with small quantity of nitrogen	4,169	6,042	8,336	9,742	47,720
IV. Salts with large quantity of nitrogen	14,180	7,817	12,572	10,307	53,074
Nitrogen.					
I. As above	14·8	99·1	111·9	135·8	97·6
II. "	15·5	187·6	382·9	334·1	477·8
III. "	45·4	129·3	215·7	352·1	739·6
IV. "	139·4	164·2	352·6	376·1	1,013·8
I. As before	− 9·0	+ 57·7	+ 88·3	+135·8	+ 84·7
II. "	− 8·3	+146·2	+393·3	+334·1	+464·9
III. "	−11·7	+ 54·6	+158·8	+318·8	+643·5
IV. "	−16·5	+ 89·5	+195·8	+242·9	+668·1

It must be remembered that seed planted contained nitrogen amounting, in the oats, to 23·8 kilos. per hectare; the beans to 41·4; the lupins, 23·6; the peas, only 12·9; and in the clover seeds, to a small amount only. The third table represents the amount of nitrogen in the above (overground) yields + or − the total nitrogen applied (both in seed and as nitrate) to each plant.

If, in addition to this, the underground growth be taken into consideration, the quantity of nitrogen in the oat crop will still be below that supplied to it, whereas the surplus of the nitrogen of the leguminosæ, already large, will be further augmented. These figures illustrate very forcibly the conclusions already given (loc. cit.).—D. A. L.

The state of Combination of Sulphur and of Phosphorus in Plants, Soil, and Humus, and the Determination of these Elements therein. Berthelot and André. Compt. Rend. **105**, 1217.

To determine the sulphur and phosphorus the sample is dried at 100° and then burned in a current of oxygen, the vapours being led over a long layer of pure anhydrous sodium (or potassium) carbonate. The carbonate is heated in a hard glass tube almost to redness, but not sufficiently to melt the carbonate or to cause it to act upon the glass; a blind test should be made to be sure that the glass is free from sulphur. When the organic matter has been completely burned away, the current of oxygen is allowed to continue for a short time in order to convert any alkaline sulphide into sulphate. The whole is let cool, when the contents of the tube are dissolved in much water, the solution is acidified with HCl, boiled and precipitated with barium chloride. If the ashes of the plants are siliceous, the silica is separated in the usual way. Thus total sulphur is determined. The filtrate from the barium sulphate contains the phosphorus as phosphate which can be precipitated by ammonium nitro-molybdate. Sulphur and phosphorus may exist in the soil, in humus, and in plants:—(1.) As sulphate or phosphate soluble in water or dilute acids. (2.) As ethereal compounds such as ethyl sulphates or phosphoglycerides, in which case the contained phosphorus and sulphur would be oxidised in the wet way to phosphoric or sulphuric acid respectively. (3.) As sulphide, sulphite, hyposulphite, and salts of other sulphur acids, the phosphorus as phosphide, phosphite, hypophosphite, &c. Oxidation would be effected as in the last case. (4.) As organic compounds such as taurin, cystin, sulphonic acids, albumen, and as triethylphosphine oxide, phenyl phosphines, and cerebrin respectively. The sulphur and phosphorus in these cases would not be completely oxidised in the wet way. The authors determine the sulphur and phosphorus in soil, &c. by extracting first with dilute hydrochloric acid, and estimating the sulphur and phosphorus in the extract, then with nitric acid, and again determining the sulphur and phosphorus oxidised, and finally they determined the total sulphur and phosphorus contained by the method described above. The results show that these substances like nitrogen are contained in a variety of forms in plants, soil, and humus, in part soluble in hydrochloric acid, in part oxidised to sulphuric and phosphoric acid by nitric acid, and again in part only completely oxidised by decomposition at a red heat, hence this method alone is suitable for their determination.—C. A. K.

Ratio between Lime and Phosphoric Acid in Bone Dust. C. I. van Lookeren-Campagne. Chem. Zeit. **2**, 24—25.

The author has obtained the following results:—

Jaw-bone of horse, CaO : P_2O_5 = 134·8 : 100.

Leg of sheep, CaO : P_2O_5 = 134·5 : 100.

Skull of cow, CaO : P_2O_5 = 134·6 : 100.

Bones which had been buried, CaO : P_2C_5 = 135·6 : 100 and 138·9 : 100.

The bones used had been thoroughly well cleaned so as to exclude any error arising from adhering calcareous soil. Taking the ratio in round numbers 135 : 100, the author has compared the per cent. phosphoric acid calculated from the lime with that obtained by analysis.

Fresh bones: CaO = 25·38 P_2O_5 = 18·78 (determined) 18·80 (calculated).

Ground bone freed from fat: CaO = 31·48 P_2O_5 = 23·30 (determined) 23·32 (calculated).

Bone meal in natural state: CaO = 23·98 P_2O_5 = 17·85 (determined) 17·77 (calculated).

Bone freed from gelatin, &c: CaO = 43·12 P_2O_5 = 32·13 (determined) 31·95 (calculated).—J. W. L.

PATENTS.

Improvements in the Manufacture of Fertilizers or Manuring Compounds. J. Davenport, Stoke-on-Trent, Staffordshire. Eng. Pat. 15,309, November 9, 1887.

Iron pyrites or any pyritiferous compound is ground to powder and applied to the land either alone or mixed with spent plaster or disused moulds from the potteries, gypsum, silica or silicious rock, burnt clay, or aluminous earth. —J. M. H. M.

A Method of Treating and Mixing or Compounding Phosphatic Compounds for Artificial Manures. A. Campbell, Upton Park, Essex. Eng. Pat. 2459, February 17, 1887.

Redonda or Alta Vela phosphate or similar material is calcined and then finely ground. The calcined redonda phosphate contains as much as 48 per cent. of phosphoric acid soluble in alkaline ammonium citrate, and is to be mixed with low grade superphosphate, or with compound manures containing nitrogen and potassium as well as phosphoric acid, in order to increase the percentage of available phosphoric acid in the resulting mixtures. —J. M. H. M.

XVI.—SUGAR, STARCH, GUM, Etc.

Examination of Manna. C. Daudt. Pharm. Zeit. **32**, 693.

According to the test of the German pharmacopœia 5 parts of manna boiled with 100 parts of alcohol should give a neutral solution, whereas the residue should be solid and not slimy. The author states that he has never yet met with a specimen of manna communis which gave a solid residue, and the solution has mostly an acid reaction. Manna canellata gives a solid residue, but its solution is acid.—S. H.

Extraction of Sugar from Sorghum. Neue Zeits. f. Zuckerind. **19**, 173.

By neutralising liquors with calcium carbonate and using American machinery instead of German, good results have been obtained at Fort Scott. One ton of cane yielded 113 lbs. of sugar, polarising 92 and 15 gals. of syrup, which in its turn gives 20 lbs. of second product sugar and 12 gals. of residual syrup; making in all a yield from 100 sorghum of 6·66 of sugar and 7·54 of syrup.—D. A. L.

Manufacture of Milk Sugar. Grandeau. Jour. fab. sucre, **28**, 44.

In Switzerland, and more especially in the neighbourhood of Marbach, large quantities of milk sugar are manufactured. The crude sugar is obtained as a coarse dirty powder by the direct evaporation of whey, 50,000 litres yielding 1,250 kilos. daily. The crude sugar is refined by dissolving in water at 65° in copper pans, and adding $\frac{3}{4}$ to 1 kilo. of alum or aluminium sulphate; the liquid is filtered through animal charcoal, boiled down to a syrup, and then allowed to crystallise slowly on wooden rods. The yield is from 55 to 60 per cent. of the crude sugar.—D. A. L.

Manufacture of Invert Sugar. Zeits. f. Zuckerind, **37**, 894.

Taking into consideration the various processes for the manufacture of invert sugar, and more especially those of Maumené (employing hydrochloric acid and silver or sulphuric acid and barium carbonate); of Seyberlich (nitric acid and sulphur dioxide); of Sachsenröder and Gottfried (tartaric or citric acids); and of Follenius (carbonic anhydride and pressure); Herzfeld regards the carbonic anhydride process as the most rational, but without restriction to Follenius' apparatus and method. The analogous sulphur dioxide method requires trial. It is however, always important:—to employ only pure high percentage white sugar, and when working at a concentration of 15 to 20 per cent. to keep the temperature as low as will possibly permit a rapid inversion; to avoid any excessive heating, especially in acid solutions; to neutralise most carefully (very necessary in thick liquors); and to concentrate in as complete a vacuum as possible at the lowest workable temperature.—D. A. L.

Composition of a Deposit on a Filter Press used for Thick Sugar Liquors. D. Zuckerind, **12**, 1303.

When filtering thick sugar beet liquors, the filtration is frequently interrupted by the clogging of the filter by a deposit which has hitherto been regarded as consisting of gummy organic compounds. Lippmann has now examined one of these deposits, and finds it consists almost entirely of hydrated silica and alumina mixed with magnesium salts of fatty (oleic, palmitic, stearic) acids. The inorganic constituents are derived from the chalk used for neutralisation, whilst the organic salts originate in the partial saponification of the beef or mutton fat employed to arrest frothing during the saturation. To prevent the inconvenience, it is recommended to boil rigorously after saturation, to filter the boiling solution mechanically and under slight pressure, and to avoid all animal and vegetable fats.—D. A. L.

Do the Cereals contain Sugar? A. v. Asbóth. Chem. Zeit. **12**, 25—26, and 53.

If the residue of the alcoholic extract of the cereals be tested for sugar after inversion, only a trace is found, and this the author suggests is probably due to the small amount of dextrin dissolved by the alcohol. The author has experimented with the methods of Schlösing, Koenig, and J. Bell for the estimation of sugar, and finds that a gum and also small quantities of dextrin are extracted from cereals by these processes which reduce Fehling's solution. —J. W. L.

On Organic Constituents in Beetroot-Juice. Deutsche Zuckerind, **11**, 1537.

Lippmann isolated cholesterin from the fat layer on the surface of syrup in the state of "froth-fermentation." The cholesterin proved identical with Hesse's phytosterin. The fact that beetroot-fat frequently contained phosphorus, led Scheibler many years ago to the conclusion that beetroot contains a complicated body, similar to protagon, which readily decomposes into a fatty acid, glycerol-phosphoric acid, and betaine, the existence of which substances in beetroot were proved by him. Lippmann extracted large amounts of beetroot with ether and alcohol, and on evaporating obtained a yellow slimy mass, a lecithine. On boiling with barium hydrate, it decomposed into oleic acid, glycerol-phosphoric acid, and betaine, thus proving Scheibler's prognostication. The simplest formula of this complicated body is probably $C_{44}H_{82}O_9PN$. Its platinum salt forms yellow flakes, soluble in ether $(C_{44}H_{81}O_8PNCl)_2PtCl_4$. On the repetition of the experiment a similar mass was obtained, but this gave on decomposition other fatty acids besides oleic acid, and choline instead of betäine. The beetroot also contains nucleines, the products of decomposition of which (the xanthine compounds) are found in the molasses.—S. H.

XVII.—BREWING, WINES, SPIRITS, Etc.

Cooling and Aerating Wort in Breweries. J. C. Holm. Zeits. f. d. gesammt. Brauwesen, 1887, 450.

A cooling apparatus is described, which is so constructed as to allow ingress to sterilised air only; moreover the aeration of the wort is effected by forcing sterilised air into the liquid while cooling. These precautions keep the wort in good condition.—D. A. L.

Vanillin in Spirit. Zeits. f. Spiritus Ind. **10**, 331.

Both Salzer and Reinke have detected vanillin in spirit; the former regards it as an adulterant added to mask the odour of fusel oil, whereas the latter author attributes its formation and presence to the action of air and the spirit during the storage of the latter in vessels made of certain kinds of wood.—D. A. L.

The Temperature of the Fermentation Chamber in Distilleries. Oesterr.-ungar. Brennerei-Zeit. **11**, 276.

Variations in temperature are as injurious as draughts of air to fermentation; consequently it is emphatically asserted by Christek that the temperature of the fermentation chamber should generally be the same as that of the principal mash, or 1—2° higher or lower if a quicker or slower fermentation is desired.—D. A. L.

Injurious Action of Coal Gas on Green-malt while on the Floors. C. Cabanis. Norddeutsche Brauer-Zeit. 1887, 379–380.

Under the influence of coal gas or of many products of combustion the development of green malt is weakened and the germs gradually die off, whilst the rootlets contract, curl up, and wither. It is hence important to have the malting rooms well ventilated and lofty.—D. A. L.

Preparation of Artificial Yeast for the Production of pure Alcoholic Fermentation in highly concentrated Brandy Mashes. J. E. Brauer. Zeits. f. d. Chem. Ind., 1887, 210.

The mash for the cultivation of the yeast may be made from potatoes or cereals with a little malt; if a strength of 25° by Balling's saccharometer is aimed at, no water must be added during the mashing. The cultivation is conducted in the following manner: 80 litres of mash and 2 litres of acid yeast are well mixed in a vessel of 100-litre capacity, 5 kilos. of new malt recently crushed fine or 3·4 kilos. of crushed kiln-dried malt are then worked in and the whole brought to 58·8° and left at rest in a closed vessel for two or three hours until the formation of sugar is complete. The temperature is now raised to at least 75°, and retained at this temperature for 10 to 15 minutes (to destroy or weaken injurious ferments), the mass is cooled to 68·7°, and during the souring must not fall below 47·5° as soon as the desired acidity 2·5 to 3 cc. of normal soda is reached it must be rapidly cooled to from 16·2 to 17·5°. From this point until the ripening of the yeast, about 10—12° of the original saccharometer indications of the mash will be fermented. When taken for use the yeast is mixed with $\frac{1}{2}$ or 1 per cent. of sulphuric acid to prevent bacterial fermentation. The author is convinced that higher yields of alcohol will be obtained by the use of this yeast.—D. A. L.

Means for rendering Alcohol unfit for Consumption "Denaturation." A. Schneider. Pharm. Centr. H. N. F. **8**, 620.

The author contends that the official method of rendering alcohol unfit for consumption is inefficient, because on distillation, with a slight excess of sulphuric acid, the methyl alcohol first comes over, then follows spirit having a pleasant odour, while it is only in the last portion of the distillate that the objectionable smell of the substances contained in crude wood-spirit and of pyridine appear. He further holds that the addition of 0·5 per cent. of petroleum spirit of b. p. 100—200° as previously recommended by him, is the best means of preparing an alcohol unfit for consumption. Spirit thus treated possesses a slight smell of petroleum spirit, but this in no way deteriorates its value for cleaning purposes, burning, &c. It burns without smoke, whilst the presence of the petroleum is at once detected by the turbidity produced on the addition of a few drops of water. The petroleum cannot be completely precipitated by water, nor can it be separated by fractional distillation even after the addition of water.—C. A. K.

Remarks on Enzymes. O. Loew. J. Prakt. Chem. 37, 101—104.

The author has obtained good active preparations of the pancreas ferment, and of malt diastase by treating the crude ferments with acetate of lead, a method recommended by Wurtz. Both gave the characteristic reactions for albumen, the latter still contained dextrin, and was not sufficiently pure for analysis. On this ground Lintner's analysis of malt diastase is considered unsatisfactory. It is suggested that the enzymes contain a very unstable group of atoms, as is shown by the changes produced by acids, alkalis, and by warming to 80°, and that this may consist of amido, and aldehyde groups. They do not reduce an ammoniacal silver solution, whence the aldehyde group must be in a comparatively inactive polymerized form, *e.g.*:—

$$HC{<}\substack{O\\O}{>}CH.$$

0·15 gr. of hydroxylamine destroys the activity of 1·0 gr. diastase in 24 hours, but the same quantity does not affect 10 gr. diastase. Equivalent quantities of ammonia and of caustic soda killed the enzyme in both cases. Nitrous acid also acts destructively on diastase at 40°. The action of formaldehyde is still more marked. Pepsin and diastase left in contact with a 15 per cent. solution of formaldehyde for one day are destroyed; emulsin, papayotin, trypsin, and many other albuminoids give precipitates with this reagent, which are insoluble in acids or alkalis. This, according to the author, seems to point to the presence of amido groups in the ferments.—C. A. K.

An improved Fermentation Apparatus. E. Bauer. Ztschr. f. angew. Chem. 1888, 11.

In the apparatus in which the carbon dioxide evolved in course of fermentation escapes through sulphuric acid, there are many sources of error. Owing to the retention of carbon dioxide a restraining influence is exerted on the ferment action, and if the fermentation should be at all vigorous, a portion of the acid may be carried away mechanically, while, on the other hand, the gases are not completely deprived of their moisture. The author fits a two-holed cork to the fermentation flask, through one perforation passes a long tube carried to the bottom of the flask, and closed above by an india-rubber cap; through the other is the tube of the drying apparatus. This consists of a narrow glass tube sealed through the bottom, and prolonged inside nearly to the top of a stoppered glass tube of wider bore, which is filled with asbestos saturated with sulphuric acid; on the side and close to the bottom of the latter is sealed a second narrow tube, bent vertically upwards close to the joint, and so carried outside nearly to the top of the apparatus, where it is again bent horizontally. Gases evolved from the flask thus pass through the inner tube to the top of the absorption tube, and passing downward through the asbestos laden with sulphuric acid, give up their moisture and pass away through the lower narrow tube. To prevent absorption of atmospheric moisture by the asbestos, the last-named tube may be connected with a calcium chloride drying apparatus. The carbon dioxide remaining in the flask at the end of the operation is replaced by removing the cap of the long tube and drawing air through the apparatus.—W. G. M.

Composition of Cognac. E. C. Morin. Compt. Rend. 105, 1019.

The author distilled 92 litres of pure cognac, prepared in 1883 from Charente Inferieur wine in Claudon and Morin's apparatus. The first portion of the distillate contained the more volatile bodies, the second consisted of tolerably pure ethyl alcohol, the third, the higher boiling alcohols, &c. The residue, chiefly water, was tested for free acids, isobutylglycol and glycerol.

The first three portions were then fractionated, 5 litres of light alcohol, 55 litres of pure ethyl alcohol and 3·5 litres of higher boiling compounds being obtained. The latter fraction smelt strongly of fusel oil and possessed a burning taste. The water remaining behind was added to that already obtained. The fractions were then redistilled in Le Bel and Henniger's apparatus. The fusel oil portion, which after dehydration by potassium carbonate weighed 352 grms., gave:—

	Grms.
Water	7
Ethyl alcohol	130
Norm. propyl alcohol	25
Isobutyl alcohol	6
Amyl alcohol	175
Furfurol	2
Wine oils	7

The water contained a little acetic and butyric acids and a small quantity of a viscous liquid, which distilled undecomposed under diminished pressure and appeared to consist of isobutyl alcohol and glycerol. The residue contained tannin, together with substances extracted from the wood.

In the following table: I. shows the compounds contained in 100 litres of the cognac; II. shows the same obtained by the fermentation of 100 kilos of sugar.

——	I.	II.
	Grms.	Grms.
Aldehyde	Trace	Trace
Ethyl alcohol	50837·0	50615·0
Norm. propyl alcohol	27·17	2·0
Isobutyl alcohol	6·52	1·5
Amyl alcohol	190·21	51·0
Furfurol bases	2·19	0·0
Wine oil	7·61	2·0
Acetic acid	Trace	..
Butyric acid	Trace	..
Isobutyl glycol	2·19	..
Glycerol	4·38	..

Butyl alcohol was absent; furfurol was detected directly by the addition of aniline to the cognac, a red colouration being produced in presence of acetic acid.—O. H.

PATENTS.

Improvements in the Manufacture of Yeast. A. Walker, Glasgow. Eng. Pat. 4271, March 22, 1887. 6*d.*

The yeast is grown in a mash prepared from malt or grain, partly saccharified by diastase and partly by mineral acid. —G. H. M.

A Process and Apparatus for Purifying Crude Spirit and Regenerating the Purifying Agent. J. A. F. Bang and M. C. A. Ruffin, Paris, France. Eng. Pat. 5337, April 12, 1887. 8*d.*

This patent relates to improvements in Eng. Pat. 10,870, 1884 (this Jour. 1885, 506), and in Eng. Pat 783, 1886 (this Jour. 1887, 147). The improvements consist of a process and apparatus whereby the spirit to be purified is passed through heavy petroleum oil, and the oil is regenerated so that the process can be carried on continuously on a given quantity of spirit during the time necessary for its purification.—G. H. M.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

Artificial Mineral Waters. Chem. Zeit. **12**, 58.

The following regulations have been suggested by the Polizei-Praesidium, of Berlin. (1.) The workshops of the factory shall be well ventilated, large, and light. (2.) The use of spring water is not allowed. (3.) The salts used in the manufacture must possess the purity ascribed to them by the pharmacopoeia. (4.) The bottles containing carbonic acid in water under pressure are to be covered during the operation of corking with a wire gauze.

—J. W. L.

Benzoic Acid in Milk. F. M. Horn. Ztschr. Chem. Ind. **2**, 329.

Benzoic acid when added to milk to prevent coagulation is readily detected by Meissl's test, but the method is inaccurate for its quantitative determination. To determine it quantitatively 10—15 g. of the previously shaken milk are mixed with 10—15 cc. of distilled water and warmed with dilute hydrochloric or acetic acid (1:100) until it coagulates. After filtering and washing the precipitate with warm water the filtrate is evaporated to dryness, and the residue taken up with 40—50 per cent. alcohol, filtered and washed with dilute alcohol. Two or three drops of ammonia are added to the filtrate, the excess boiled off, and the solution, which must be filtered if not quite clear, exactly neutralised and treated with its own volume of absolute alcohol. The benzoic acid is then precipitated with a dilute solution of copper sulphate, and the copper benzoate weighed after drying at 100° on a weighed filter paper. Provided the solution is neutral and alcoholic the precipitation is complete. The copper benzoate can then be treated with nitric acid, and the copper oxide weighed, or it may be reduced to cuprous sulphide or metallic copper in a Rose's crucible. For the qualitative detection of benzoic acid the above alcoholic filtrate may be extracted with ether, and the ethereal solution allowed to evaporate spontaneously. If the residue be heated on the water bath the benzoic acid will sublime, and may be recognised by its characteristic odour.

—C. A. K.

A New Saccharine Preparation. Schumacher - Kopp. Chem. Zeit. **12** (7), 106.

The firm of Sprüngli and Son, of Zürich, have recently introduced into commerce a preparation of saccharine cocoa, free from oil, which will doubtless be applied as a convenient method of administering saccharine to persons suffering from diabetes and stomachic catarrh. This preparation is a fine powder of extreme solubility, possessing a sweet taste and a faint acid reaction. Analyses pointed to a complete absence of metallic impurities, and of falsification with meal. The following results were obtained:—

	Per Cent.
Moisture	3·89
Ash	6·45
Fat	28·78
Phosphoric acid	16·88
Saccharine	·76

The results for the ash and phosphoric acid show that the preparation is free from fatty substances.—V. H. V.

(*B*)—SANITARY CHEMISTRY.

The Absence of Microbes in expired Air. J. Straus and W. Dubreuilh. Compt. Rend. **105**, 1128.

The authors have shown by bacteriological experiments that the air exhaled by man and animals is free from microbes, by allowing it to act on sterilized meat extract. Breathing is, therefore, a purifying process as far as microbes are concerned, as has been previously recognised by Lister.

Experiments by Grancher, and also by Charrin and Karth, have further shown that the air exhaled by consumptive people is free from microbes.—C. A. K.

The Injurious Action of several Gases and Vapours of Hygienic and Technical Importance. M. v. Pettenkofer and K. B. Lehmann. Sitzungsber d. Math. Phys. Cl. d. K. bayer. Akad. d. Wissensch zu. München. 1887, 179.

Experiments made on this subject with the following substances go to show that the general information contained in the text books needs considerable correction.

Hydrochloric acid gas.—Animals exposed to air containing 3·4 per cent. of the gas for 1½ hours, were seriously affected; rats withstand the gas best; cats and rabbits died the following day from the above dose. A strong man can only stand air containing 0·05 per cent. of the gas for a short time, and the limit for workmen who have become used to it is put at 0·1 per cent.

Ammonia resembles hydrochloric acid gas in its action, but it is not so injurious. 0·3 per cent. in air is dangerous, and 0·5 per cent. to those accustomed to it.

Chlorine.—0·001 per cent. to 0·005 per cent. affects the respiratory organs; 0·01 per cent. to 0·06 per cent. produces dangerous symptoms, and 0·6 per cent. soon proves fatal.

Bromine acts like chlorine. Men cannot stand more than 0·002 per cent. to 0·004 per cent. if not habituated; if habituated, not more than 0·01 per cent. This shows that fumigation with chlorine or bromine in the case of cholera epidemics is of no value, since to produce fatal effects on bacteria they must be exposed to air containing 3 per cent. of chlorine for 3 hours, or if it contains 0·4 per cent. for 24 hours.

Sulphuretted hydrogen is less poisonous than chlorine or bromine, doses of 0·7 per cent. in air being needed to kill animals exposed to it for 5 hours.

Carbon bisulphide was found to vary greatly in its action in different samples, although quite free from sulphuretted hydrogen, the chief poisonous action appearing to be due to unknown impurities it contained. A cat placed in air containing 2·3 m. gr. of carbon bisulphide to the litre for 7 hours expired 10 hours afterwards.

Aniline.—0·1 per cent. in air proves dangerous, cats being especially sensitive, while rabbits and guinea pigs are comparatively slightly affected.

Nitrobenzene vapour, even in large quantities, produces no serious effect.

The authors consider that these gases and vapours do not only produce local effects and changes on the body or on the blood, but that the central organs of the nervous system are acted upon; also that the more highly developed the organism is, the greater is its sensibility.—C. A. K.

Antiseptic value of β-Naphthol. C. Bouchard. Compt. Rend. **105**, 702.

The author considers that in certain cases β-naphtol possesses advantages over all known antiseptics, a fact due mainly to its insolubility. 0·2 gr. of naphthol dissolve in 1,000 parts of water; 1 gr. in 1,000 parts of water containing 5 per cent. of alcohol, and 2 gr. in 1,000 parts of water containing 10 per cent. of alcohol. 0·33 gr. in 1,000 gr. of meat extract or of gelatin completely prevents the development of various forms of microbes and micrococci; the same quantity restrains the growth of the typhoid fever bacillus and to some extent that of the tubercolosis bacillus. β-naphthol also prevents the decomposition of urine, and in the proportion of 0·2 gr. per litre of water stops further decomposition. Its antiseptic action on microbes is four times as great as that of carbolic acid, but sixteen times less than that of mercury di-iodide. The toxic dose for rabbits is 253 more than that of mercurous iodide, so that in equivalent physiological doses its antiseptic power is 14—15 times greater. 250 gr. naphthol per 65 kg. body weight is the toxic dose for man, while 2·5 gr. daily suffices as an intestinal antiseptic. Injected subcutaneously 3 gr. per 1 kilo. body weight is fatal. The antiseptic dose of this substance is considerably less than that of iodoform, iodol, or of naphthalene, while the toxic dose is greater (with the exception of iodol).—C. A. K.

The Cause of the Action of Various Waters on Lead-pipes.

M. Müller. J. prakt. Chem. **36**, 317.

The author has paid special attention to the carbonic anhydride and oxygen dissolved in water, to which he attributes their action on lead-pipes; even distilled water cooled in contact with the air contains these gases and will attack lead. If the carbonic acid present is by volume double that of the dissolved oxygen then the action is very energetic; on the other hand, the action of oxygen is very feeble in the absence of carbonic anhydride, and there is no visible corrosion when the water contains the normal proportion of dissolved oxygen of about $1\frac{1}{2}$ or more vols. per cent. of the carbonic anhydride. The product of this action on lead has not a constant composition; an analysis gave:—H_2O 3·49, CO_2 11·89, and PbO 84·41 per cent. In all cases when active distilled water, either alone or with carbonic anhydride added to it, was brought in contact with lead, after some time more or less of the metal was dissolved; the quantity dissolved increasing with the amount of carbonic anhydride present. The dissolution proceeds but slowly and reaches a maximum, beyond which point the lead again disappears from the solution, this is due to the fact that lead carbonate is practically insoluble in pure distilled water, but is dissolved in tangible quantities by water containing carbonic anhydride; consequently the lead is dissolved as long as there is free carbonic anhydride in the water, but directly this is removed by combining with the lead oxide or basic carbonate, then also the lead in solution is soon deposited. The action of natural waters on lead will therefore vary with their aeration and the amount of carbonic anhydride they contain, but as previous investigators have not recognised this fact, they have been led to attribute this action to various causes which have in their turn given rise to the contradictory statements on this subject. The protective action of ammonia is simply due to its combining with the carbonic anhydride, and even then this action is limited to small quantities, since when ammonia is present in a water in larger quantities either as mono- or bi-carbonate, or in the presence of free carbonic anhydride small quantities of lead always pass into solution. Solutions containing lime, or soda free from carbonic anhydride, attack lead vigorously in presence of dissolved oxygen, but not at all when the oxygen is excluded; this explains the destruction of lead pipes set in walls with cement; if, however, the wall remains dry, this action does not take place. Sodium carbonate in small quantities will render active distilled water inactive, but when the water is well aerated it does not prevent lead being dissolved; sodium bicarbonate, on the other hand, not only prevents lead being dissolved, but also precipitates lead already dissolved, and the lead becomes slowly covered with a very tenacious white deposit. Calcium bicarbonate acts in a similar manner and therefore would act protectively in waters containing it. The action of sulphates appears also to be connected with the dissolved carbonic anhydride, inasmuch as water containing gypsum and calcium bicarbonate does not dissolve any lead, but when gypsum alone and in addition free carbonic anhydride are present then lead soon passes into solution in unlimited quantities. The chlorides, nitrates, ammonia compounds, and organic substances present in river or well waters when in small quantities exert neither a protective nor injurious action on lead. When, however, there are large quantities of organic matter, then by its decomposition the waters become rich in carbonic anhydride and attack lead-pipe, provided calcium bicarbonate is absent. In sewage the abnormal quantity of ammonium would destroy the lead-pipe. From these results it would appear that an analysis of a water will at once decide as to its capacity for dissolving lead.—D. A. L.

(C)—DISINFECTANTS, &c.

Sodium Sulphibenzoate as an Antiseptic Agent in the Treatment of Wounds.

E. Heckel. Compt. Rend. **105**, 896.

Sodium sulphibenzoate is the name given by the author to the product obtained by dissolving benzoic acid in a concentrated solution of sodium sulphite; it is easily soluble in water, and is quite harmless, even in large doses, while it readily sterilizes very many forms of microbes. It has been tried as an antiseptic in several hospitals, and Fontan reports that 4—5 gr. dissolved in 1 litre of water acts as an excellent antiseptic in washing, or against ferments; also in the healing of wounds. It is better than carbolic acid and equal to mercury salts in its antiseptic power, while its harmless nature renders it preferable to the latter: compared with iodoform, it is cheaper, and has no smell.—C. A. K.

Antiseptic Action of Iodoform and of Ethereal Oils, and the Absorption of Gaseous Antiseptics by Gelatin.

G. Riedlin. Arch. f. Hygiene **7**, 309.

Iodoform has hardly any antiseptic action on yeast, but is a powerful antiseptic against cholera germs, its vapour being sufficient to prevent their growth. Turpentine stops the growth of bacteria, and when dissolved in gelatin (1 : 200) also that of torulae. Lavender oil, eucalyptus oil, and rosemary oil are good antiseptics, the first especially against forms resembling the typhus bacillus; the emulsions of these oils have hardly any antiseptic action. Clove oil is also an antiseptic. Iodol has no action on cholera or on any other bacteria. Peru balsam acts powerfully on the cholera bacillus and on the forms allied to the typhus bacillus. A 5 per cent. solution of sodium sulphoichtyolicum hinders the growth of torulae but does not kill them. Aniline oil and so called aniline water are good antiseptics.

As regards the absorption of gases by gelatin, the author finds that ammonia, carbon bisulphide, and allyl mustard oil diffuse into it most readily; then chloroform and the vapours of iodoform, potassium cyanide, and strong acetic acid in the order given; the degree of absorption depending on the volatility and on the molecular weight of the substance.—C. A. K.

XIX.—PAPER, PASTEBOARD, Etc.

Agalith, a New Weighting Material for Paper Manufacture.

Monit. de la papeterie française, 1887.

Agalith is found in large quantities in the United States of America. It is a hydrated magnesium silicate containing small quantities of iron and alumina, resembling asbestos in its composition. In colour it is white, with a greenish tinge; it has a sp. gr. of 2·2–2·5, and can be readily ground up. Used for weighting paper, it produces an excellent result, whilst the mechanical loss of paper and of weighting material is extremely small.—C. A. K.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

β-Naphthol.

B. Fischer. Pharm. Zeit., 1887, 632.

β-naphthol may be obtained crystalline for medicinal purposes by simply crystallising the commercial product from light petroleum or benzene.—D. A. L.

Strophanthus. H. Helbing. Pharm. Zeit., 1887, 664.

Strophanthus fruit from the Niger is long, thin, and slender, externally greyish-black, furrowed in the direction of its length with numerous bristly hairs, and studded with small grey excrescences. The seed is rather small, brown, and intensely bitter. The pappus is brown and short, whilst the feathery tuft is long haired. Seeds from Winnebah are not very long, and of medium width. Some strophanthus seeds of commerce were found to consist of at least two varieties, which is an important point, since the various kinds of strophanthus may possibly vary considerably in strength.—D. A. L.

Fabiana Imbricata. G. Nivière and E. Liotard. Jour. Pharm. Chim., 1887, 389.

This plant is recommended in liver and urinary complaints. Fabiana imbricata belongs to the Solanaceæ. The twigs are covered with very small scaly leaves overlapping one another like tiles; the blossom is white and the stem tubular, like nightshade. The odour of the plant resembles that of feverfew.

Dried at 110° it loses its odour. It contains no alkaloid, the medicinally active agent appears to be a glucoside like aesculin. The residue left after extraction with carbon bisulphide, yields a blue-fluorescent alcoholic solution at 85°, which is turned violet-blue by a few drops of sulphuric acid. On evaporating the alcoholic extract it leaves a residue soluble in water, and when this solution is heated with a little sulphuric acid, it reduces Fehling's solution, and like aesculin gives a yellow precipitate with lead acetate. —D. A. L.

Conessa Bark and Seeds. R. Blondel. Les nouv. remèd. 1887, 411.

Conessa bark has been known for over 200 years as a remedy against dysentery, and has from time to time undergone numerous changes of name. There are many varieties of the tree, and the active variety so closely resembles an inactive variety as to be scarcely distinguishable from it; this fact is supposed to account for the many names the plant has received, as well as for the inactivity frequently noticed in the commercial conessa bark. To clear up this matter the author has made a careful study of the two varieties, and has published a detailed botanical description of them; but the simple fact that the seeds from the inactive are sweet, whilst those from the active tree are bitter, he considers sufficient to prevent natives from collecting bark from the wrong tree, and attributes the inactivity of the commercial drug to the collection of useless bark, either old or too young, or from dead wood.—D. A. L.

Phenacetin, a new Antipyretic. E. Utescher. Apoth. Zeit. 1887, 2, 436.

Phenacetin is very reliable as an antipyretic, and quite free from injurious secondary effects; in doses of 0·5 to 0·7 gr. it reduces the temperature 2° to 2°·5. (This Journal, 1887, 676.) Chemically it is para-acetphenetidine, its formula being $C_2H_5O - C_6H_4 - NH . C_2H_3O$. It forms small white (slightly pink) crystalline scales, which possess neither taste nor smell; they are very difficultly soluble in cold water, more readily so in warm water or in glycerine, and dissolve easily in alcohol. The melting point is 132°·5. It is recognised by heating with alcohol and sulphuric acid, when the characteristic smell of ethyl acetate is observed; by heating a few drops of the solution thus formed with caustic potash solution and chloroform the carbylamine reaction is obtained; boiled with caustic potash alcohol is formed, and may be recognised by the iodoform test. This last reaction serves to distinguish it from acetanilide (antifebrin), as does its *m. p.* (antifebrin melts at 112°), and also the fact that a few drops of fuming nitric acid turn it permanently yellow, while antifebrin first becomes brown, then blue, and finally colourless. This new febrifuge is manufactured by F. Bayer and Co.—C. A. K.

Pure Guaiacol. Zeits. f. angew. Chem. 1888, 12.

The use of this body as a drug (for phthisis) having been proposed by Sahli, tests for the purity of commercial samples are needed. Pure guaiacol ($C_6H_4 . OH . O . CH_3$) prepared from beech tar creosote has a sp. gr. of 1·1171 at 13°, and boils at 200°, according to Hlasiwetz and Gorup, its alcoholic solution affording an emerald green colour with ferric chloride. For its preparation, crude guaiacol of B.P. = 200° – 205° is shaken repeatedly with ammonia solution, fractionated, dissolved in a like volume of ether, and mixed with concentrated alcoholic potash; the precipitate is recrystallised from alcohol and decomposed with dilute sulphuric acid. The so-called commercial guiacol contains only about 35 per cent. of the pure product, and needs, therefore, careful purification previous to its use in medicine. The following three tests have been applied:—(1.) 2 cc. of the commercial compound shaken with 4 cc. of petroleum benzine at 20° gave a clear solution; whilst the pure guiacol separated out completely. (2.) 5 cc. of the commercial (35 per cent.) and pure substance mixed with 10 cc. of glycerin of 1·19 sp. gr. gave similar results; a 70 per cent. guaiacol was for the most part precipitated. (3.) 2 cc. of pure guaiacol added to 2 cc. of caustic soda solution of 1·3 sp. gr. became heated, but on cooling to the temperature of the room yielded a white crystalline mass; the impure compound (even when containing 70 per cent. of the pure substance), remained liquid under like conditions. A combination of the third test with specific gravity and boiling point determinations is therefore recommended.—W. G. M.

Tincture of Iodine. C. Daudt. Pharm. Zeit. 32, 694.

The tincture is best prepared by dissolving 1 part of iodine in 9·2 parts of absolute alcohol, and adding 0·8 parts of water afterwards. Iodine dissolves very quickly in absolute alcohol, but its solution in spirits of wine is a very tedious operation.—S. H.

Sozoiodol. B. Fischer. Pharm. Zeit. 32, 700.

H. Trommsdorf, of Erfurt, Germany, lately brought out under this name a preparation, which is intended to replace iodoform, its principal advantage being a complete absence of smell. Sozoiodol has the formula—$(SO_3H)C_6H_3(OH) . I$, and forms a white, glittering powder of slightly acid taste, slightly soluble in cold water, more easily in hot water. On heating it is decomposed, giving off violet vapours. As a test for purity 0·5 grms. of sozoiodol are shaken with 10 cc. of water and filtered. Silver nitrate added to the filtrate, produces a white precipitate of sozoiodol-silver, which must be completely soluble in dilute nitric acid. A white or yellow residue shows the presence of chlorides or iodides respectively.—S. H.

A New Alkaloid in Solanum Grandiflora. D. Freire. Compt. Rend. 105, 1074.

The fruit of solanum grandiflora, var. pulverulentum (fruit de loup), which grows in Brazil, has the shape of a large pear. It is green, smells very badly, and has a bitter and unpleasant taste. The powdered fruit was mixed with slaked lime and with some water, and then allowed to stand for four hours. It was then dried on the water-bath, extracted with absolute alcohol and the solution evaporated to half its volume. A resinous substance is precipitated, which is filtered, the filtrate concentrated to a small volume and allowed to cool. A solid residue is obtained, which is treated with water and a few drops of hydrochloric acid, filtered and precipitated with ammonia. The precipitate is washed, dried in a vacuum over sulphuric acid, when it forms a white powder, which is very bitter, insoluble in water, easily soluble in alcohol and dilute acids; heated with potassium hydrate it gives off ammonia copiously and the substance exhibits the usual reactions of alkaloids. With a drop of concentrated sulphuric acid and a little manganese peroxide it gives a yellow colour, which quickly turns into green and ultimately into violet. With concentrated nitric acid, it gives a yellow colour, rapidly changing into purple. The author proposes to name the new alkaloid "Grandiflorin."—S. H.

Cocaïne. By. A. Einhorn. Ber. **21**, 47—51.

The homologues of cocaïne can be prepared by passing hydrochloric acid into a solution of benzoylecgonine in the corresponding alcohol; these ethereal salts have already been described by Merck.

Succinic acid is formed when anhydroecgonine or ecgonine is oxidised with potassium permanganate, 10 grms. ecgonine hydrochloride yield about 2·2 grms. succinic acid. Ecgonine hydrochloride yields succinic acid on oxidation with boiling nitric acid, from 2 grms. of the salt about 1 grm. succinic acid is obtained.

The formation of succinic acid shows that the side chain in the cocaïne derivative must be either in the α or β position, and the group $C.CH_2.CH_2.C$ contained in the succinic acid originates from the reduced pyridine ring.

—F. S. K.

On Colchicine. S. Zeisel. Monatsh. Chem. **9**, 1—30.

The author has previously shown that colchicine $C_{22}H_{25}NO_6$ is a methyl ether of an acid—colchicëine $C_{21}H_{23}NO_6$—into which it is converted by boiling with aqueous NaOH. By the action of ammonia colchicine is converted into the amide of colchicëine $C_{21}H_{24}N_2O_5$. If colchicëine is heated with conc. HCl on the water bath, acetic acid is eliminated, and a compound, $C_{19}H_{21}N_2O_5$ (trimethylcolchic acid), is formed. By longer heating with HCl demethylation takes place, and the compounds $C_{18}H_{19}NO_5$ and $C_{16}H_{15}NO_5$ (dimethylcolchic acid and colchic acid) are formed. Hence these compounds bear to each other the following relation:

$C_{16}H_{15}NO_5 = C_{15}H_9(OH)_3(NH_2)CO_2H$, colchic acid.

$C_{18}H_{19}NO_5 = C_{15}H_9(OH)(OCH_3)_2(NH_2)CO_2H$, dimethylcolchic acid.

$C_{19}H_{21}NO_5 = C_{15}H_9(OCH_3)_3(NH_2)CO_2H$, trimethylcolchic acid.

$C_{21}H_{23}NO_6 = C_{15}H_9(OCH_3)_3(NH.CO.CH_3)CO_2H$, colchicëine (acetyltrimethylcolchic acid).

$C_{21}H_{24}N_2O_5 = C_{15}H_9(OCH_3)_3(NH.CO.CH_3)CO.NH_2$, amide of colchicëine.

$C_{22}H_{25}NO_5 = C_{15}H_9(OCH_3)_3(NH.CO.CH_3)CO_2CH_3$, colchicine.

Colchic acid, $C_{16}H_{15}NO_5$ is prepared by completely demethylating colchicëine by heating it with four parts of conc. HCl at 140°. Its hydrochloride is very soluble in water. Chlorine water produces no coloration; platinic chloride, mercuric chloride, mercuric potassium iodide, cadmium iodide, picric acid, phosphomolybdic and phosphotungstic acids produce yellow precipitates; auric chloride gives a brown precipitate. Fe_2Cl_6 produces a deep brownish-red coloration, which is not taken up by chloroform. On adding a trace of a nitrate to the solution in conc. H_2SO_4 a dull red colour is produced, which changes to a splendid red colour on adding excess of ammonia.

Dimethylcolchic acid $C_{18}H_{19}NO_5 + 4\frac{1}{2}H_2O$ forms microscopic yellow prisms, of melting-point 141°—142°. Its hydrochloride $C_{18}H_{19}NO_5, HCl + H_2O$ forms sparingly soluble white microscopic needles. Its solution gives the following precipitates:—Mercuric chloride and cadmium iodide, whitish, soluble in HCl; mercuric potassium iodide, yellowish, darkened by HCl; auric chloride, brown; picric acid, yellow; platinum chloride and tannic acid, none. It dissolves in conc. H_2SO_4 with an orange colour, and on the addition of a trace of a nitrate gives the same colour reaction as colchicëine.

Trimethylcolchic acid, $C_{19}H_{21}NO_5 + 2\ H_2O$, forms microscopic prisms, melting at 159°. Its hydrochloride forms glistening yellowish-white plates, moderately soluble in cold water with a yellow colour, Its reactions closely resemble those of colchicëine Chlorine, bromine, and iodine water give white to brown precipitates; cadmium iodide, a yellowish white precipitate which dissolves on warming; picric acid, a yellow crystalline precipitate; auric chloride, a brown precipitate. Fe_2Cl_6 produces a garnet red solution with green dichroism; on further addition of F_2Cl_6 it becomes green and then gives with chloroform the same reaction as colchicëine. The platinochloride $(C_{19}H_{21}NO_5, HCl)_2 PtCl_4 + 2\ H_2O$ forms small yellow needles.

Amide of colchicëine (acetyltrimethylcolchic amide) $C_{21}H_{24}N_2O_5$, forms crystals nearly insoluble in cold water, but readily in dilute HCl. The latter solution gives yellow precipitates with mercuric chloride, cadmium iodide, potassium mercuric iodide, phosphomolybdic acid, phosphotungstic acid, picric acid, and tannic acid. With potassium nitrite a splendid violet coloration is produced. The aqueous alcoholic solution of the amide gives with ferric chloride a deep brown coloration with a rose-red dichroism.

—A. G. G.

Condurango and Guayaquil and Mexico. Chem. Zeit. **11**, 1601—1602; **12**, 26—27.

A specimen of condurango from Guayaquil consisted of chips of twigs, with the bark adhering and measuring 0·4—1·3 c.m. From a microscopical examination they appeared to belong to two different plants, although of the same family. All the pieces had a coating of soft yellow cork which was not quite uniform. At parts where the cork was divided the colour was almost black. In Fig. 1 (*a*) is cork, (*b*) a green line, inside of which come bast cells (C). The bark measures about ⅓ of the whole diameter. The woody part (*d*) is light yellow and very porous. Between this and the pith is a radially striped part (*e*). The pith has disappeared to a great extent.

Fig. 1

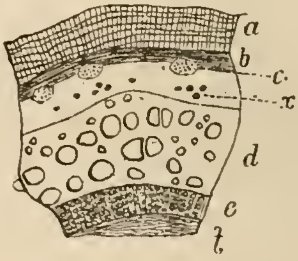
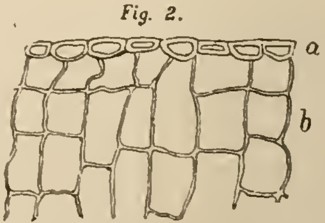
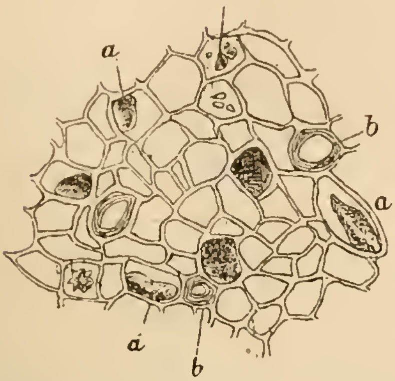


Fig. 2.



The cork (Fig. 2) is formed from the under epidermis, and some of the thickened cells of the latter may be seen. The Ecuador condurango shows these also. The cork cells are large and longer than broad (*b*), and swell up rapidly when moistened with water; in the Ecuador condurango these are flatter. Inside the cork cells is a tissue consisting of thickened collenchymatous cells full of chlorophyll, a constituent apparently absent from the gonolobus condurango. Calcium oxalate crystals of large size are present in this part of the structure. The remainder of the tissue consists of rounded cells (Fig. 3) containing starch.

Fig. 3



Strongly thickened bast fibres appear at regular intervals; they are however much thinner than those of the Ecuador condurango. The structure of the wood is very characteristic; that part nearest the pith is radially striped, this being visible to the naked eye. The vessels are pitted, excepting those nearest the pith, which are spiral (Fig. 5 *a*), (*b*) secondary wood, (c) vessel of the secondary wood. The medullary rays of the secondary wood (Fig. 4. *a*) distinguish it from the primary wood, which contains none. The structure of the Ecuador condurango does not possess the peculiarities of the primary wood of the Guayaquil drug, and the medullary rays are in much greater number. Mexican condurango differs from the S. American in that there is a strong collenchyma next the bark (Fig. 6. *a*), whilst nearer the pith again is a layer of thickened bast fibres, containing very large crystals of calcium oxalate (*c*).

—J. W. L.

Fig. 4

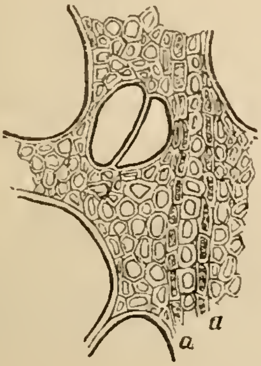


Fig. 5

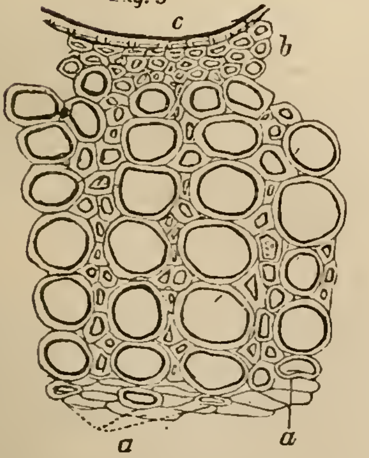
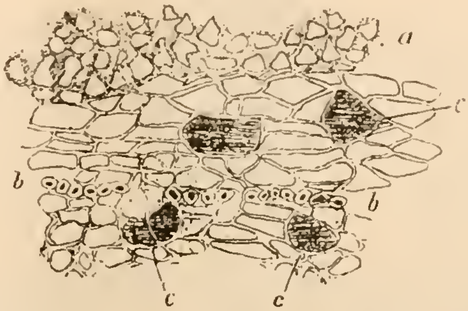


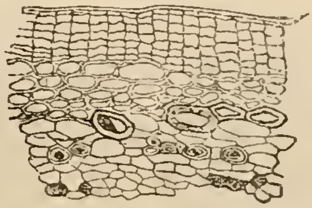
Fig 6



Jurumbeba. Chem. Zeit. 12, 87.

Two plants of this name, *Solanum paniculatum L.* and *Solanum manimosum L.*, are found in South America. The former is a valuable purgative, the latter is poisonous. *Solanum paniculatum L.* (Kosteletzki Med. Pharm. Flora **3**, 958) is a bush 1·5 to 2 metres high, the branches being covered with a white down. The leaves are serrate cordate, with smooth upper and hairy under surface; the stems are thorny. A specimen of the plant imported as a drug, consisted of roots, leaves, and pieces of branches, all broken small. A transverse section of a piece of branch is represented in Fig. 1. The cuticle of the bark consists of 6 to 8 layers of rather large cork cells, next to which several rows of collenchymatical thickened cells are seen. Some of the bast cells contain calcium oxalate crystals. The roots, berries, and seeds will be shortly described.

—J. W. L.



Withania coagulans (*syn. Puneeria coagulans*). Chem. Zeit. 12, 54.

The ferment contained in the seeds of this plant, which is used in India for cheese-making, is extracted as follows:—The seeds are treated with a 5 per cent. sodium chloride solution, 2 per cent. hydrochloric acid, 3 per cent. sodium carbonate, or with water. The sodium chloride extract proved the most active with milk at 38°, and its action is destroyed by boiling. It is soluble in glycerol, and is precipitated by alcohol, but it loses nothing of its fermentive property by this treatment. The great drawback to its general use is that it colours the whey brown. The concentrated solution appears to give the best results. The berry is 1—1·5 cm. in diameter, is dark red or dark brown coloured, and contains a large number of flat yellowish seeds measuring 2 mm. by 1·5 mm., and which are finely pitted.

Fig. 1 represents the section through the seed, showing the thin shell, the endosperm, and the embryo.

Fig. 1.

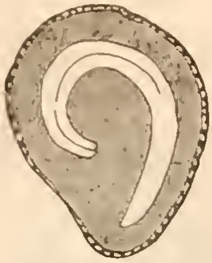
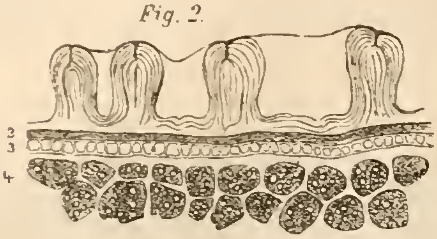


Fig. 2 is a transverse section of the shell of the seed (× 75), (1) the testa, (2) a layer of very flat cells, (3) the tegmen.

Fig. 2.



Figs. 3 and 4 represent transverse sections through the cells of the epidermis, the former showing the structure of the inner side, the latter that of the top side. Phloroglucol in hydrochloric acid colours the seed husk red, excepting the inner thickened coat of the cells of the epidermis. With a solution of iodine in zinc chloride the seed husk is coloured yellow, excepting the inner thickened coat, which becomes blue. The endosperm (Figs. 2, 4) and the embryo contain oil and aleurone.—J. W. L.

Fig. 3

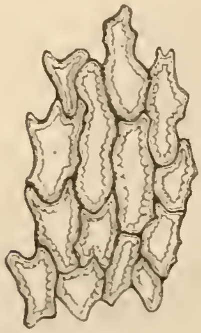
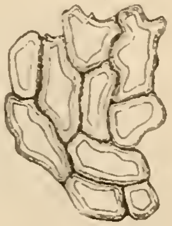


Fig. 4



A new Source of Germanium. By G. Krüss. Ber. **21**, 131—133.

Oxide of germanium is contained in the mixture of acids which is obtained by fusing euxenite with hydrogen potassium sulphate. The residue is first boiled repeatedly with hydrochloric acid until free from iron, washed, and digested at 100° in closed vessels for eight days with several litres of freshly-prepared ammonium sulphide. The extract, together with the wash water, is evaporated down and treated according to Winkler's method for the preparation of germanium; the white precipitate of germanic sulphide obtained on passing sulphuretted hydrogen into the sulphuric acid solution, contains a considerable quantity of free sulphur, which is got rid of by heating in a current of carbonic acid.

A small portion of this product was reduced to germanous sulphide by heating gently in a current of hydrogen; another portion was reduced to metal by heating more strongly.

Finely divided germanium is somewhat volatile; on heating it is converted into a white oxide, which is soluble in water and melts under borax to a grey-white regulus. A few drops of germanium chloride were prepared by carefully heating a small quantity of the metal with eight times its weight of dry mercuric chloride.

Euxenite contains about $\frac{1}{10}$ per cent. of germanium.

—F. S. K.

Therapeutic Substitutes for Chrysarobin, C. Liebermann. Ber. **21**, 447.

See p. 205.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

A Sensitive Orthochromatic Collodion Emulsion Process. Phot. Rundschau.

F. Malmann and Ch. Scolik have recently made experiments with a view to preparing a colour-sensitive collodion emulsion. They found that the greatest sensibility is shown by an emulsion prepared with an excess of bromide and coloured by eosin-silver, or prepared by precipitation with ammoniacal silver oxide. The exposure can take place with or without a yellow glass plate.—S. H.

Reactions of the Photochloride of Silver. Carey Lea. Phot. Mittheil. **24**, 220.

If photo chloride of silver be exposed to light its original pink colour is changed to purple and purple-black. It seems as if in the silver chloride, blackened by the light, the subchloride is combined with the normal chloride according to the manner of lakes, and not in equivalent proportions. By a continued action of the light the decomposition should be greater than is actually the case.—S. H.

Sepia-Brown Platinum Prints. Phot. Rundschau. **1**, 224.

Three hundred grms. of potassium oxalate are dissolved in 1,000 grms. of water. Ten grms. of oxalic acid and 100 grms. of a concentrated cupric chloride solution are added to the potassium oxalate solution. The whole is warmed to 80° C., and the exposed platinum paper is drawn through it. The temperature has great influence on the shade of the print. The latter is then treated with very dilute hydrochloric acid and, after washing with water, it is steeped in a 5 per cent. ferrous sulphate solution. Finally it is again well washed.—S. H.

Identity of the Substances producing the Latent Image in Photography with the "Photo-salt." Carey Lea. Phot. Rundschau. 1887, **1**, 244.

Sodium hypophosphite, in the entire absence of light, produces exactly the same effect as light on the haloid silver salts, the latent image produced behaving in the same way towards photo-chemical reagents as the latent images produced by light. With silver chloride a positive image is formed, and with the bromide a positive or a negative image may be obtained. The latent images thus got are destroyed by potassium iodide, while with potassium bromide or chloride the development of the image is only slowed.

—C. A. K.

Developer for Instantaneous Photographs. Photog. Archiv. 1887, **28**, 384.

The following mixture is recommended as a convenient developer for instantaneous photographs: a solution is made of 240 grms. potassium carbonate, 180 grms. potassium oxalate in 900 cc. water, to which is added three drops of sulphuric acid; another solution is made of 120 grms. of ferrous sulphate in 800 cc. water. For use, four parts of the former are added to one part of the latter. To hasten or complete the developing process two drops are added of a solution of 6 grms. ammonium bromide, 6 grms. ammonia, and 1 grm. sodium thiosulphate in water.—V. H. V.

A cheap Copying Process in Photography. By W. Lagrange. Phot. Wochenbl. 1887, **13**, 418.

In order to reduce the amount of silver salts in copying negatives, the author suggests the following process: a blue print of the negative is obtained in the ordinary manner by ammonium ferric oxalate and potassium ferricyanide, which is subsequently washed with water acidulated with hydrochloric acid and floated on a dilute solution of silver nitrate. The picture disappears as silver ferricyanide and basic ferric nitrate are formed; it is then reproduced by ferrous oxalate as a gelatin negative. It is advisable to expose the picture, before developing, for a short time to sunlight, in order to obtain a black tone.—V. H. V.

Ammoniacal Solution of Cuprous Chloride as a Developer. Phot. Wochenbl. 1887, **13**, 417.

An ammoniacal solution of cuprous chloride, prepared in the ordinary way, may be used as a developer, provided that air is as far as possible excluded. The chemical change is as follows: $2\ AgBr + Cu_2Cl_2 = Ag_2 + CuCl_2 + CuBr_2$; but in the presence of air the developing solution is quickly oxidised and the cupric salts formed destroy the negative. —V. H. V.

Uranium Nitrate for Printing Photographs. By C. T. Roche. Phot. Wochenbl. 1888, **14**, 5.

Photographic paper is floated on a solution of uranium nitrate, and then dried in the dark. Copies are taken in sunlight, the time of exposure varying according to circumstances. The paper is washed with a dilute solution of potassium ferricyanide, which produces a brown-toned picture. The above solution can also be used for toning silver-bromide pictures, as recommended by Vogel.—V. H. V.

PATENT.

Improvements relating to Means for Fixing and Clearing Photographic Pictures or Images. H. B. Berkeley, London. Eng. Pat. 17,693, December 23, 1887. 6*d*.

After the image has been developed the positive or negative is placed without being washed in a clearing and fixing solution containing a sulphite, bisulphite, and thiosulphate; by the employment of this solution it is claimed that discolouration is prevented.—O. H.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENT.

Improvements in the Method of and Apparatus for Manufacturing Lucifer Matches. J. Fraser, London. Eng. Pat. 3554, March 8, 1887. 8*d*.

By methods already known the splints are cut and arranged parallel to each other, but at small intervals upon a travelling band. The improvements consist in making this band of such a width that one or both ends of the splints project beyond it, and then winding it (still carrying the splints) upon a spool, so that the middle or body of each splint is firmly held between two adjacent convolutions of the band. The projecting ends can then be dipped in the composition requisite to complete the manufacture of the matches. —A. R. D.

XXIII.—ANALYTICAL CHEMISTRY.

A New Dialyser. E. Bauer. Zetschr. f. angew. Chem. 1888, 11.

The fluid to be dialysed is introduced into a flask of suitable form, over the bottom of which the membrane is stretched. The flask rests by a projecting rim on the lower vessel, and between the two is placed an india-rubber ring. The lower vessel is provided with an overflow tube, which serves to keep the level of the liquid constant, and allows the dialysed solution to be recovered without loss. The upper flask is closed with a cork carrying a thermometer in one perforation, and in the other a glass tube, through which the liquid is introduced under the control of a Marriotte's flask. —W. G. M.

Laboratory Apparatus. A. Beutell. Chem. Zeit. **12**, 24, 53, 86.

Waterbath Regulator.—The supply water is contained in a large flask. Through the stopper a syphon passes and is connected with *e* (Fig. 1). The tube B is also connected with the supply flask by means of a tube which only passes

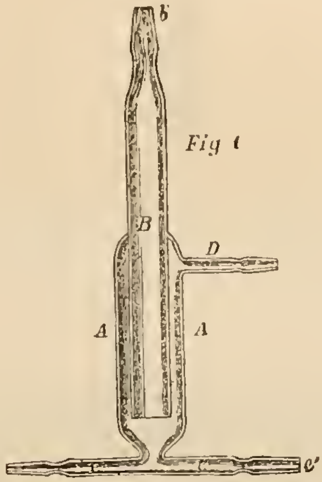


Fig 1

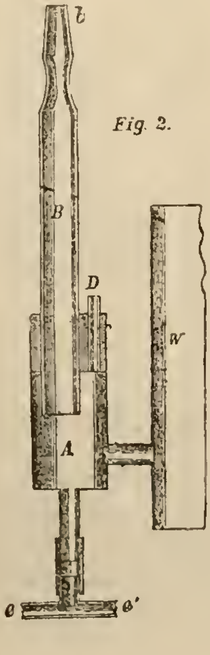


Fig. 2.

to the under side of the stopper. A number of water baths may be connected with this regulator at c^1. As the water first flows out of the supply flask, air passes through D (which is open to the atmosphere) and B, to replace the water. So soon as the surface of the latter reaches the under end of B, the communication with the air is cut off, and the syphon stops supplying water. A convenient width for B is 1·3 cm.

Kekulé's waterbath may be readily converted into a regulator such as the above. The letters in Fig. 2 refer to the tubes having the same functions as in Fig. 1, above described.

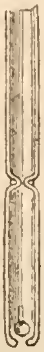


Fig 3.

Valve for Wash-bottle.—Fig. 3 represents the bottom end of the long tube, which is partly closed at the mouth and has a constriction a little above this. A small glass bulb is inserted beforehand, which prevents the water from falling back into the flask after use whilst the constriction at the upper part prevents the glass bulb from rising too far.

Valve for Wash-bottle containing Ammonium Sulphide, &c.—A third tube is inserted through the stopper, bent downwards, and a small piece of india-rubber tube attached which may be closed by the hand when in use. By releasing it the vapours issue through this instead of into the mouth of the operator.

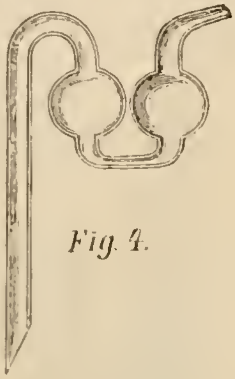


Fig. 4.

Valve to Exclude Air.—In Fig. 4 the tube between the two bulbs is very narrow and contains a drop of mercury.

Absorption Apparatus for Overflow Burettes.—In order to exclude carbonic acid from barium hydrate solution the apparatus described in Fig. 5 is useful. A contains soda-lime. In B is a drop of mercury just sufficient to close the end of A. In F there is always the same quantity of the solution which effectually excludes the atmosphere.

—J. W. L.

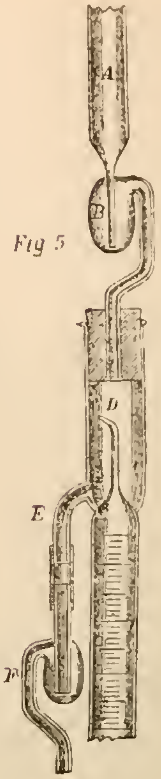
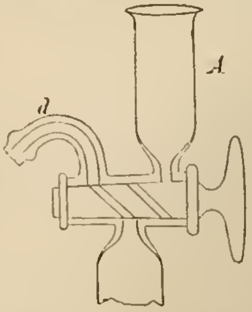


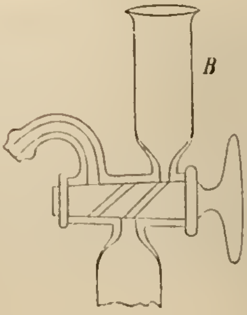
Fig 5

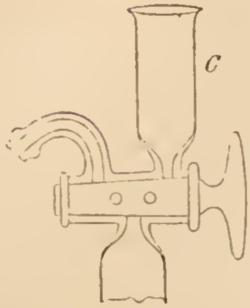
Improvement in the Construction of the Nitrometer.

G. Lunge. Ber. 21, 376.

The three-way tap which connects the funnel with the measuring tube is replaced by a tap of Greiner and Fried-







rich's construction. Its application and object is evident from the accompanying illustrations.—S. H.

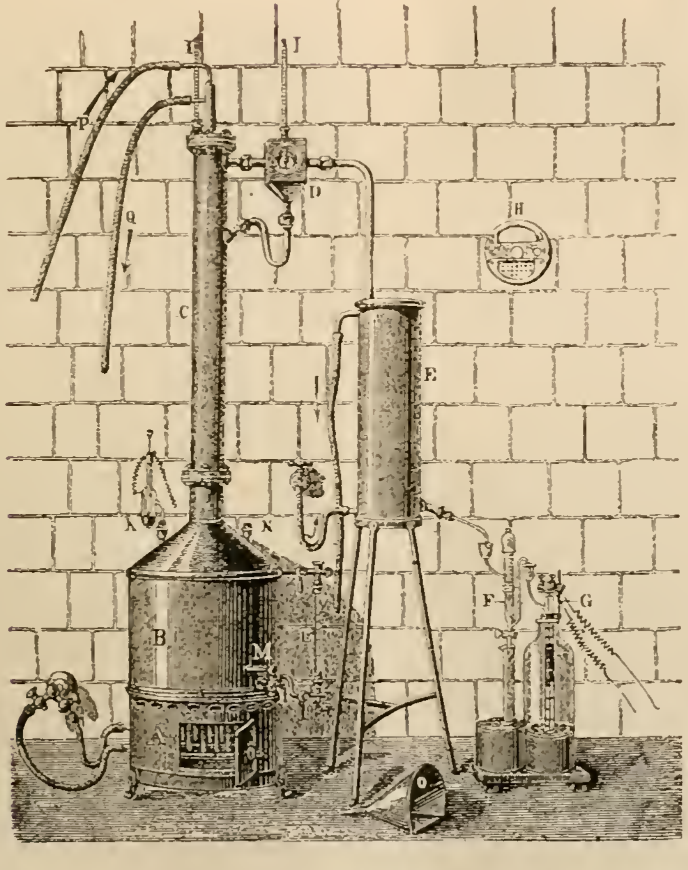
The Value of the Microscope in detecting Starch in Chocolate. P. Zipperer. Chem. Zeit. **12**, 26.

In carefully prepared chocolates, containing respectively 1 pt., 3 pts., and 5 pts. potato starch in 5,000 pts. chocolate, even the former was readily recognised under the microscope; the reagent used was iodine solution. The author suggests that in deciding the question of adulteration of chocolates with starch, the latter should be estimated chemically, the microscope being too delicate.—J. W. L.

A Laboratory Apparatus for Fractional Distillation. G. E. Claudon and E. C. Morin. Bull. Soc. Chim. **48**, 804.

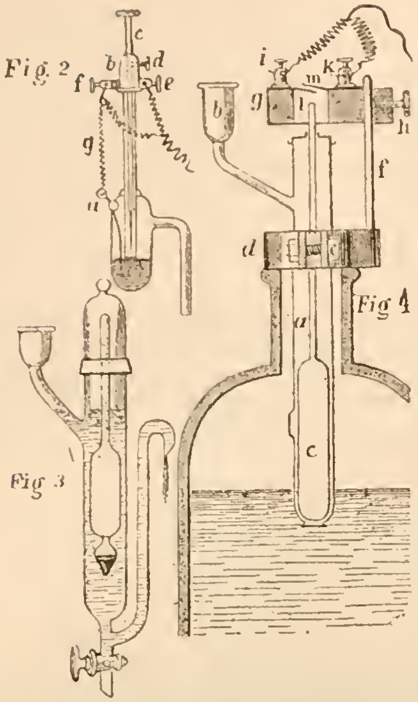
The following form of apparatus, made from refined copper, is proposed for the distillation of large quantities of liquids in a short time. It consists of (Fig. 1) an oven A, a boiler B, a column C, an apparatus D for separating foam, a cooler E, besides subsidiary apparatus, such as a manometer K, and test-vessel F. The oven A has two series of ring burners, each of which can be regulated at will; the boiler is provided with a cock M, a gauge L, a charging pipe N, and a cork for the manometer K; the boiler is slightly inclined towards the cock. The column C consists of an external sheath consisting of ten plates as shown at H; in the axis is a tube, the water flowing through which may be regulated; at the upper end of the column is a thermometer.

Fig. 1



The signal manometer K (Fig. 2) consists of a pin ending in a piece of platinum wire passing through the copper piece *b*; this is fastened by means of *d*. *c* is contact with *b*, while *f* is insulated from *b*, and is contact, by means of *g*, with the platinum wire dipping into the mercury. When the gas flame and flow of water are properly regulated, *c* is so placed that the end of the point of the platinum wire is a few millimetres above the level of the mercury, so that an increase of temperature and of vapour pressure can at once be signalled. The test-vessel F (Fig. 3) serves to determine the specific gravity of the distillate and to charge the receivers, the apparatus (Fig. 4) serving to signal when the receiver is full, consists of a glass tube *a* opened at the lower end and at the side. In *a* is a small float *c*. A plate of wood or ebonite, fastened by two bolts, bears a copper rod *f*, on to which a second piece *g* is fastened by means of the screw *h*. If the receiving flask is full the float comes in contact with the small platinum plates *l* and *m*, whereby the circuit is closed and the electric bell rung.

It is necessary, for the apparatus to work well, that the distillation should be commenced slowly, and the gas flame gradually raised. A mixture of alcohol and water can be distilled at the rate of 4—5 litres per hour, while a



mixture of butyl and amyl alcohols can be distilled at double the rate. The apparatus also serves for the distillation of crude petroleum, benzene, and aniline. Its efficacy is equal to that of Le Bel Henninger column with 15 bulbs; it is constructed by Wiesnegg, of Paris.—V. H. V.

PATENT.

Improvements in Apparatus for use in estimating, measuring and comparing Colour, Texture, and Appearance of Liquid or Solid Bodies, Materials, or Fabrics, viewed by transmitted or reflected Light. J. W. Lovibond, Salisbury. Eng. Pat. 3859, March 14, 1887. 8*d*.

The apparatus described is an improvement on Eng. Pat. 12,867 of 1886 (this Journal 1887, 522). Instead of, or in addition to, the coloured glasses described in that specification, the patentee employs a glass vessel having its front and rear walls, which are of clear glass, inclined towards each other so as to form a vessel of rectangular cross section and of wedge-like form, the height of the vessel being about 12 inches, the width at the top 1½ inches, tapering down to ½ inch at the lower end. The lateral walls of this vessel are made of wood on which is marked a scale denoting the distance apart of the front and rear walls. By means of a rack and pinion the vessel can be raised and lowered opposite the end of one of the tubes, the vessel containing either a standard colour or the solution to be tested. For testing or comparing the colours of opaque objects, a small stage is fitted opposite the ends of the two tubes, so that the objects under examination can be illuminated by reflected light, otherwise, the method of testing is similar to that for transparent objects.—O. H.

Applications of Nitro-compounds in Analytical Chemistry. H. Bornträger. Rep. Anal. Chem. 7, 741—742.

The most important of these compounds is nitrosulphonic acid, which occurs as a by-product in the manufacture of sulphuric acid. It can be used for the following purposes:—I. The precipitate of manganese dioxide, which is formed in flasks and burettes by the reduction of potassium permanganate solution, can be immediately dissolved out by a mixture of equal parts of nitrosulphonic acid and conc. HCl. II. The same mixture (even in the cold) rapidly dissolves gold, whereas platinum is not attacked by it. An alloy of the two metals can therefore be analysed by treating it in the cold with a mixture containing equal parts of nitrosulphonic acid and HCl. After neutralising with caustic soda the gold is precipitated by ferrous sulphate; the pp. is boiled with strong hydrochloric acid, and weighed as metal. If the undissolved platinum contains any iridium, it should be boiled with aqua regia, which dissolves the platinum and traces of the iridium. The solution is precipitated with H_2S, the sulphides are filtered off, heated to redness, and again treated with hot aqua regia; the platinum dissolves out, whereas the iridium sulphide is not attacked. The platinum is converted into the double chloride, heated to redness, and weighed as platinum; the iridium is weighed partly in the metallic form, partly as sulphide. III. Nitrocompounds furnish the best means of liberating iodine from its compounds. This property can be utilised on the large scale for the extraction of gold from auriferous sands.—D. E. J.

Remarks on the Analysis of Clays. Meineke. Rep. Anal. Chem. 7, 757—758.

In a previous communication (Rep. Anal. Chem. 7, 214) the author had recommended that after the bulk of the silica contained in the sample had been determined in the usual way, the alumina and oxide of iron precipitated by ammonia should be again dissolved in dilute sulphuric acid, and the undissolved silica added to that already found. He now points out that this method may lead to incorrect results if the ammonia used has been kept (as is usually the case) in glass bottles; such ammonia always contains silica in solution, and alumina precipitated by means of it is never free from silica. Almost all oxides precipitated from ammoniacal solution contain silica, *e.g.*, MnO_2 when precipitated by bromine or hydrogen peroxide and ammonia. Manganese sulphide, on the other hand, even when precipitated in presence of excess of ammonia, contains only traces of silica. Six analyses of clays are given in support of these statements. In each case a solution was prepared which was entirely free from silica. In the first five analyses the iron and alumina were precipitated from these solutions in vessels of porcelain, and in the last analysis a platinum dish was used. The precipitated oxides were found to contain from 0·3 per cent. to 1·0 per cent. of SiO_2.

It is therefore necessary, before proceeding to the estimation of the alumina, to remove all silica by repeated evaporation; and any silica which may be found in the precipitated alumina must then be regarded as not having been contained in the substances. The presence of this co-precipitated silica is probably the reason why so many analyses of silicates add up to more than 100.—D. E. J.

Estimation of Sodium Hydrate along with Sodium Carbonate. Isbort and Venator. Zeits. angew. Chem. 1888, 109.

A known quantity of the sample to be tested is dissolved in water, cooled if necessary, and tinged with a few drops of an alcoholic solution of rosolic acid. Standard acid is then run into the solution until a distinct yellow colour is produced, which point can be clearly seen. The quantity of acid used corresponds with the amount of sodium hydrate present. The solution is then heated to boiling, when the red colour is restored and a further addition of standard acid is made, until on boiling the yellow colour becomes permanent. The amount of acid used gives the total alkalinity, while the difference is equivalent to the sodium carbonate present.—S. H.

Estimation of Manganese in Pig-iron. C. Reinhardt. Zeits. angew. Chem. 1888, 108.

Hampe's method for the estimation of manganese is not suitable for iron which contains much silicon, as the presence of relatively large quantities of silicic acid in suspension causes a violent bumping of the solution on boiling, whereby a loss is inevitable. Belami's modified process is preferable. Three or four grammes of iron borings are dissolved in 30 to 40 cc. of hydrochloric acid (1·19 sp. gr.), adding a little potassium chlorate. The solution is boiled until it is reduced to half the volume, and, after adding an equal quantity of hot water, filtered into a 500 cc. flask. The filter is washed and 15 to 20 cc. of strong nitric acid added to the filtrate, which is subsequently boiled until it assumes a light yellow colour. It is then cooled, neutralised with zinc oxide suspended in water filled up to the mark, shaken, and filtered through a dry filter. 250 cc. of the filtrate are taken for the precipitation of the manganese, which, after boiling, is effected by sodium acetate, bromine water, and zinc oxide. The precipitate of manganese peroxide is reduced with a known quantity of oxalic acid, and the excess of the latter is determined by titration with potassium permanganate.

—S. H.

Volumetric Determination of Carbon in Iron. J. Wiborgh. Jernkontor Ann. 42, 74.

The method is based on the measurement of the carbonic acid given off on oxidising a sample of iron. The apparatus used consists of a strong test tube 14 cm. long and 2 cm. wide, which is inserted in a brass case. This tube is closed with an india-rubber stopper with two holes, through one of which passes a funnel with a tap, and through the other a glass tube. The latter is connected by tubing with a glass tap, which is fixed in a stopper with two holes, the other hole carrying a funnel with tap. This stopper closes the top of a Bunte burette, the bottom of which has a tap which is connected by tubing with a bottle filled with water. The gas-burette is surrounded by a cylinder containing water, to avoid fluctuations of temperature. The sample to be heated must be powdered very finely. 0·2 grm. are weighed out for wrought iron or steel, 0·1 grm. for cast-iron. The sample is introduced into the dry test tube and 4 cc. of a concentrated copper sulphate solution are poured upon it and allowed to act for 10 minutes. If a smell of hydrocarbons is noticed, the oxidation is at once proceeded with. 1·2 grms. of crystallised chromic acid are added to the contents of the test tube, which is gently shaken and eventually cooled by water. In the mean time the burette is filled with water by means of the bottle and the funnel until the water reaches the glass tap. The test tube is then dried, inserted in the brass case, closed with the stopper and connected with the gas-burette. The level bottle is lowered, so that a partial vacuum prevails in the burette throughout the test. 8 cc. of sulphuric acid of 1·7 sp. gr. are then very gradually introduced into the test tube by means of the funnel and carefully heated to boiling. After 10 minutes' boiling the sample of iron will be dissolved. The tube is then cooled, when the water in the burette will rise. After cooling, water is run into the tube to drive the gas into the the burette. When this is done, the test tube is disconnected from the burette and the volume of gas read off in the burette. 10 per. cent. potassium hydrate solution is then run into the burette by means of the funnel at the top, and the burette shaken until the carbonic acid is absorbed. By reading off the volume of gas remaining the amount of carbon can be calculated.—S. H.

Combustion of Coke and Graphite with Silver dust. F. Stolba. Listy. Chem. 12, 63.

The addition of silver dust (prepared in the wet way by the reduction of silver chloride) facilitates the combustion of coke and of graphite. 1 gr. of coke requiring four hours for combustion, is completely burned in two hours on addition of its own weight of silver dust, while with graphite with the addition of the silver the complete combustion is eight to twelve times as rapid as without it. The burning is promoted by mixing the contents of the crucible; the platinum is in no way injured. The author is of opinion that the action of the silver in this process, which may prove of value in ash-determinations, is due to the formation of silver carbide, which is readily burned, and that oxygen absorbed by the silver at the temperature of ignition helps to oxidise the carbon.—C. A. K.

Rapid Method for the Determination of Manganese in Pig-iron, Steel, &c. G. Weissmann. Chem. Zeit. 12, 206.

Perillon's volumetric method for the determination of manganese in pig-iron only gives approximate results. The author dissolves 0·4 gr. of the borings in 30 to 40 cc. of a solution containing 10 parts of nitric acid (conc.), 10 parts of water and 2 parts of sulphuric acid (conc.). To this solution 4 to 5 grs. of chemically pure peroxide of lead are added, and the whole boiled for two minutes, allowed to settle, again boiled for two minutes and allowed to settle again. The permanganic acid is then filtered off through well-ignited asbestos, and the residue washed until the washings are no longer coloured. The manganese is then titrated with a 1 per cent. solution of ferrous ammonium sulphate. The method yields concordant results, and only takes one hour. Special attention must be paid to the purity of the peroxide of lead.—C. A. K.

On the Chemical Examination of Blacking. V. Hölbling. Zeits. f. angew. Chem. 1888, 12—15.

The author describes the method adopted by him to estimate the quantities of the raw materials used in the manufacture of blacking, from the results of an analytical examination of the finished product. These raw materials usually consist of molasses from beet or potato sugar, or starch (such as potato pulp); concentrated sulphuric acid, bone black, a fat, frequently glycerine, and a tannate of iron produced by mixing gall-nut extract and ferrous sulphate, and sometimes soda or chalk to neutralise excess of acid. By mixing the molasses and acid cold, much, but by no means all, of the sugar is carbonised according to the equation :—

$$C_6H_{12}O_6 + 2\ H_2SO_4 = 5\ C + CO_2 + 2\ SO_2 + 8\ H_2O.$$

At a higher temperature more is converted, and at the boiling point of the acid (320°—330° C.), when all water would be expelled, the action is complete; but in this case the carbon is not so thoroughly subdivided as it should be for blacking manufacture, and no sugar being left unconverted it is non-hygroscopic. All sugar, whatever its source, is converted by the acid into invert sugar, and as this only, it is found therefore in the manufactured article. The bone black is also attacked by the acid, its calcium triphosphate being converted into di- or mono-phosphate, or free phosphoric acid and calcium sulphate, according as the acid is in small or large excess. The added chalk or soda also yield sulphates. The fat moreover is converted by excess of acid into its fatty acid and glycerin. Thus in finished blacking there will be found :—carbon, phosphoric and sulphuric acids (partly combined, partly free), lime, soda, iron, and in negligible quantities, alumina, magnesia, potash, silica, &c.

The unconverted sugar may be readily determined, but it is impossible to separate the carbon resulting from the molasses from that introduced in the bone-black. Since, however, the latter alone contains a notable quantity of phosphoric acid, the estimation of this body will give an approximation to the amount of original bone-black and its associated carbon, provided that the composition of the bone-black departs but little from the average (= 84 per cent. $Ca_3(PO_4)_2$; 6 per cent. $CaCO_3$; and 10 per cent. C.). Thus the bone-black carbon is found and, being deducted from the total carbon, gives that due to the molasses; and from this, by the above equation, the original proportions of sugar and acid may be approximately estimated.

The actual analysis is conducted as follows: a weighed quantity is boiled with water, washed on a tared filter until the washings are colourless (they are at first of a deep yellow). The aqueous extract is made up to (say) 500 cc. and reserved for use. The filter and precipitate are dried at 100° and weighed; the fat is then extracted in a Soxhlet's apparatus by petroleum ether, and weighed after distilling off the ether. The residue containing only carbon and inorganic matter is incinerated and weighed; the difference in weight gives the total carbon. The inorganic matter is estimated by incinerating a fresh portion of the original blacking; the ash is dissolved in HCl, filtered, mixed with citric acid, and the lime precipitated as oxalate; the phosphoric acid in the filtrate is thrown down as the ammonium magnesium salt; and the iron and sulphuric acid are determined in aliquot parts of the filtrate from the phosphate, the soda being then found by difference. The nature of the fat employed may be found by Köttsdorfer's saponification process (*Z. anal.* 1879, 199), or by v. Hübl's iodine method: after saponification, by shaking with petroleum ether, the unsaponifiable fat will be dissolved and may thus be estimated.

In 25 cc. of the aqueous extract obtained as above the invert sugar is determined by Herzfeld's method (*Ztschr. Zucker* 1885, 967) by weighing as copper oxide the suboxide produced in an alkaline copper solution, and calculating by aid of the table given in the original description.

Reichl's test serves for the detection of glycerin; two drops of the aqueous extract are heated carefully to 120° with a like quantity, each of melted phenol and strong sulphuric acid; the presence of glycerin is indicated by the formation of a brown mass, soluble in ammonia with carmine colour. Quantitatively, the method of v. d. Becke and Mayer (*Z. Anal.* 1880, 291) is applied to 100 cc. of the extract. The presence of more than 1 to 2 per cent. of iron probably indicates the use of tannate. A portion of the aqueous extract is therefore acidified with hydrochloric acid, shaken with acetic ether and separated in a separating funnel; the ether is poured into water and boiled to expel the former, and the liquid tested by ferrous sulphate, or otherwise, for tannic acid. If this body be present it is dissolved from an aliquot portion of the extract by acetic ether, and titrated with potassium permanganate (Löwenthal, *Z. Anal.* 1877, 33 and 201; 1881, 91). The extract matter from gallnut and molasses is finally determined by incinerating the weighed residue from a fraction of the aqueous extract; the loss of weight, after allowing for the glycerin, sugar, and tannic acid, gives the number sought for. The water is found by drying at 100°.

As an example of this method of calculation, the author gives the following analysis:—

	Per Cent.
Water	12·36
H_2SO_4 (free)	1·38
Glycerin	3·45
Invert sugar	10·49
Extract matter	5·37
Mineral oil	4·02
Bone fat	4·89
Carbon	12·63
CaO	16·06
SO_3	10·04
P_2O_5	12·65
Fe_2O_3	0·84
Na_2O	5·78

Hence: the 12·65 pts. P_2O_5 correspond to 27·62 $Ca_3(PO_4)_2$ or to 32·87 bone black, and therefore to 3·28 bone black carbon. But since there were 12·63 total carbon, that from the sugar must be 12·63 − 3·28 = 9·35, and this corresponds to 28·05 sugar originally used, and by adding the 10·49 still unconverted, the total is found to be 38·54. But the molasses used contained 24·7 per cent. (reckoned as invert sugar), thus the molasses equivalent to 38·54 is 156·03. The sulphuric acid required to carbonise the above quantity of converted sugar is 30·54, and hence the total acid used was 44·22; and finally the sodium carbonate from Na_2O found is 5·78. Thus the original ingredients should have been mixed as follows:—

Bone black	32·87	or	33
Molasses	156·03	„	156
Sulphuric acid	44·22	„	44
Soda	9·88	„	10
Mineral oil	4·02	„	4
Bone fat	4·89	„	5
Glycerin	3·45	„	3·5

Obviously the results obtained might differ considerably from the amounts actually used, if the raw materials did not approximate to the average composition taken as the basis of the calculations.—W. G. M.

Studies in the Analysis of the Raw Materials and Products of the Iron Industry. C. Meineke. Zeits. f. angew. Chem. 1888, 3—7.

On the Precipitation of Manganese as Sulphide.—This method of separating manganese, although much safer than the peroxide precipitation (in which the oxide obstinately retains considerable quantities of lime, magnesia, and silica) has not found general favour, because the red sulphide usually obtained in the presence of but little ammonium chloride and ammonia filters badly; moreover there is a tendency to form oxides and hyposulphites which pass through and render the filtrate turbid; the separation from the above-mentioned bodies is, however, complete. If the manganese can be precipitated as the green (anhydrous) sulphide, all the difficulties vanish; it can be washed easily by decantation, settles well, and finally filters quickly without tendency to oxidise. Classen obtains the green modification by adding a little potassium oxalate to the solution, heating to boiling, rendering weakly ammoniacal, and at last adding ammonium sulphide, but this method is not well suited to a separation from calcium salts.

Good results always attended the use of the following method:—The solution was boiled, a large excess of ammonia added, then, without interrupting the boiling and neglecting any precipitate produced by the ammonia, a sufficiency of ammonium sulphide was added, the boiling was continued for a few minutes and the solution was allowed to stand for five minutes before filtration. A little manganese still remains in the filtrate, but not more than in the precipitation at ordinary temperature and long standing, it should be recovered by evaporating off the free ammonia, decomposing the excess of ammonium sulphide with hydrochloric acid, filtering from sulphur, and precipitating with a few drops of bromine water and ammonia. In very accurate work the trace of residual sulphide, clinging to the walls of the precipitating vessel, may be also redissolved in a few drops of HCl and thrown down with bromine. The excess of ammonia, though fatal in cold precipitations, is quite harmless when the sulphide is obtained from boiling solutions. By a series of test analyses quoted, the author shows that neither large additions of ammonium chloride and acetate, ammonia or sodium chloride, nor the presence of lime or magnesia salts, cause any appreciable diminution in the accuracy of the process. The usual method of weighing the sulphide as such, after ignition with sulphur in a current of hydrogen, is unsatisfactory, as it requires special apparatus, and is inaccurate owing to the oxidation during incineration of that portion of the precipitate which adheres firmly to the filter paper, and as Fresenius has shown, Mn_3O_4 once produced is never completely sulphurised again under the usual conditions. It is much safer to burn the sulphide at first gently, but afterwards at a full red heat in an oxidising atmosphere, by slanting the crucible over the burner, and in order to decompose any sulphate that might be produced, a little ammonium carbonate is added. Heating for 30 minutes is sufficient for the conversion of even large quantities of the sulphide.

Estimation of Iron by Nitroso-β-Naphthol.—V. Knorre and Ilinski's method (*Ber.* 1887, 283, &c.), is so far applicable to iron determinations, that this metal is precipitated by it; and the author has experimented as to its suitability for iron works practice. The iron should be present in the solution as sulphate or chloride, and nitrates must be carefully excluded; the metal should preferably be in the condition of peroxide, as the ferric compound with the nitroso-naphthol filters better than the ferrous; the peroxidation is effected by a few drops of bromine. The solution is now carefully neutralised with ammonium carbonate until a slight permanent precipitate appears, which is redissolved in one drop of hydrochloric acid. The boiling solution of nitroso-β-naphthol, containing about 1 gram per

0·1 gram Fe dissolved in 50 per cent. acetic acid, is introduced drop by drop with constant stirring until a drop removed from the clear solution gives a red-brown precipitate with cobalt solution. V. Knorre recommends precipitation in a boiling solution, but the author prefers treatment in the cold, because such a neutral solution when boiled tends to throw down basic chlorides which would interfere with the result; again, in the hot solution the nitroso-β-naphthol precipitate forms hard lumps quite impenetrable by the wash water; and finally, the precipitate is distinctly soluble in hot water, which involves much loss of time in cooling.

Precipitated in the cold, and with stirring, the iron compound filters well, and is washed until a drop of the washings gives no longer a residue when heated on platinum foil; it is then so far dried on the funnel that the filter may be removed without tearing. The upper rim of the paper is then folded over the precipitate, and the whole is transferred to a weighed porcelain crucible. The latter, lightly covered, is now cautiously heated over an asbestos plate at a very low temperature until slight explosions are observed (they are quite harmless, as the precipitate remains surrounded with the yet uncarbonised filter). When these cease, the temperature is gradually raised; and it is finally heated over a powerful flame with free access of air. It is weighed as Fe_2O_3. Too rapid heating causes the precipitate to swell up, and sometimes occasions loss by spirting, and on this account the treatment of large precipitates is a lengthy operation. The author recommends, therefore, that not more than 0·5 grm. of an ore should be used; but if a larger quantity be employed, the precipitate should be distributed over several filters. An objection to this process is that copper and cobalt, which are frequently present in iron ores, and even phosphoric acid, are precipitated with the iron. Experiments would show that usually the co-precipitation of these bodies is complete, so that, by carefully estimating their amounts in other ways, and deducting them from the weight of ferric oxide obtained, the true weight of iron required should be found. Thus, the process should be useful for control determinations, though in one experiment the whole of the phosphoric acid was not thrown down with the iron, which would have invalidated the proposed correction.—W. G. M.

A simple Estimation of Potassium by Platinum Chloride in presence of Sulphates. E. Bauer. Zeits. f. Angew. Chem. 1888, 11.

The sulphuric acid is first accurately estimated in a sample of the substance; the portion under examination for potassium is then acidified with hydrochloric acid and, avoiding excess, an amount of standard baryta solution almost equivalent to the sulphuric acid present is added. The potassium can be directly estimated in the filtrate.

—W. G. M.

Estimation of Lead in Tin Alloys. Y. Schwartz. Chem. Zeit. 12, 52.

One grm. of the alloy, which has been rolled out into very thin sheets, is warmed gently with 20 cc. concentrated hydrochloric acid for about half an hour. Bromine water is now added until any undissolved metal is brought into solution, the excess of bromine is expelled by boiling and the solution diluted to 100 cc. This is poured into a solution of 40 grm. sodium sulphydrate in 150 cc. water, the latter being constantly agitated. After allowing the precipitate to settle, it is filtered and washed with very dilute ammonium sulphydrate. The precipitate and filter are treated in a porcelain dish with 10 cc. concentrated nitric acid, and, after the first violent reaction is over, 5 cc. sulphuric acid are added. Heat is now applied gently until the solution is almost colourless, and the precipitate filtered, washed, and weighed. The weighed sulphate of lead is dissolved in basic ammonium tartrate, and any stannic oxide which it may contain is filtered, weighed, and subtracted.

—J. W. L.

Analyses of the Mineral Waters Los Bauctos. L. Darapsky. Chem. Zeit. 12, 54.

Sp. gr. at 15° = 1·0076. The residue dried at 160° weighed 9·544 grm. per litre.

SiO_2	0·273
SO_3	0·150
CO_2 (combined)	0·086
Cl	4·515
$Al_2O_3 + Fe_2O_3$	0·088
CaO	0·768
MgO	0·017
Na_2O	2·726
K_2O	0·384
Li_2O	0·135

Or equivalent to—

SiO_2	0·273
$Al_2O_3 + Fe_2O_3$	0·088
$CaCO_3$	0·196
$CaSO_4$	0·254
$CaCl_2$	1·097
$MgCl_2$	0·035
NaCl	5·144
KCl	0·732
LiCl	0·382

—J. W. L.

On the reactions of Congo-red towards acids and salts. E. Brücke. Monatsh. Chem. 9, 31—41.

From an extended series of experiments the author comes to the conclusion that except in certain cases, Congo-red cannot be used as an indicator for volumetric analysis.

This is chiefly owing to the fact that the presence of any salt in the solution entirely destroys the precision of the change of colour, probably from the partial formation of an acid salt. The colour then passes through various shades of violet and requires the presence of a considerable excess of acid before it becomes blue. If a salt such as sodium chloride, ammonium chloride, or sodium sulphate, is added to a solution of Congo-red which has been turned blue by sulphuric or hydrochloric acid, the colour is changed back again to red. Alcohol, glycerol, and sugar produce a similar effect. Weak acids, such as carbonic acid and boric acid, change the colour of Congo-red to violet but not to blue.

—A. G. G.

Testing Chloroform. L. Scholvien. Pharm. Zeit. 32, 686.

A sample of chloroform tested by the author, and which as regards its sp. gr., boiling point, and reaction with both silver nitrate and sulphuric acid, satisfied the tests prescribed by the pharmacopœia, smelt of aldehyde. A piece of solid caustic potash soaked in the chloroform turned brown, the chloroform itself becoming yellow. After treating this solution with alcoholic ammonia and gently distilling off the chloroform, the residue gave the characteristic smell of aldehyde-ammonia, and on shaking the distillate with water and adding Schiff's reagent (SO_2 solution of rosaniline) to the aqueous solution, the yellow colour was quickly turned to violet-red. The aldehyde may be removed by saturating the chloroform with dry ammonia, extracting it with water and removing the chloroform from the aqueous extract by aspirating a current of air through the warm solution. If the solution be now distilled after the addition of dilute sulphuric acid the aldehyde passes over. In the case examined, the distillate smelt of a mixture of aldehyde and paraldehyde, and gave the characteristic aldehyde reactions. The author points out that owing to chloroform being now prepared to a considerable extent from acetone, this substance is likely to occur as an impurity, the boiling points of the two bodies only differing by 5°.—C. A. K.

Testing Chloroform. G. Vulpius. Arch. Pharm. 25, 998.

According to the pharmacopœia water shaken with twice its volume of chloroform must not affect silver nitrate solution or blue litmus paper. Several chloroform samples satisfying the above conditions were found to show an acid reaction when treated as follows:—To 1 cc. of water, one drop of phenol-phtaleïn solution and one drop of centinormal caustic potash solution are added and then shaken with 5 cc. of the chloroform. In four cases the solution was decolorised in two minutes. On adding a second drop of the caustic potash solution decolorization again took place, and with one sample this was the case after addition of two more drops of the alkali. From this it appears that the substance giving the acid reaction is more soluble in chloroform than in water, whence the aqueous extract remained neutral to litmus paper.

As a further check on the purity of chloroform the author suggests that 10 cc. shaken in a stoppered bottle with 2 cc. of water coloured with two drops of phenol-phtaleïn solution and one drop of decinormal caustic potash solution should not decolorise the latter in 24 hours.—C. A. K.

Determination of the Purity of Beetroot Sugar. A. Ihl. Chem. Zeit. **12**, 25.

Methylene-blue, added to a boiling solution of beetroot sugar containing some sodium carbonate, becomes reduced and decolorised in presence of the smallest quantities of inverted sugar, grape sugar, or dextrin.—J. W. L.

New Peptone Reaction. E. Bauer. Ztschr. f. angew. Chem. 1888, 11.

On neutralising a malt peptone solution (prepared according to Schulze and Barbieri's method) with phosphoric acid, after submitting it to the biuret reaction, a cherry-red precipitate is obtained. Tannic acid, however, always gives, in the filtrate, a precipitate, which is somewhat soluble in water.—W. G. M.

On the Estimation of the Ash in Organic Substances. H. Kronberg. Chem. Zeit. **11**, 1600.

In the case of substances which froth up or are more or less explosive when heated, it is better to weigh the substance in a tube, and add it in very small portions at a time into the crucible. If much carbon is left it is sometimes expedient to moisten the cooled mass with water, dry, and ignite again.—J. W. L.

Determination of Tannin. F. Gannter. Zeits. Anal. Chem. **26**, 680.

The author compares the relative value of ferric acetate and powdered hide as a precipitating agent in the estimation of tannin by Löwenthal's process with a standard solution of potassium permanganate. It was found that the results obtained by the use of hide were always higher than those obtained when ferric acetate was used. It is also shown that difference between the results varies with the quantity of substance employed for the analysis; thus in one case when 2 grams of the material were dissolved in a litre of water, the result obtained by the use of powdered hide was 10 per cent. higher than when ferric acetate was used, whilst in another case when 20 grams of material were dissolved in the same quantity of water, the difference only amounted to 1 per cent.—G. D.

The Reicherts-Meissl Method for testing Butter, and Wollny's Modification of the same. F. Goldmann. Chem. Zeit. **12**, 183, 184, and 216.

The concordant results obtained by Wollny's modification of the above method (this Journal 1887, 831) are confirmed by the author, but he raises the question whether the numbers obtained really represent the whole of the butter-fat contained, or only a fraction thereof. Wollny states that, whereas the first distillate of 100 cc. of the volatile fatty acids required in a special instance 28·16 cc. of a decinormal baryta solution, the twelfth distillate required 33·95 cc., and considers that this difference remains proportional even after several distillations, and therefore that nothing is to be gained by repeating the distillation. This view is opposed by the author, who states that by continuous distillation the whole of the volatile fatty acids may be distilled over and titrated together in the distillate. In carrying out the operation Wollny's directions are followed in the main. Attention is called to the necessity of protecting the caustic soda and baryta solutions from carbon dioxide, also to the fact observed by Wollny, that the whole of the alcohol cannot be removed by distillation on the water bath. To counteract the error introduced by the presence of carbonate in the alcoholic caustic soda solution used for saponifying, a blind experiment should be made with 2 cc. of the caustic soda solution, 10 cc. of alcohol, and 5 cc. of dilute sulphuric acid (1:4). A constant error, equal to 0·1 cc. of the decinormal baryta solution, was found, which amount is therefore to be subtracted from the final result. To remove the last traces of alcohol, which after decomposing the soap with acid would introduce a plus error, owing to the formation of "esters," distillation in the ordinary manner by steam is resorted to; the second flask containing the soap, the first flask water previously boiled. After distilling over 50 cc. into the receiver the distillate was found to be perfectly free from alcohol, and contained within 0·05 per cent. of the alcohol employed. (To be continued.)—C. A. K.

Detection of and Determination of Aldehyde in Commercial Alcohol. U. Gayon. Compt. Rend. **105**, 1182.

To prepare a sulphurous acid solution of rosaniline for the detection of aldehyde, 20 cc. of a solution of sodium bisulphite of 30° B. are added to 1 litre of fuchsin solution (1:1000), allowed to stand for one hour, and when quite colourless treated with 10 cc. pure concentrated hydrochloric acid. If the hydrochloric acid be added before the bisulphite, the reagent is readily coloured by pure ethyl alcohol. This solution is specially sensitive, and with it 1 part of aldehyde in 500,000 of alcohol may be detected. To carry out the test, dilute the alcohol to a strength of about 50°, and to 2 cc. add 1 cc. of the above solution, shake, and allow to stand. The quantitative determination of the aldehyde is effected colorimetrically, the tint being compared with that given by alcoholic solutions of aldehyde.—C. A. K.

Application of the Azotometer to the Determination of Nitrogen by Kjeldahl's Method. O. Schönherr. Chem. Zeit. **12**, 217.

By using P. Wagner's modification of the azotometer the nitrogen in blood manure, horn manure, dung, &c. may be as readily determined according to Kjeldahl's method (this Journal 1886, 179) as by distillation into standard acid. The method is quick and gives concordant results. The decomposition is effected in a round-bottomed flask having a graduation mark of 150 cc. 3 gr. of dung are treated with 15 cc. of sulphuric acid (consisting of two parts of concentrated to one part of fuming sulphuric acid); in the case of blood or horn manure and the like 2 gr. of substance are taken and treated with 20 cc. of sulphuric acid containing 100 gr. of phosphorus pentoxide per litre. The heating is continued until the solution is colourless, when it is oxidised with potassium permanganate. After cooling the strongly acid solution is nearly neutralised by cautious addition of caustic soda solution containing 280 gr. sodium hydrate per litre, and then diluted up to the 150 cc. mark; 20 cc. of the solution are then treated in the azotometer with 50 cc. of sodium hypobromite as usual. If the solution turns brown owing to the liberation of bromine, the neutralisation with alkali was insufficient. The quantity of nitrogen absorbed by the 70 cc. of liquid must be allowed for and the resulting nitrogen must be calculated on the total amount of substance taken. Manures containing 9 per cent. of nitrogen give 30 cc. of gas, and hence the method is capable of great accuracy; parallel analyses seldom differ more than 0·02 to 0·06 per cent. The purity of the acid employed and the fact that the azometer is air-tight, should be tested by a blind experiment with sugar. It is important that the cooling vessel of the azotometer is sufficiently large, and that the water has attained the temperature of the room. The whole operation requires only occasional attention.—C. A. K.

Criticism of and Improvement on Goldenberg's Method for the Determination of Tartaric Acid. N. Lorenz. Chem. Zeit. **12**, 215—216.

The author has found that in his improved form of Goldenberg's method for the determination of tartaric acid in wine-lees, &c. (Zeit. Anal. Chem. **22**, 270) an average of 18 m. gr. of cream of tartar remain dissolved in the mixture of acetic acid and alcohol used to precipitate it. The same error applies to Goldenberg's original method, and as in this case 1·5 gr. of substance are taken a minus error of 1·2 per cent. of cream of tartar is introduced. This error is compensated for to some extent by a second due to no allowance being made for the space occupied by the precipitated calcium carbonate on making up the solution to 100 cc. after treating the original substance with 2 to 2·5 gr. of potassium carbonate, an error which increases with the richness of the sample in calcium tartrate, and which, when deducted, may leave a total minus error of 0·5 to 0·7 per cent. In the author's modified form of Goldenberg's method, (this Journal 1888, p. 136) 3 gr. of substance are tested, and thus the former of the above errors only amounts to 0·6 per cent., while the compensating error owing to the precipitated calcium carbonate brings the total error down to 0·1 per cent. in the case of pure cream of tartar. With commercial calcium tartrate the total error amounts to to 0·1 per cent. on the plus side. The modified method compares still more favourably with the original when applied to the analysis of wine-lees. A number of comparative analyses by the two methods are given. The modified method yields higher results: in the analysis of calcium tartrate (3 analyses) the perceutage of cream of tartar is 0·63 per cent. to 0·95 per cent. higher; in that of cream of tartar (7 analyses) 0·58 per cent. to 1·72 per cent. higher, and in that of wine-less (4 analyses) 1·83 per cent. to 2·87 per cent. higher than the results obtained by the original method.—C. A. K.

On Kjeldahl's Nitrogen Determination. E. Bauer. Ztschr. f. angew. Chem. 1888, 11.

In a determination by mercuric oxide, the oxidation by potassium permanganate was omitted, as the solution was perfectly clear. But in the distillation the vapours, by an oversight, were allowed to escape freely without coming in contact with the acid. A distinct odour of methylamine (di- and tri-methylamines) was now observable. This cannot affect the determination of the nitrogen by titration, because the amines are equivalent to ammonia for volumetric purposes, but a gravimetric reading as platinum-amine-chloride would give false results unless the platinum were weighed in the metallic state. This throws some light on the action of the permanganate, which would oxidise the amine into the corresponding aldehyde or acid, or even to carbon dioxide and water, while the nitrogen would pass off as ammonia, thus :—

$$N(CH_3)_2H + O_2 = 2\,CH_2O_2 + NH_3$$
$$2\,CH_2O_2 + O_2 = 2\,CO_2 + 2\,H_2O.$$

—W. G. M.

Analyses of North Carolina Wines. J. P. Venable and W. B. Phillips. Chem. Zeit. **12**, 54 and 87.

A number of these wines have been analysed. The method used is that suggested by the German commission on wine analysis, as published by Barth. The acidity was determined before and after boiling, the difference being calculated as acetic acid. The tannin was estimated by the colorimetric method. The extraction was continued in the water bath 2½ hours at about 97°, which may make the results differ slightly from those obtained at 100—110°, as according to Barth. The results obtained were :—

Brand.	Year.	Sp. Gr.	Alcohol, by Weight.	Alcohol, by Vol.	Tartaric Acid.	Acetic Acid.	Total Acids.	Sugar.	Tannin.	Extract.	Ash
			PerCent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Dry Mish	1884	0·9916	9·64	11·96	0·568	0·041	0·609	0·31	0·025	2·459	0·128
Dry Mish	1885	0·9957	9·51	11·81	0·655	0·044	0·699	0·60	0·020	3·162	0·122
Sweet Mish	1885	1·0336	9·71	12·15	0·501	0·028	0·529	5·50	0·025	14·275	0·108
Dry Imperial Scuppernong	1884	0·9949	9·36	11·61	0·713	0 055	0·765	0·08	0·025	2·597	0·110
Dry Imperial Scuppernong	1885	1·0009	9·37	11·62	0·770	0·022	0·792	2·20	0·025	4·259	0·106
Dry Black Scuppernong .	1886	0·9944	8·43	10·47	0·655	0·026	0·681	0·20	0·030	2·885	0·139
Sweet Scuppernong	1884	1·0323	9·07	11·26	0·647	0·015	0·662	5·75	0·020	13·889	0·112
Dry Norton	1885	0·9965	9·14	11·35	0·724	0·041	0·765	0·25	0·025	2·785	0·224
Sweet Norton	1885	1·0331	9·07	11·26	0·693	0·013	0·706	4·75	0·020	14·927	0·197
Dry Bulay	1885	0·9951	8·38	10·40	0·818	0·031	0·849	0·45	0·015	2·179	0·113
King Grape..............	1885	0·9932	12·77	15·77	0·770	..	0·770	1·75	trace	3·320	0·173
White Victory	1885	1·0392	12·38	15·30	0·755	..	0·755	4·25	trace	16·646	0·106
Sweet Martha	1884	1·0332	11·15	13·81	0·708	..	0·708	2·95	0·005	15·103	0·148
Sweet Concord...........	1884	1·0317	10·85	13·43	0·578	..	0·578	3·00	0·010	15·448	0·204
Thomas Arger	..	1·0365	11·54	14·27	0·554	..	0·554	3·00	0·010	14·931	0·090
(N. C. Claret) Ives Seedling	1884	0·9952	10·46	12·96	0·963	..	0·963	0·25	0·030	3·137	0·174
Clinton Port.............	1885	1·0314	12·92	15·96	0·886	..	0·886	2·00	trace	10·952	0·202
Dry Scuppernong........	1885	0·9931	13·80	17·02	0·655	0·014	0·669	0·50	0·005	3·698	0·116
Sweet Scuppernong......	1884	1·0347	11·85	14·65	0·809	..	0·809	3·00	0·005	14·300	0·140

—J. W. L.

New Books.

OUTLINES OF QUALITATIVE ANALYSIS. By GEORGE W. SLATTER, F.I.C., F.C.S., &c. London: Thos. Murby, 8, Ludgate Circus Buildings, E.C.

SMALL 8vo. volume, bound in cloth and containing Preface, Table of Contents, Introduction, two pages devoted to "Useful Hints," two to "Apparatus Required," 117 pages to General Subject-matter, seven pages to Tabulated Matter, and, finally, four pages to a Selection of Questions. With the text are interspersed some half a dozen wood-cuts. Amongst the tables given at the end of the little work are one of "Solubilities," and one giving the systematic, and also the commercial, names of salts with the formulæ; moreover, not only the formulæ for the conversion of the thermometric scales, but also of the hydrometer scales of Twaddell and Baumé into each other and into specific gravity, are given.

Trade Report.

(From the Board of Trade and other Journals.)

ERRATA.—February No.—The table at the top of p. 143 refers to Nitrate of Soda, and the first table on p. 144, under "Mineral Resources of the United States," refers to Quicksilver Statistics for the United Kingdom.

BOARD OF TRADE NOTICES.

MINE OF VALLE IMPERINA.

The Board of Trade have received from the Italian Consul-General a pamphlet on the mine of Valle Imperina, near Agordo. It is written by P. Toso, engineer in the Royal School of Mines, and is printed at Rome. This mine, the wealth of which has been known for five centuries, has, since 1843, been the exclusive property of the State. It produces zinc, iron, copper, sulphur, and arsenic. The writer believes that the importance of the mine is likely to be greatly increased by the extension of the railway from Treviso to Belluno, and by improvements in the processes used for extracting the mineral products. In particular he suggests the sale of material, which is now wasted, for use in the manufacture of sulphuric acid in Venice, Tuscany, Bavaria, and elsewhere, and cheaper and more expeditious methods of dealing with the copper ore.

The Consul-General, in forwarding this publication, states that it is the intention of the Italian Government to dispose of the mine, and to give every inducement to its becoming a private undertaking.

FINES INCURRED UNDER THE RUSSIAN CUSTOMS REGULATIONS.

A communication, dated the 29th February last, has been received from the Foreign Office with reference to numerous complaints that have been received from commercial bodies in England of the infliction of heavy fines by the Russian Customs authorities. It is pointed out that in many cases fines, which are incurred in accordance with the strict letter of the Russian Customs Regulations, are not enforced, but that nevertheless the exporter is charged in the account by dishonest clearing agents, as though the fine had really been exacted. It is therefore advisable that in all cases agents should be called upon to produce the official receipts for fines stated by them to have been paid.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

The New Customs and Excise Duties on Matches.

The *Journal de St. Pétersbourg* for the 30th January (11th February) last, with reference to the imposition of certain new duties upon matches in Russia, says:—

"By an order of the Imperial Council approved by the Emperor on the 4th January last, matches made in Russia will pay an excise duty of one quarter copeck per box of less than 75 matches, and one copeck per box of from 75 to 300 matches.

"Matches imported from abroad will pay a duty of one half copeck per box of 75 matches or less, and of 2 copecks per box of from 75 to 300 matches.

"The license for factories will be at the rate of 50 roubles per year for those in which the work is performed by hand, of 100 roubles per year for those working with machinery moved by horses, and of 150 roubles per year for those where steam is used.

"Dealers in matches may sell the remainder of their stores of matches without excise stamp for a month subsequent to the enforcement of the new taxes, after which all boxes of matches must be provided with stamps attesting that the Excise has been paid.

"The new Excise duties will come into operation on the 1st May 1888."

Classification of Articles in Customs Tariff.

Note.—Poud = 36 lbs. avoirdupois. Gold rouble = 3*s.* 2*d.*

The following decisions affecting the classification of articles in the Russian Customs Tariff have recently been given by the Russian Government:—

Fluor spar.—Section 14, Part 1. Duty, 4 copecks per poud.

Apparatus of alloys of zinc and antimony, and with parts of other materials, for producing hydrogen.—Section 177. Duty, 88 copecks per poud, with an addition of 20 per cent. on each rouble of duty leviable.

FRANCE.

Changes in Customs Tariff.

The following is a statement of the Customs duties now leviable in France on the importation of the under-mentioned articles, which, in consequence of the lapse of the Treaty of 1881 between France and Italy, now pay under the French General Tariff instead of paying conventional rates as formerly.

Classification of Articles.	Rates of Duty now leviable.
	Fr. Cts.
Madder	Free.
Sumac and fustic	Free.
Gall-nuts and acorn-cups	Free.
Graphite or plombagine	Free.
Boracic acid	Free.
Potash and carbonate of potash:	
Of European production, if imported direct, &c.	Free.
Do. do., otherwise imported	100 kilos. 2·46
Vegetable ashes	Free.
Sulphate of quinine	5 % *ad val.*
Chemical products, not specially mentioned in tariff, including extracts of quinine and phosphor paste	5 % *ad val.*
Ochres, ground or prepared for painting	100 kilos. 0·25
Italian, sienna and umber earths	„ 0·50
Talc, pulverised	„ 0·25
Perfumeries, other than soaps:	
Alcoholic	„ *37·50
Non-alcoholic	„ 12·00

Note.—The articles stated above as being now free of duty under the French General Tariff were also previously free in virtue of the Franco-Italian Treaty.

SWITZERLAND.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lbs. avoirdupois. Franc = $9\frac{6}{10}d.$

On Category 9*a*, "bichloride of mercury" is to be added after "corrosive sublimate."

Ammoniacal sulphate of copper (for use in destroying mildew), Category 16. Duty 30 centimes per quintal.

In the note attached to Category 17 "acetate of lead" (Saturn salts) should be inserted in the place of "pyrolignite of lead," which is taken out.

MADAGASCAR.

Customs Tariff.

The French *Annales du Commerce Extérieur* for the month of November last, state that the treaties concluded with the Hova Government fix the duties to be collected on imports into and exports from Madagascar at a maximum of 10 per cent. *ad valorem.* For a certain number of articles, however, the duty of 10 per cent. *ad valorem* has been temporarily replaced by specific duties, as shown in the following table:—

Provisional Export Duties.

Classification of Articles.	Rates of Duty.
	Fr. Cts.
Bones	Per 100 kilos. 0·50
Wax	„ 20·00
Gum copal	„ 12·00
Ginger	„ 4·00
Hides, salted and tanned	Per hundred 25·00
Horns	„ 0·75
Caoutchouc	Per 100 kilos. 12·00

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* In addition to Excise duty.

CUSTOMS TARIFFS FOR CHEMICAL PRODUCTS.

(*Chem. Zeit.* 12, 88.)

Product.	Customs Tariff per 100 Kilos. in						
	America.	Germany.	France.	Italy.	Austria-Hungary.	Switzerland.	Russia, per Poud.
	Dol's.	M.	Fr.	L.	Fl. (Gold).	Fr.	Rbl. (Gold).
Aconite	Free	Free	..	..	..	..	..
Ether (of all kinds)	220	20	..	4	24	7	6
Essential oils	25 %	20	..	300	10	..	15·85
Caustic potash	20	4	..	5	4	1	..
Caustic soda	2·20	4	6·50	0·50	4	1	..
Alum	1·32	3	0·90	0·50	1·50	0·30	0·25
Alum (powdered and crystals)	1·32	3	..	..	..	..	0·30
Alunite	..	3	..	Free	Free	..	0·07
Albumin	Free	Free	Free	Free	6	2	0·33
Alizarin	Free	Free	5 %	Free	10	3	15
Alizarin paste	Free	Free	..	Free	10	3	15
Alkaloids	25 %	Free	..	1,200	10	7	..
Alcohol	2	180	30 per h. l.	30 per h. l.	24	0·2 per gr. tr.	..
Alcoholic varnish	1·32 per Gal. 40 %	20	30	30	24	..	..
Various alcoholic substances	*	20	..	..	..	..	..
Aluminium	Free	Free	500	5	Free	3	1·50
Ammonia	20 %	Free	2	5	1·5	1·0	1·20
Ammonium carbonate	20 %	Free	..	4	3	2	1·20
Ammonium acetate	55	Free	..	4	10	..	1·20
Ammonium sulphate (crude)	20 %	Free	Free	0·5	1·5	Free	0·50
Do. (pure)	20 %	Free	7·75	0·5	1·5	0·2	0·50
Other ammonium salts (crude)	20 %	Free	3	4	10	Free	1·20
Do. (pure)	20 %	Free	7·75	4	10	0·2	1·20
Aqueous ammonia	40 %	Free	..	..	Free	..	..
Amyl alcohol	10 %	Free	6·25	38 to 47	10	7·0	6·0
Starch	20 %	9	..	8 to 12	6	0·60	1·20
Aniline	20 %	Free	Free	Free	1·50	1·0	..
Aniline arsenate	Free	..	..	..	..	..	..
Aniline dyes	35 %	Free to 20	..	Free	10	7	15
Crude aniline oil	Free	Free	..	10 to 15	1·5	..	..
Aniline salts	Free	Free	..	..	..	..	..
Anthracene	..	Free	Free	Free	1·5	1·0	15
Antimony (metal)	10 %	Free	Free	8	..	1·5	0·22
Do. (regulus)	10 %	Free	6	1·0	Free	1·5	0·22
Ores of antimony	Free	Free	Free	Free	Free	1·5	..
Arrowroot	30 %	9	..	8 to 12	10	10	1·30
Arsenious acid (crude)	Free	Free	Free	Free	0·50	0·30	0·55
Arsenious acid (other sorts)	20 %	Free	Free	Free	0·50	0·30	0·55
Metallic arsenic	20 %	Free	Free	1·0	0·50	3	0·55
Sulphide of arsenic	20 %	Free	5 %	4	0·50	1·0	..
Arsenic acid	..	Free	..	Free	10	1·0	..
Prepared medicines	40 %	Free	..	120	24	40	12
Asbestos (rough)	Free	Free	..	..	..	..	..
Do. (prepared)	25 %	10–60	..	..	..	..	..
Asphalt	Free	Free	Free	0·50	1·50	0·30	0·06 to 0·13

* Two dollars per gallon for the alcohol contained in the substance, plus 25 %.

—J. W. L.

UNITED STATES.

Customs Decisions.

Straw pulp, for paper-makers' use, is held to be dutiable at the rate of 10 per cent. *ad valorem*, under the provision in Schedule M. (T. I., 398) for "pulp, dried, for paper-makers' use," such straw pulp not being the pulp of the "Esparto or Spanish grass, and other grasses" which is specified in the free list (T. I., 691).

Certain earthenware crucibles manufactured of white clay are held to be dutiable at the rate of 55 per cent. *ad valorem*, under the provision in Schedule B. (T. I., 127) for "all other earthen, stone, and crockery ware, white, glazed, or edged, composed of earthy or mineral substances, not specially enumerated or provided for."

Certain gelatine sheets, claimed by the importer to consist of paper and gelatine, but which upon investigation were found to be thin transparent sheets made wholly of gelatine, and containing neither paper nor cellulose, are held to be dutiable at the rate of 30 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 3) for "gelatine and all similar preparations."

NEW CUSTOMS TARIFF OF ITALY.

See Board of Trade Journal for March, pp. 260-274.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

IMPORTS INTO THE UNITED KINGDOM FROM SPAIN.

PRINCIPAL ARTICLES.		January 1887.	January 1888.
Chemical products unenumerated	Value £	4,713	4,380
Copper ore and regulus	Tons	3,021	4,810
	Value £	63,746	111,738
Manganese ore	Tons	900	..
	Value £	900	..
Pyrites of iron or copper	Tons	54,122	55,117
	Value £	102,814	94,967
Quicksilver	Lbs.	600,000	770,960
	Value £	58,500	102,798
Rags, Esparto	Tons	3,900	9,511
	Value £	23,623	56,356

Total Value	1887.	1888.
January	£818,935	£993,680
February	£890,692	£885,003

EXPORTS OF BRITISH AND IRISH PRODUCE FROM THE UNITED KINGDOM TO SPAIN.

PRINCIPAL ARTICLES.		January 1887.	January 1888.
Alkali	Cwts.	20,501	17,860
	Value £	7,627	5,000
Caoutchouc, manufactures of	Value £	808	968
Cement	Tons	293	300
	Value £	567	721
Chemical products (including dye stuffs)	Value £	3,922	1,909
Coal, products of (including naphtha and paraffine)	Value £	3,135	1,650
Glass manufactures	Value £	327	625
Grease, tallow, and animal fat	Cwts.	965	1,202
	Value £	1,050	1,191
Manure	Value £	2,486	17,587
Painters' colours and materials	Value £	987	2,259
Paper of all sorts	Cwts.	426	716
	Value £	1,176	1,507
Soap	Cwts.	291	184
	Value £	251	185

Total Value	1887.	1888.
January	£235,826	£280,237
February	£297,122	£309,828

UNITED STATES IMPORTS AND EXPORTS IN 1886 AND 8887.

IMPORTS OF MERCHANDISE.

Articles.	Quantities.		Values.	
	1887.	1886.	1887.	1886.
Free of Duty.			Dollars.	Dollars.
Asphaltum, crude, lbs.	62,216,885	65,129,889	97,377	108,528
Chemicals :—				
Lime, chloride of, lbs.	103,086,679	101,974,620	1,686,742	1,418,023
Potash, muriate of, lbs.	40,891,063	47,062,964	597,588	723,010
Soda, nitrate of, lbs.	163,776,049	139,381,060	2,253,806	2,373,068
Sulphur or brimstone, crude, tons	90,703	101,644	1,461,056	1,862,044
Diamonds, uncut, including glaziers'	..	..	286,072	300,226
Fertilizers :—				
Guano, tons	10,195	13,344	252,265	302,154
Phosphates for fertilizing, tons	24,197	30,837	206,933	310,413
All other	..	..	792,620	1,417,336
Ores :—				
Gold-bearing	..	..	14,028	654
Silver-bearing	..	..	4,228,107	2,534,919
Plaster of Paris, unground, tons	133,661	141,600	147,228	150,586
Platinum, unmanufactured, lbs.	5,277	3,511	508,716	373,941
Plumbago, cwts.	187,161	119,428	376,554	231,692
Tins, bars, blocks, or pigs, grain, lbs.	29,344,553	29,531,355	6,921,948	6,728,908
Dutiable.				
Brass and manufactures of	..	..	378,290	410,907
Cement, barrels	1,506,721	916,152	1,469,183	963,225
Chemicals :—				
Potash, nitrate of, lbs.	9,601,381	10,132,805	264,560	278,859
Soda, bicarbonate of, lbs	1,893,183	3,417,803	31,603	59,967
Soda, carbonate, sal soda and soda ash, lbs.	280,777,383	301,963,864	2,843,892	3,244,700
Soda, caustic, lbs.	89,162,856	79,746,941	1,651,337	1,553,158
Soda, all other salts of	16,171,130	10,593,681	51,665	40,770
Clays, including kaoline, tons	42,497	32,504	293,439	261,504
Coal, bituminous, tons	850,331	861,021	2,620,975	2,515,879
Copper :—				
Ore (fine copper contained therein), lbs.	3,935,432	4,795,050	199,696	346,781
Pigs, bars, ingots, old, and unmanufactured, lbs.	212,539	531,789	15,086	40,381
Manufactures of	..	..	107,100	126,722
Earthen, stone, and china ware	..	..	6,138,769	5,402,524
Glass and glass-ware	..	..	7,687,051	6,757,108
Iron and steel and manufactures of	..	..	56,420,540	41,630,779
Jewellery, of gold, silver, and precious stones	..	..	11,684,830	10,203,152
Lead and manufactures of	..	..	608,165	1,061,617
Marble, stone, and manufactures of	..	..	901,637	965,268
Metals, compositions, and manufactures of, n.e.s.:—				
Bronze manufactures	..	..	814,626	782,890
All other	..	..	2,277,401	2,157,185
Mineral substances, n.e.s.	..	..	145,325	191,233
Salt, lbs.	712,444,637	792,937,313	1,267,111	1,450,634
Zinc :—				
Spelter, and manufactures of, in blocks, pigs, and old	9,517,070	4,791,521	309,744	150,101
Manufactures of	..	..	44,703	48,278

Exports of Foreign Merchandise.

—	Quantities 1887.	Quantities 1886.	Values 1887.	Values 1886.
			Dollars.	Dollars.
Free of Duty.				
Asphaltum, crude, lbs...	170,518	638,157	3,995	8,051
Chemicals :—				
Lime, chloride of, lbs..	15,000	14,919	315	511
Potash, muriate of, lbs.	..	..	..	..
Soda, nitrate of, lbs....	6,331,161	36,598	136,753	2,325
Sulphur or brimstone, crude, tons	20	9	400	181
Diamonds, uncut, including glaziers'...........	4,000	18,250	800	2,506
Fertilizers :—				
Guano, tons............	..	..	..	..
Phosphates for fertilizing, tons............	140	15	2,320	295
All other	..	..	..	1,821
Ores :—				
Gold-bearing	..	..	..	..
Silver-bearing	..	..	600	..
Plaster of Paris, unground, tons..........	..	..	..	..
Platinum, unmanufactured, lbs.	189	..	22,800	..
Plumbago, cwts.	..	..	..	..
Tins, bars, blocks, or pigs, grain, lbs..............	308,660	151,868	100,980	32,886
Dutiable.				
Brass, and manufactures of	585	..	10,163	2,183
Cement, barrels.........	9,878	8,502	12,065	11,511
Chemicals :—				
Potash, nitrate of, lbs..	369,251	..	10,135	..
Soda, bicarbonate of, lbs.	45,498	67,115	646	1,100
Soda, carbonate, sal soda and soda ash, lbs.	39,302	184,901	542	2,213
Soda, caustic, lbs.	1,237,905	1,189,023	24,383	24,242
Soda, all other salts of	..	24,470	..	286
Clays, including kaoline, tons	1	28	13	277
Coal, bituminous, tons ..	176	7,220	1,997	24,102
Copper :—				
Ore (fine copper contained therein), lbs..	48,724	215,288	4,890	22,199
Pigs, bars, ingots, old, and unmanufactured, lbs.	900,159	82,768	94,145	5,831
Manufactures of	..	..	12,094	8,063
Earthen, stone, and china ware.................	..	..	14,759	17,718
Glass and glass-ware....	..	..	26,878	11,471
Iron and steel, and manufactures of............	..	..	149,808	242,702
Jewellery, of gold, silver, and precious stones...	..	..	27,095	59,639
Lead, and manufactures of.....................	..	..	286,229	478,077
Marble, stone, and manufactures of	..	..	3,738	2,251
Metals, compositions, and manufactures of, n.e.s. :—				
Bronze manufactures	..	..	1,597	1,031
All other............	..	..	48,716	46,145
Mineral substances, n.e.s.	..	..	..	..
Salt, lbs.................	1,753,010	1,939,451	3,276	3,309
Zinc :—				
Spelter, and manufactures of, in blocks, pigs, and old	13,495	1,135	175	59
Manufactures of	..	..	18	427

Exports of Domestic Merchandise in 1886 and 1887.

Articles.	Quantities 1887.	Quantities 1886.	Values 1887.	Values 1886.
			Dollars.	Dollars.
Brass, and manufactures of....................	..	..	275,019	183,686
Bricks	..	..	80,543	104,724
Chemicals :—				
Acids	..	..	97,916	100,313
Ashes, pot and pearl, lbs.	947,024	572,159	39,263	28,681
Coal :—				
Anthracite, tons.......	825,486	667,076	3,469,166	2,718,143
Bituminous, tons......	706,364	544,768	2,001,936	1,440,631
Copper :—				
Ore, tons..............	25,064	20,876	2,774,464	2,341,164
Ingots, bars, and old, lbs.	12,347,507	19,504,087	1,223,260	1,960,189
Sheets, lbs.............	123,886	49,334	24,668	8,583
All other manufactures of....................	..	..	92,064	76,386
Fertilizers, tons.........	221,272	170,032	1,405,501	1,090,715
Gunpowder and other explosives............	..	..	482,949	486,319
Iron, steel, and manufactures of	..	..	16,235,922	14,867,087
Jewellery, and manufactures of gold and silver	..	..	463,950	428,326
Lead, and manufactures of....................	..	..	140,065	136,666
Lime and cement, bbls. .	63,500	83,247	97,771	123,684
Marble, slate, and stone, and manufactures of ..	..	..	541,932	593,728
Mineral oils :—				
Crude, galls............	80,650,286	76,346,480	5,141,833	5,068,409
Refined...............	..	..	41,757,009	43,076,795
Ore, gold and silver bearing....................	..	..	87,604	56,731
Paints and painters' colours................	..	..	497,470	401,060
Paraffine and par. wax, lbs.	33,135,338	27,441,126	2,618,601	1,843,604
Quicksilver, lbs..........	895,413	477,332	455,790	210,853
Salt, lbs.	4,685,680	4,828,863	27,213	29,580
Tin, manufactures of	..	..	172,561	151,555
Zinc, and manufactures of :—				
Ore or oxide, tons ..	235	1,331	17,286	49,455
Pig, bars, plates, and sheets, lbs.	136,670	917,229	9,017	75,192
All other manufactures of	..	..	16,789	13,526

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Lard made from Cotton-seed Oil in America.

A despatch, dated the 10th February last, has been received from Sir L. Sackville West, Her Majesty's Minister at Washington, enclosing a memorandum on the sale of lard made from cotton-seed oil, the production of which is said to be seriously affecting that of real lard in the United States. The following is a copy of the memorandum in question:—

"A Bill is now before the Senate for regulating the sale of adulterated lard, that is to say, lard made from cotton-seed oil, by the imposition of a tax of one cent per lb. The cotton-growing States have memorialised Congress against this measure. They assert that the imposition of such a tax will practically destroy the manufacture of cotton-seed oil, render worthless the mills in which millions of dollars of the hard earnings of the entire country are invested, throw out of employment thousands of poor operators and labourers, and drive from the markets of the world one of the chief products of the United States.

"The extent to which cotton-seed oil is used as an adulterant of lard is admitted by those who use it. A firm in Galveston (Texas) has admitted that they alone consumed one-fifth, or from 3,000,000 to 3,500,000 gallons of the total cotton-oil product of the United States in the manufacture of lard, and that the firm made and sold last year 60,000,000 lbs. of so-called refined lard, of which only 60 per cent. was lard, the remainder being cotton-seed oil and beef fat.

"The 'Cotton-Seed Oil Trust,' which monopolises the industry of producing the oil, works it may here be observed, some of the largest lard factories in the United States. The consumers of lard do not complain that cotton-seed lard is an injurious production, but that they have no means of knowing when they are purchasing real lard, and hence they seek for some legislative measure to establish the difference between the two productions."

Trade in Explosives in France.

The following particulars of the import, export, and production of explosives in France in 1885 and 1886 have been furnished to Mr. J. A. Crowe, Her Majesty's Commercial Attaché for Europe, by the Directors of Commerce and Indirect Taxes, and are contained in his report dated the 13th February last:—

"As regards imports, we should remember that gunpowder, gun-cotton, nitro-glycerine, picrate, and fulminate, are all prohibited, that dynamite is allowed to enter at a duty of 2 francs 50 centimes per kilog., under special regulations; and that loaded cartridges are admitted, under special arrangements, at a duty of 25 francs per 100 kilos.

"The imports of dynamite and loaded cartridges into France in 1886 were as follows:—From Belgium, 68,605 kilos. of dynamite, and cartridges, *nil*; from England, dynamite, *nil*, and 133 kilos. of cartridges; from Italy, dynamite, *nil*, and 18 kilos. of cartridges; from Switzerland, dynamite, *nil*, and 1,458 kilos. of cartridges; giving totals of 68,605 kilos. of dynamite and 1,609 kilos of cartridges.

"Belgium is the sole importer of dynamite.

"The exports of explosives have been as follows:—Military powder, 994 kilos in 1886, and *nil* in 1885; sporting powder, 30,018 kilos. and 13,924 kilos.; mining and foreign trade powder, 833,164 kilos. and 817,779 kilos.

"The production of dynamite and gunpowder is controlled by the Excise, and official returns show the sales to have been as follows:—Sporting powder, 433,518 kilos. in 1886 and 490,562 kilos. in 1885; mining powder, 2,559,128 kilos. and 2,815,258 kilos.; military powder, 164,286 kilos. and 171,888 kilos.; powders sold of all kinds on the Swiss and Italian frontier-districts of Corsica, Monaco, and Tunisia, 148,967 kilos. and 100,193 kilos.; dynamite, 396,618 kilos. and 447,359 kilos.; nitro-glycerine, 668 kilos. and 774 kilos.

"The total amount of gunpowder that paid Excise was 4,169,081 kilos. in 1886, and 4,409,604 kilos. in 1885.

"The Excise on gunpowder gave 12,970,255 francs (518,808*l.*) in 1886, as against 13,862,411 francs (554,496*l.*) in 1885."

Danish Institute for Encouragement of Industry.

See Board of Trade Journal for March, p. 283.

MISCELLANEOUS TRADE NOTICES.

Change of the Oriental Museum of Vienna into an Austrian Commercial Museum.

The *Moniteur Officiel du Commerce*, in its issue of the 26th January last, with reference to the change of the Oriental Museum of Vienna into the Austrian Commercial Museum, says:—

"A recent Imperial decree has authorised the Oriental Museum to take henceforth the title of 'Imperial and Royal Austrian Commercial Museum.' This title, which implies to some extent Government protection, is only granted generally to a very small number of scientific and other societies.

"This sovereign favour, as well as the new charter duly sanctioned by the proper authorities, confirms the change of the Oriental Museum, which has been in question for more than a year.

"Founded in 1873, at the time of the last international universal exhibition which was held at Vienna, that is to say, at a time when, notwithstanding the vicinity of the East, the articles peculiar to those regions were still very little known in Austria, the Oriental Museum has largely contributed, during the 14 years of its existence, to spread the taste in that direction. It may be said that, under this impetus, a certain number of branches of Austrian industry have adopted the Oriental style, and have succeeded in accurately reproducing many clever and elegant examples of it.

"The principal means by which the Oriental Museum has attained its object have been by frequent exhibitions of art applied to industry, organised sometimes at Vienna and sometimes in the provinces; the permanent exhibitions of Oriental collections; the introduction into technical schools of Oriental models and designs; finally, the very active campaign in favour of Oriental art which has been conducted by authorised writers in the review, entitled *Œsterreichische Monatsschrift für den Orient*.

"The Oriental Museum has besides endeavoured to knit still closer the old commercial relations of Austria-Hungary with the Eastern countries, to develop them, and to extend their range to the regions of the extreme East. It is principally in this direction that its activity has been exercised. The increasingly higher returns of trade between Austria-Hungary and the East Indies are the indisputable result of its efforts. It has applied itself, moreover, to forming mercantile associations and syndicates dealing chiefly with exports to distant countries; to publishing works intended to convey further information as to the people and manners of India and Asia; finally, to establishing connexions, by means of correspondents, between the mercantile world of the East and the manufacturers and merchants of Austria.

"The Minister for Foreign Affairs has appointed a member of the Consular Service to assist during the period of change. He has also entrusted to him the publication of consular trade reports of Austria-Hungary. This department, as well as that of Commerce and Public Instruction, will be represented in the sittings of the Administrative Council by special delegates. Thus the Commercial Museum of Vienna enjoys equally the protection of the Government and that of the representatives of commercial and industrial interests in the Empire.

"Article 3 of the Articles of Constitution indicates some of the new objects which this new commercial museum will endeavour to effect:—

"1. The development of collections of artistic and ethnographical specimens already commenced; the temporary exhibition of these collections in the provinces.

"2. The establishment of a bureau for giving information respecting Customs tariffs, costs of transport, ways of communication, and decisions of foreign tribunals in commercial cases.

"3. The enlargement of the library.

"4. Correspondence with members of the institute, as well as with the most important scientific and commercial corporations.

"5. The study of economic progress in foreign countries.

"6. The establishment of a laboratory for the analysis of raw and industrial products of foreign countries.

"7. The organisation of meetings and conferences upon subjects of interest to trade and geographical research.

"8. The issue of publications dealing with the question of the establishment of similar institutions in foreign countries, and containing miscellaneous information respecting commercial interests generally."

Patents for Inventions in Switzwerland.

The following information respecting patents for inventions in Switzerland is extracted from the *Moniteur des Intérêts Matériels* for the 19th February last:—

"In July last, the Swiss people accepted, by 203,506 votes against 57,862, an addition to the Federal Constitution, which places within the jurisdiction of the Confederation, legislation 'upon the protection of new designs and models, as well as of inventions represented by models and applicable to industry.' This provision requires two distinct laws. The bill relating to industrial models and designs has not yet appeared, but an extra-parliamentary commission of 16 members has inquired into the project of the Federal Department of Commerce and Agriculture with reference to patents for inventions.

"The result of their labours has been that the Federal Council adopted, in its sitting of the 20th January, a message to the Federal Assembly and a *projet de loi* of 32 articles upon invention patents.

"The Constitution refers only to inventions *represented by models.* This condition, which does not exist in any other country, will give to the Swiss law a peculiar character. It has for its object to exclude, and it does exclude from protection and limitation of the law upon patents, the chemical industries. It will also result in eliminating patents taken out for inventions badly matured, and of which the authors are unable to explain the technical working.

"The first article describes a model as any plastic representation of an invention which shows clearly the nature and use of the latter. The Federal Council does not consider that the deposition of the model by the inventor should be made obligatory, but will be contented with proof that this model exists.

"In the *projet de loi* it is laid down that the delivery of the patents will be submitted to a preliminary examination, the sole object of which is to draw the attention of the inventor to nullifying causes which might prejudice his patent: the refusal of the patent is only to be justified if the necessary formalities of deposition have not been fulfilled.

"In order to reconcile the necessity of stating the ownership of an invention at the time when it is conceived, and of the required production of a model, the *projet* provides for the delivery of a provisional patent, demanded at the time of the invention, the only effect of which will be to maintain for three years the claim of the inventor to a final patent granted upon proof of the existence of the model; the final patent alone will confer on the proprietor an exclusive right to his invention, and the power of prosecuting those who infringe it."

COAL IN TURKEY.

The Belgian Consul at Salonica, writing to the Belgian *Bulletin du Musée Commercial* of the 11th of February last, states that an extensive bed of coal, discovered in 1886, is now being examined close to Gheoghely railway station, not far from Salonica. At first the prospects of mining did not appear very hopeful, but of late there had been reason to believe the bed to be richer than was at first supposed. The Government has not yet been persuaded to give any company a firman permitting them to work the mine.

ANTIMONY IN TURKEY.

The Belgian *Bulletin du Musée Commercial* for the 18th February quotes from the *Journal de la Chambre de Commerce de Constantinople* the statement that M. Miltiades Constantinidis, who is the proprietor of a mine of antimony in the island of Samos, is receiving offers from various capitalists with a view to the working of this mine. The latter is said to be very rich, and a certain quantity of the ore, lately examined, produced from 58 to 60 per cent. of antimony.

SPAIN.

The Andalusian Sulphur Industry.

The production of sulphur is one of the principal industries in Andalusia. Its centre is in the neighbourhood of Almeria, where it has attained a high degree of development. Rich sulphur mines are found in various parts of the mountains in that district. An old-established and very successful sulphur refinery, situated just outside Almeria, has recently passed from the possession of a local bank into that of a company called "Sociedad Minero Industrial de Almeria," and since that the works have been so much extended that they will soon be able to export thousands of tons of its two specialties—flowers of sulphur and washed sulphur.—*Chemist and Druggist.*

SPANISH COLONIES.

Quicksilver in Cuba.

It is thought that the unsatisfactory condition of sugar-growing will cause greater attention to be paid to the development of the immense mineral resources of Cuba. Among the mines for which titles have been granted by the Government are two quicksilver mines, covering an area of 27 hectares, and one for antimony, covering 60 hectares. The Government are willing to offer all the advantages possible with a view of developing the country, but there would be a difficulty from insufficiency of labour for working on a large scale—a difficulty which, however, could easily be surmounted by importing miners from Spain or elsewhere.—*Chemist and Druggist.*

THE CHEMICAL TRADE IN RUSSIA.

The chemical industry in the Moscow district is represented as being in a very flourishing condition, and having greatly extended the market for its products during the year 1887. Some of the Russian works are now about to undertake the manufacture of the finer chemicals and pharmaceutical preparations, which have hitherto been supplied to Russian consumers by foreign, principally German, manufacturers. It is said that the output and sale of hydrochloric acid in particular is very rapidly increasing in Russia, from which it may be inferred that the alkali industry in that country is also assuming larger proportions. Meanwhile the rumours that Russia intends to adopt something like a free-trade policy towards British goods, or at least concede to the latter much more favourable terms than she does to articles of German produce, are persistently revived. If adopted, such a policy would certainly not tend to improve the commercial relations between Germany and Russia, but Great Britain would no doubt reap a considerable, if temporary benefit.—*Chemist and Druggist.*

STRAITS SETTLEMENTS.

Essential Oils.

Essential oils of lemon grass, patchouli, nutmeg, and other aromatic plants form fairly important items of export from Singapore. At present there are but two distilling works. The distillers are themselves cultivators of the plants they distil, among which lemon grass holds a prominent place. There are also factories of essential oils in Ceylon and India, and competition is pretty close. As per trade statistics, the exports of essential oils of all sorts, quantities not stated (they are sold per oz.), amounted in 1884 to 15,187 dolls., and in 1885 to 11,706 dolls. These amounts are probably incorrect, much more being both manufactured and exported, but probably not reported to the export office. There is such an abundance of aromatic leaves, flowers, roots, barks, and woods in Malaysia that it surprises one that the industry is not being more extended.—*Chemist and Druggist.*

THE PRODUCTION OF CUTCH.

We hear from Rangoon that there is some probability of a serious diminution of the production of cutch in Upper Burmah, as indeed there has already been a palpable decline in the exports from Rangoon during the last few years. In 1883-84 the quantity exported *viâ* Allonmyo was very nearly 150,000 maunds, the following year it fell to 104,000, and in 1885-86 to only 70,000 maunds. The last-named year being the first of the occupation of King Theebaw's dominions by the British, trade suffered owing to the unsettled state of the country; but in 1886-87, although the country was probably quieter than it had been during the decline of Theebaw's reign, there was a further falling off, and the quantity exported was only 64,000 maunds. The decrease in exports *viâ* Tounghoo from 10,000 to four maunds only need not cause any surprise, since the disturbed state of the Nyngian and Yemethen districts, which produce the cutch brought into Toungkoo, sufficiently accounts for the entire collapse of this trade. In the Irawaddy district, too, the trade has decayed. The cause of this decline is to be found in the reckless and wasteful way in which the supply has been dealt with. In the time of King Theebaw forest conservancy was not known, and the lessees of the forests cared nothing for preserving the trees from fire, or of conserving the young timber.—*Chemist and Druggist.*

CHEMISCHE FABRIK AUF ACTIEN, BERLIN.

The directors of the Chemische Fabrik auf Actien in Berlin, better known here as Schering's Works, have decided to pay a dividend of 24 per cent. for the year 1887, the net profit being 872,580 m., or 43,629*l*. The company's turnover during the year 1887 was considerably in excess of the previous year's, and, according to appearances, further progress will be made in 1888. Several new preparations have lately been added to the list of the firm's articles, but the contemplated manufacture of aluminium has been abandoned for the present.—*Chemist and Druggist.*

THE BRAZILIAN DRUG TRADE.

The value of the imports of chemicals into Rio de Janeiro during the financial year 1886-87 is declared at 2,278,962 milreis, of which 554,650 m. came from the United Kingdom, and 418,712 m. from Germany. In 1885-86 the figures were 2,375,617 m. (United Kingdom 519,862 m., Germany 408,782). Of articles of pharmaceutical interest the imports are given as follows:—

——	1885-86.	1886-87.
	Ms.	Ms.
Seed and plants..................	2,123,727	2,072,997
From United Kingdom	608,888	407,094
„ Germany..............	291,204	344,244
Perfumery, dyes, &c.............	2,913,608	3,080,795
From United Kingdom	563,368	519,678
„ Germany	198,104	183,492

—*Chemist and Druggist.*

THE BORAX COMPANY.

At a general meeting of the shareholders of the Borax Company held in London on March 8, it was stated that the company had purchased the right of working for fifty years two mines in Asia Minor containing boracite, from which borax, boracic acid, &c., are manufactured. It has also purchased a factory near Paris, which is capable of turning out the full quantity of borax products for which a market can be found. The two mines are expected when in full working order to yield 9,000 tons of boracite per year.

—*Chemist and Druggist.*

Export Duty on South American Cinchona.

It is said that from May 1 an export duty equal to 3*d*. per lb. will be levied on all cinchona bark exported from Bolivia. The report requires confirmation, as it does not seem likely that either the Bolivian or the Chilian Government (for probably the duty applies to barks shipped by Chilian ports) would impose a duty which will seriously interfere with the rising industry of cinchona planting in Bolivia.—*Chemist and Druggist.*

Importation of Pharmaceutical Preparations into Japan.

Important alterations are reported to have been made in the regulations affecting the importation of pharmaceutical articles into Japan. Hitherto all medicinal drugs and preparations brought into that country have been subjected to examination by the Japanese Government, and, if found to answer the tests, were stamped with an official seal as "fit for medical use." Japanese subjects were not allowed to sell any articles except those bearing that seal, and all others were therefore practically unsaleable. This regulation has now been abolished, and in future all preparations made according to the Japanese Pharmacopœia will receive the official seal, while upon all other pharmaceutical preparations it will be merely stated according to what official formula they have been prepared. This is intended to have the effect of creating upon native buyers the impression that only those preparations made according to the requirements of the Japanese Pharmacopœia are genuine. A copy of the Latin edition of this Pharmacopœia has been supplied to each importer of foreign drugs and chemicals.

—*Chemist and Druggist.*

The New Russian Duty on Kerosene.

Chem. Zeit. 12, 52.

Mendelejeff suggests that all kerosene exported from Baku shall be exempt from duty under the new Russian Act, otherwise he fears the trade will suffer severely in foreign markets. On the other hand, he would put a duty on naphtha exported.—J. W. L.

The Mining of Manganese in Chili.

Chem. Zeit. 11, 1619.

Manganese was mined in Chili for the first time by an English company about 9 or 10 years ago near the town of Hospital, a station on the South Chilian Railway. The ore decreased in strength with the depth, and the mine was therefore abandoned after a few years' working. Messrs. Guill, Tripler, and Co., shortly afterwards discovered manganese deposits in Oralle, province of Coquimbo. The railway is about six leguas from the mines, and the expenses for mining and carrying the ore on board ship to Coquimbo are about 15 pesos per ton. The ore contains from 35 per cent. to 40 per cent. Mn. The mines of Robert John and Co., in Serena, are worked under much the same conditions. Urbano Gonzalez and Co. possess mines in Leoncito and Arrayan, with an ore containing 45 per cent. to 50 per cent. Mn. The expenses for mining and transport to the sea-coast are from 10 to 12 pesos per ton. The mines of Garcia and Co., in Joaquin Naranjo, contain manganese of high strength, testing on an average 50 per cent. Mn. These firms do all the manganese business in Chili, and ship from Coquimbo from 3,000 to 4,000 tons per month, chiefly to England. Quite recently large and rich beds of manganese have been discovered in the province of Atacama, north of Coquimbo. The first batch of ore was shipped at the beginning of 1887, and contained as much as 56 per cent. Mn. The distance of the mines from the railway is only five leguas, and it is intended to build a railway to the mines, whereby the working expenses may be expected to be no more than 5 or 6 pesos per ton of manganese ore. The manganese trade of Chili will then be monopolised by the mine-owners of Atacama.—S. H.

The Ultramarine Industry.

Chem. Zeit. 12, 52 *and* 85.

On account of the unpromising state of this industry, it is suggested to form a "ring" among the manufacturers.

The following suggestions are made in order to place this industry in a better position:—(1.) Mutual working of the German ultramarine works. (2.) Reduction of the output from the German works. (3.) As direct a sale as possible to the consumers. (4.) Joint purchase of materials. (5.) Association between manufacturers of the same district.—J. W. L.

STATISTICS.

Board of Trade Returns.

Imports.

—		February 1886.	February 1887.	February 1888.
Drugs, unenumerated..	Value £	50,742	45,060	79,587
Chemical manufactures and products, unenumerated	„	113,603	94,483	116,003
Chemicals and dye-stuffs, unenumerated	„	218,144	194,504	235,325
Oils, not enumerated...	„	82,228	83,141	82,040
Alkali	Cwt.	5,607	3,449	4,180
	Value £	3,292	2,149	3,370
Brimstone	Cwt.	99,053	59,519	74,544
	Value £	23,721	13,825	16,910
Nitrate of soda	Cwt.	111,444	30,097	214,060
	Value £	61,112	13,505	95,251
„ of potash......	Cwt.	28,762	19,322	32,645
	Value £	25,226	16,465	27,419
Quicksilver	Lbs.	936,600	723,085	806,850
	Value £	75,000	70,121	95,107
Cinchona bark.........	Cwt.	9,082	11,416	8,646
	Value £	61,316	56,081	36,493
Gum Arabic	Cwt.	16,936	2,017	5,438
	Value £	60,817	10,320	28,548
Lac, seed, shell, stick, and dye	Cwt.	11,166	7,122	10,732
	Value £	33,402	20,028	28,452
Bark (for tanners' or dyers' use)..........	Cwt.	17,361	12,841	11,886
	Value £	5,687	4,446	3,722
Aniline	Value £	22,471	20,866	23,554
Alizarine	„	22,149	17,925	18,197
Other coal-tar dyes	„	18	5	1,181
Cochineal	Cwt.	1,720	980	700
	Value £	11,053	6,033	4,599
Cutch and gambier	Tons	2,805	1,563	1,582
	Value £	61,035	34,643	38,878
Indigo	Cwt.	28,950	23,715	20,745
	Value £	738,150	560,472	478,415
Madder, madder-root, &c.	Cwt.	2,494	1,661	1,315
	Value £	2,821	2,231	1,807
Cocoa-nut oil	Cwt.	5,377	5,174	5,567
	Value £	6,829	8,777	6,691
Olive oil	Tuns	1,396	2,744	2,263
	Value £	55,478	100,984	70,517
Palm oil	Cwt.	63,345	63,419	75,198
	Value £	74,319	66,734	74,211
Petroleum oil	Gals.	3,503,148	8,721,788	6,835,610
	Value £	111,439	230,733	197,332
Oil seed................	Tons	1,221	965	1,600
	Value £	29,436	22,764	38,943
Turpentine	Cwt.	32,734	25,206	29,167
	Value £	45,033	35,383	40,677

EXPORTS.

—		February 1886.	February 1887.	February 1888.
British and Irish produce—				
Drugs and medicinal preparations, unenumerated ……	Value £	59,898	63,321	68,691
Sundry chemicals ·	„	148,299	174,819	178,297
Painters' colours and materials ………	„	96,277	104,393	110,147
Alkali ……………	Cwt.	481,683	441,411	482,721
	Value £	136,546	125,209	127,312
Bleaching materials.	Cwt.	109,864	127,944	128,310
	Value £	41,336	47,709	48,350
Seed oil…………	Tons	5,797	5,759	6,569
	Value £	122,910	119,094	134,599
Soap……………	Cwt.	35,037	38,804	44,441
	Value £	38,785	37,553	42,157
Foreign and Colonial merchandise:				
Chemicals, unenumerated …………	Value £	12,463	12,280	30,828
Cinchona bark ……	Cwt.	10,030	17,476	10,491
	Value £	46,699	76,560	31,653
Cochineal…………	Cwt.	1,034	653	367
	Value £	7,698	4,514	2,282
Cutch and gambier .	Tons	773	611	757
	Value £	19,405	15,481	19,708
Gum Arabic ………	Cwt.	2,109	3,852	3,752
	Value £	10,374	17,196	15,941
Indigo……………	Cwt.	10,793	10,008	11,163
	Value £	261,930	229,046	260,599
Lac, seed, shell, stick, and dye ………	Cwt.	6,708	4,381	4,102
	Value £	19,432	12,484	12,593
Cocoa-nut oil ……	Cwt.	6,174	3,186	2,690
	Value £	8,562	4,507	3,330
Olive oil …………	Tuns	121	130	302
	Value £	6,329	5,769	11,085
Palm oil …………	Cwt.	36,418	33,519	58,983
	Value £	42,734	36,568	58,516
Petroleum oil ……	Gals.	44,412	26,620	38,854
	Value £	2,125	1,223	1,562
Quicksilver………	Lbs.	367,964	242,380	118,169
	Value £	28,332	22,979	13,712
Nitrate of potash …	Cwt.	1,155	818	2,808
	Value £	1,021	667	2,428

GERMAN SUGAR STATISTICS.

—	1871.	1872.	1873.	1874.	1875.
Tons of beet per acre…	8·1	10·2	10·9	8·3	11·3
Production of sugar. Tons	186,441	262,551	291,041	256,412	358,048
Percentage diffusion works………	16·7	19·5	23·7	34·0	47·3
Tons sugar per 100 tons beet………	8·28	8·26	8·25	9·30	8·60
Tons beet for one ton sugar………	12·07	12·11	12·12	10·75	11·60
Tons sugar per acre……	0·67	0·84	0·90	0·97	0·97

—	1876.	1877.	1878.	1879.	1880.
Tons of beet per acre…	10·1	11·0	11·6	10·1	13·1
Production of sugar. Tons	289,422	378,009	426,155	409,415	555,915
Percentage diffusion works………	60·0	68·0	80·0	88·7	90·3
Tons sugar per 100 tons beet………	8·15	9·24	9·21	8·52	8·79
Tons beet for one ton sugar………	12·47	10·82	10·86	11·74	11·37
Tons sugar per acre ….	0·82	1·02	1·07	0·86	1·15

—	1881.	1882.	1883.	1884.
Tons of beet per acre …	11·8	13·8	11·9	11·3
Production of sugar. Tons	644,775	848,124	986,402	1,154,417
Percentage diffusion works………	94·0	94·0	95·5	96·0
Tons sugar per 100 tons beet………	9·56	9·55	10·54	10·3
Tons beet for one ton sugar………	10·46	10·47	9·42	9·70
Tons sugar per acre ….	1·32	1·35	1·25	1·16

The figures show that the yield of sugar per acre in 1882 was double that in 1871.—*Chemical Trade Journal.*

PRODUCTION, DELIVERIES, AND EXPORTS OF SULPHATE OF AMMONIA DURING FIVE YEARS, 1883–87.

—	1887.	1886.	1885.	1884.	1883.
Production:— England, Scotland, and Ireland, from all sources ………	Tons. 107,000	Tons. 103,000	Tons. 97,000	Tons. 87,000	Tons. 75,000
Deliveries and exports:—					
Germany, Denmark, Sweden, &c………	33,000	34,000	39,000	35,000	28,000
France, Spain, and Italy……………	21,000	16,000	12,000	13,000	12,000
Belgium and Holland	16,000	19,000	14,000	10,000	8,000
America and Colonies	11,500	10,000	5,000	7,000	6,000
Home consumption for agricultural and chemical purposes (including the liquor used in various processes of manufacture) …………	23,200	22,000	21,000	19,000	17,000
Stocks ………………	1,800	2,000	6,000	3,000	4,000
	107,000	103,000	97,000	87,000	75,000

—*Bradbury and Hirsch, Liverpool.*

TABLE OF AVERAGE PRICES OF SULPHATE AMMONIA, 1878–1887.

Good Grey 24 per cent. f.o.b. Hull, per Ton.

Year	Jan.	Feb.	March.	April.	May.	June.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1878	20 10 0	21 0 0	21 5 0	20 10 0	20 7 6	21 0 0
1879	17 17 6	18 2 6	18 7 6	17 15 0	17 15 0	17 5 0
1880	19 15 0	19 5 0	18 12 6	18 10 0	17 13 0	18 15 0
1881	19 17 0	20 5 0	20 0 9	19 15 0	19 11 3	20 5 0
1882	20 17 6	21 2 6	21 6 3	20 10 0	20 4 3	20 10 6
1883	18 15 0	18 3 9	18 8 0	17 3 9	16 18 3	17 5 6
1884	14 0 6	14 5 0	14 11 6	14 10 6	14 7 6	14 13 9
1885	12 12 9	12 1 3	11 18 3	11 15 4	11 3 6	11 18 3
1886	10 14 6	11 5 7½	12 11 11	12 5 0	10 17 0	11 0 7½
1887	11 12 0	11 14 6	12 3 9	11 5 3	11 13 3	12 3 9

Year	July.	August.	Sept.	Oct.	Nov.	Dec.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1878	20 15 0	20 10 0	20 10 0	19 2 6	18 10 0	18 12 6
1879	18 0 0	18 15 0	18 10 0	19 0 0	19 15 0	20 0 0
1880	19 5 0	19 5 0	18 15 0	19 0 0	19 5 0	19 10 0
1881	20 6 3	20 10 0	20 7 6	20 10 0	20 11 3	20 15 0
1882	20 15 0	20 11 3	20 9 6	20 1 3	19 6 9	19 7 6
1883	16 5 0	16 7 0	16 10 0	15 5 8	13 17 0	13 13 0
1884	14 19 6	15 8 6	15 6 3	14 12 6	13 18 0	13 3 1½
1885	11 14 3	11 16 6	11 2 6	10 12 6	10 8 9	10 5 9
1886	11 3 6	11 5 7½	10 18 5	10 13 9	10 11 11	10 15 7½
1887	12 12 6	12 12 0	11 17 0	11 9 0	11 9 9	11 19 6

AVERAGE PRICES, 1878–1887.

Year.	Average.	Year.	Average.
	£ s. d.		£ s. d.
1878	20 5 0	1883	16 11 0
1879	18 8 9	1884	14 9 3
1880	19 0 0	1885	11 9 1½
1881	20 4 6	1886	11 3 7½
1882	20 8 6	1887	11 17 8

AVERAGE PRICES, 1868–1877.

	£ s. d.		£ s. d.		£ s. d.
1868	14 10 0	1872	21 0 0	1875	18 10 0
1869	15 15 0				
1870	16 0 0	1873	18 3 9	1876	18 12 6
1871	19 0 0	1874	17 2 6	1877	19 16 3

—*Bradbury and Hirsch, Liverpool.*

TABLE OF AVERAGE PRICES OF NITRATE OF SODA, 1878–1887.

In Liverpool, 95 per cent., per Cwt.

Year	Jan.	Feb.	March.	April.	May.	June.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1878	15 6	15 9	16 0	16 3	16 0	15 6
1879	13 0	13 3	13 4½	13 6	13 9	14 3
1880	19 0	18 9	18 6	17 6	14 6	13 6
1881	15 3	15 0	15 3	15 6	14 6	13 9
1882	14 3	14 0	14 6	14 3	13 6	12 6
1883	12 0	12 3	12 6	12 0	11 0	10 9
1884	10 3	10 2	9 10	9 6½	9 4	9 6
1885	9 4½	9 3	9 4	9 9	9 8	9 10
1886	11 1½	11 1½	11 1½	11 1	9 6½	9 1
1887	9 3	9 5	10 6	11 3½	11 4	9 3

Year	July.	August.	Sept.	Oct.	Nov.	Dec.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1878	15 6	15 0	14 6	14 3	13 3	13 0
1879	14 9	14 6	14 6	16 3	13 0	18 6
1880	14 9	14 6	14 4½	14 0	14 0	14 6
1881	14 0	13 9	14 6	14 9	14 6	15 0
1882	12 9	12 9	12 6	12 3	12 0	12 0
1883	10 9	10 7½	10 9	10 6	10 4½	10 3
1884	9 9	10 1½	10 1½	9 9	9 3	9 3
1885	10 7½	10 11½	11 2	10 8½	10 4½	11 0
1886	9 1	9 1	9 0	9 1	9 1	8 9
1887	8 9¼	8 9	8 11½	8 11	8 8	8 11

AVERAGE PRICES, 1878–1887.

Year.	Average.	Year.	Average.
	s. d.		s. d.
1878	15 0½	1883	11 2
1879	14 9	1884	9 9
1880	15 8	1885	10 2
1881	14 8	1886	9 9
1882	13 1	1887	9 6

—*Bradbury and Hirsch, Liverpool.*

EMPLOYERS' LIABILITY ACT (1880) AMENDMENT (No. 2).

THE following Bill to amend the Employers' Liability Act, 1880, has been introduced by Mr. Burt, Mr. Joicey, Mr. Haldane, and Mr. Lockwood :—

WHEREAS it is expedient to amend the Employers' Liability Act, 1880 :

Be it therefore enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows :

1. The first section of the Employers' Liability Act, 1880 (hereinafter called the principal Act), shall be construed as if in lieu of subsections (2.), (3.), and (5.) of that section there were inserted the following :—

(2.) By reason of the negligence of any person in the service of the employer.

This section shall apply only in the case of accidents occurring after the *passing of this Act.*

2. The amount of compensation recoverable under the principal Act or this Act shall not exceed five hundred pounds.

The third section of the principal Act shall be repealed.

3. The provisions of the principal Act and this Act shall have effect and be enforced by every court in every case, notwithstanding any contract or agreement excluding all or any of the provisions of the said Act or this Act, or otherwise interfering with the operation thereof:

Provided—

(1.) That this Act shall not affect any contract or agreement made before the *passing of this Act*; and

(2.) That in determining in any case the amount of compensation payable by an employer, the court shall take into consideration the value of any payment or contribution made by such employer to or for the injured person in respect of his injury, and also the value of any payment or contribution made by such employer to any insurance fund or compensation fund, to the extent to which any person, who would otherwise be entitled to compensation, has actually received compensation out of such payment or contribution at the expense of such employer.

4. Where under the provisions of the principal Act a person has a right of action against an employer who is a sub-contractor, he shall also have the same right of action against any superior contractor, and such superior contractor shall be entitled to be indemnified by the sub-contractor in respect of the negligence of whom or of whose servants the cause of action arises. This section shall apply only in the case of accidents occurring after the *passing of this Act.*

5. The notice required by the fourth section of the principal Act may be given at any time within three months after the occurrence of the accident. The absence of or any imperfection in such notice shall not be a bar to action, but shall be a ground for depriving the plaintiff of costs if and so far as the court in its discretion so directs.

6. Where personal injury to a workman who is illegitimate results in death, the same rights of compensation shall exist for the benefit of his father or mother or of brothers and sisters by the same father and mother as if he and such brothers and sisters were legitimate.

7. No appeal shall be brought from any judgment, whether of a county court or a superior court, except where the sum recovered exceeds two hundred pounds, without special leave of the court to which the appeal is to be brought, and that court may direct as a condition of giving such leave that the cost of the application for leave and of the appeal, or any part thereof, shall in any event be paid by the appellant.

8. An action shall not, except by consent, be removed into a superior court unless the amount claimed exceeds one hundred pounds.

9. The principal Act and this Act shall apply to all servants whether employed on land or at sea.

10. This Act and the principal Act shall be construed as one Act.

11. This Act may be cited as the Employers' Liability Amendment Act, 1888.

REGISTRATION OF FIRMS.

THE following Bill for the Registration of Firms has been introduced by Sir A. Rollit, Sir B. Samuelson, and others. Its full text is as follows :—

WHEREAS it is expedient to provide for the registration of firms and of persons carrying on business under names or styles other than their own:

Be it therefore enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:

1. This Act may be cited for all purposes as the Registration of Firms Act, 1888.

2. This Act shall come into operation on the first day of January one thousand eight hundred and eighty-nine, which date is hereinafter referred to as the commencement of this Act.

3. In the construction of this Act the following words and expressions shall have the meanings in this section assigned to them, unless there be something in the subject or context repugnant to such construction:

"Firm" shall mean any two or more persons lawfully associated for the purpose of carrying on any business, but shall not include a company incorporated by or in pursuance of any Act of Parliament, Letters Patent, or Royal Charter, or a mining company subject to the jurisdiction of the Stannaries:

"Firm-name" shall mean the name or style under which any business is carried on, whether in partnership or otherwise:

"Prescribed" shall mean prescribed by rules made in pursuance of this Act:

"Usual name" shall include a signature habitually used for business purposes.

4. From and after the commencement of this Act—

(*a.*) Every firm carrying on business or having any place of business in the United Kingdom, under a firm-name which does not consist of the full or the usual names of all the partners or all the acting partners without any addition;

(*b.*) Every person carrying on business or having any place of business in the United Kingdom, under any firm-name consisting of or containing any name or addition other than the full or the usual name of that person;

shall register in the manner directed by this Act the name under which their or his business is or is intended to be carried on.

5. Registration under this Act shall be effected by sending by post or delivering to the registrar at the register office in that part of the United Kingdom in which the place of business of the firm or person registering is or is intended to be situated, a statement in writing containing the following particulars:

(*a.*) The firm-name.

(*b.*) The nature of the business.

(*c.*) The place or places of the business.

(*d.*) The full name, usual residence, and other occupation, if any, of the person or persons carrying on or intending to carry on the business.

(*e.*) If the business is commenced or any new place of business established after the commencement of this Act, the date of the commencement of the business or establishment of the place of business.

6. The persons carrying on or intending to carry on any business under a firm-name requiring to be registered as aforesaid shall write and sign or shall acknowledge a statement of the particulars required for registration if in the United Kingdom, in the presence of a justice of the peace, sheriff, solicitor, law agent, or writer to the signet, and if abroad, in the presence of a British consul or notary public, by whom respectively such signature or acknowledgments shall be attested.

7. The firms and persons required to be registered as aforesaid shall register before they commence business.

Provided that if such firms or persons have carried on business before the commencement of this Act it shall be sufficient if they register within one month after that date.

8. The name of any firm or person registered under this Act shall be used in all matters connected with or relating to the business carried on by such firm or person.

9. Where a change occurs in the constitution of a registered firm, the members of the firm as reconstituted shall, within one month after such change, send by post or deliver to the registrar a statement thereof in the form in the Schedule to this Act annexed (or in any other prescribed form).

10. A registered firm changing its firm-name shall be registered as if it were a new firm, and the statement sent or delivered to the registrar shall mention the former name of the firm as being abandoned by it, as well as the particulars required for a new registration.

11. If any person by this Act required to send or deliver any statement shall make default without reasonable excuse in sending or delivering the same in manner and within the time specified by this Act, he shall, for every day during which the default continues, be liable on summary conviction before two justices of the peace, to a fine not exceeding one pound.

12. Where any firm or person by this Act required to send or deliver any statement to the registrar has therein made default, and during the default commences any action in the firm-name, or for a cause of action arising out of any dealing by such firm, or person in the firm-name, the court shall order the firm or person in default to send or deliver to the registrar the proper statement, and may stay all proceedings in the action until the order be complied with, or allow proceedings to be continued on an undertaking to comply with the order within a time to be limited by the court. The power by this section given to the court may be exercised by a judge at chambers and by a master or district registrar exercising the authority or jurisdiction of a judge at chambers.

13. Every one commits a misdemeanor and shall be liable to imprisonment with hard labour for a term not exceeding two years who makes, signs, sends, or delivers for the purpose of registration under this Act any false statement purporting to be made under this Act and known by him to be false.

14. On receiving any statement made in pursuance of this Act the registrar shall cause the same to be filed, and he shall send by post or deliver a certificate of the registration thereof to the firm or person registering.

15. At each of the register offices herein-after referred to the registrar shall keep, in proper books to be provided for the purpose, a register and an index of all the firms and persons registered, and of all the statements registered in reference thereto.

16. The registrar of joint-stock companies shall be the registrar of firms for the purposes of this Act, and the several offices for the registration of joint-stock companies in London, Edinburgh, and Dublin shall be the offices for the registration of firms carrying on business within those parts of the United Kingdom in which they are respectively situated.

17. Any person may inspect, make extracts from, or copies of the statements filed by the registrar in the register offices aforesaid, and there shall be paid for such inspection such fees as may be appointed by the Board of Trade not exceeding one shilling for each inspection; and any person may require a certificate of the registration of any firm or person, or a copy of or extract from any registered statement to be certified by the registrar, and there shall be paid

for such certificate of registration, certified copy, or extract, such fees as the Board of Trade may appoint not exceeding two shillings for the certificate of registration, and not exceeding sixpence for each folio of seventy-two words, or in Scotland for each sheet of two hundred words.

A certificate of registration, or a copy of or extract from any statement registered under this Act, purporting to be signed and certified by the registrar, shall in all courts and before all arbitrators or other persons be admitted as prima facie evidence thereof, and of the fact and date of registration as shown thereon.

18. The registrar or other officer in charge of the register shall, within seven days after the registration of any statement under this Act, send an extract thereof in the prescribed form to the officials herein-after mentioned, whenever it shall appear that any of the places of business therein described or referred to are situated within the jurisdiction of the courts to which such officials are attached; (that is to say)

(*a.*) When the registration is in England, to the registrars of county courts (exclusive of those attached to county courts within the London bankruptcy district, as defined by the Bankruptcy Act, 1869):

(*b.*) When in Scotland, to the sheriff clerks of the sheriffs' courts:

(*c.*) When in Ireland, to the clerks of the peace or other officials whose duty it is to enter up judgments, decrees, or orders of the civil bill courts.

Every abstract so transmitted shall be filed, kept, and indexed by the official to whom it has been sent, and any person may inspect, make extracts from, or copies of the same, or obtain certified copies thereof in the like manner and upon the like terms as at the register offices in London, Edinburgh, and Dublin.

19. The Board of Trade may, either before or after the commencement of this Act, and thereafter, from time to time, make rules and revoke or alter rules when made (but as to fees with the concurrence of the Commissioners of the Treasury) concerning any of the following matters:—

(*a.*) The fees to be paid to the registrar under this Act, so that they do not exceed the sum of five shillings for the registration of any one statement:

(*b.*) The mode of payment and the application of fees payable under this Act:

(*c.*) The duties or additional duties to be performed by any registrar for the purposes of this Act:

(*d.*) Generally the conduct and regulation of registration under this Act, and any matters incidental thereto.

20. The Board of Trade may from time to time appoint such additional assistant registrars, clerks, and servants as they may think necessary for the registration of firms under this Act, and may remove them at pleasure.

21. *There shall be paid out of moneys to be provided by Parliament to the registrar, assistant registrars, clerks, and servants such remuneration in respect of the additional duties performed by them under this Act as the Board of Trade may from time to time, with the concurrence of the Commissioners of the Treasury, direct.*

22. Subject to any rules to be made under this Act, all fees payable under this Act shall be paid and applied in the same manner as fees paid under the Companies Act, 1862, or any Act amending the same.

23. For the purpose of making the statements required by this Act, the forms in the Schedule to this Act or any prescribed forms to the like effect may be used, and if used shall be sufficient.

SCHEDULE.

Forms of Statement.

A.—*Original Registration of a Firm.*

The firm-name is
The business of the firm is
It is intended to carry on the business at
Names of persons carrying on [*or* intending to carry on] the business.

Full name (to be written or acknowledged by each person himself).	Usual residence	Other occupation, description, and addition (if any).

Date of intended commencement of business or establishment of new place of business, if after the commencement of the Act.

Signed and declared
at
on the day of 18 .
Before me
A Justice of the Peace for
British Consul at
Notary public of

B.—*Notice of Change in Constitution of Registered Firm.*

We the undersigned [*the members of the firm as re-constituted*] hereby give notice that on the day of 18 , the following change took place in the constitution of the firm registered by the name of & Co., that is to say:—

A. B. retired from the firm.
C. D. became a member of the firm.

Description of a New Member.

Full name	Usual residence	Other occupation, description, and additions (if any).

Signed and declared, &c.

C.—*Notice of Change of Registered Firm-name.*

(*In Addition to Form A.*)

The persons now registering are the persons who heretofore carried on business under the registered firm-name of
& Co., which is abandoned as from the date of this notice.

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

2442. W. Begg, Sale. A furnace for the prevention of smoke. February 18.

2511. A. Chapman, London. Apparatus for evaporating saccharine or other solutions or liquids. February 20.

2548. F. Windhausen, London. Apparatus for refrigerating purposes, applicable also to machines for compressing air and gases, &c. February 21.

2549. F. Windhausen, London. Apparatus for refrigerating purposes, applicable also to machines for compressing air and gases. February 21.

3006. S. M. Lillie, London. Heating apparatus for evaporating and other purposes. Complete Specification. February 28.

3014. O. Braun, London. Centrifugal machines. February 28.

3123. T. Burtenshaw. *See* Class II.

3429. J. G. Lawrie, Glasgow. Corrugated furnaces. March 6.

3570. J. R. Philip, Glasgow, Centrifugal machines. March 8.

3636. A. H. Allen, Sheffield. Construction of filters, and treatment of water to prevent its action on lead. March 9.

3863. J. B. Hannay and R. P. Doxford, Glasgow. Apparatus for burning liquid fuel in steam boiler furnaces. Complete Specification. March 13.

3910. C. R. Hoopes, London. Apparatus for utilising liquid fuel in steam boiler and other furnaces. Complete Specification. March 13.

3911. C. P. Kinnell and G. Rothnie, London. Thermostat for automatically regulating the supply of gas or liquid fuel. March 13.

3976. H. H. Leigh.—From J. Bernström, Sweden. Apparatus for heating liquids to be treated in centrifugal separators. Complete Specification. March 14.

3984. G. Gosling, London. Apparatus for consuming smoke and economising fuel in furnaces. March 14.

3992. L. T. Wright, London. Means for indicating the extent to which gasholders are charged. March 14.

3993. J. H. Barry, London. Revolving furnaces. March 15.

4042. C. A. Beaurain-Vautherin, London. Crucibles. March 15.

* COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2599. W. Jäger. Centrifugal machine filters. February 25.

5530. A. Harris. Gas producers. February 25.

5927. J. K. Broadbent and A. Budenberg. Apparatus for preventing smoke and regulating supply of air to furnaces. February 25.

1888.

1083. A. Don. Apparatus for prevention and consumption of smoke and more complete combustion of fuel in furnaces. February 25.

II.—FUEL, GAS, and LIGHT.

APPLICATIONS.

2448. F. V. Hadlow, Buxted. An improvement in the artificial manufacture of coal, so as to render it comparatively smokeless. February 18.

2513. E. W. Harding, London. Improvements in the manufacture of solid fuel and in the production of coal gas. February 20.

2597. H. H. Lake.—From A. C. Humphreys, United States. Improvements in apparatus for the manufacture of gas. Complete Specification. February 21.

2628. O. Bowen, London. Improvements in artificial or compressed fuel. February 22.

2675. S. Chandler, jun., and J. Chandler, London. Improvements in apparatus for washing or purifying gas. February 22.

2807. W. Brown, London. Improvements in gas lighting and apparatus therefor. February 23.

2816. W. Williams, Liverpool. The application of the heat generated by the manufacture of coke from coal or slack, for heating pans and drying rooms and for other purposes connected with the manufacture of salt, chemicals, and other articles. February 25.

2858. H. Tipping, London. Improvements in the production of oxygen and nitrogen gases from atmospheric air, and in means or apparatus employed therein. February 25.

2943. R. Palmer, Sheffield. Improvements in seal pipes for reducing the pressure in gas retorts. February 28.

3004. O. Eckenstein, London. An improved method of producing actinic light. February 28.

3024. S. Chandler, jun., and J. Chandler, London. Improvements in apparatus for washing or purifying gas. February 28.

3025. C. Crastin, London. An improved manufacture of hoods or mantles chiefly designed for incandescent gas-burners. February 28.

3026. C. Crastin, London. Improvements in and relating to gas-burners. February 28.

3068. T. C. Chalk, London. Improvements in candles. February 29.

3082. N. Fouquemberg, London. Improvements in machinery for agglomerating fuel and other substances. Complete Specification. February 29.

3159. E. Lowe, London. An improved manufacture of grid for gas purifiers. March 1.

3179. E. Bowen, Swansea. Improved economic treatment of certain bye-products of gas and tin-plate manufactures. March 2.

3316. W. F. Stark, London. An improvement in the manufacture of candles. March 3.

3423. T. Burtenshaw, Westminster. Improvements in "Tar burners" and in the furnaces to which they are applied for heating gas retorts and other purposes. March 6.

3476. E. R. K. von Ehrenwalten and C. Fabricus, London. Portable illuminating apparatus, with automatic production of the illuminating gas or vapour. March 6.

3495. A. McDougall, Manchester. Improvements in apparatus for the manufacture of gas. March 7.

3538. G. Seagrave and P. A. Olivier, London. Improvements in or connected with apparatus for the carburation of gas or air. March 7.

3566. R. Dempster and J. Dempster, Manchester. Improvements in apparatus for feeding retorts with coal or other substance for pistillation. March 8.

3802. A. Tack and F. Girard, Brussels. A novel manufacture of coke in plain or block form for metallurgical and other purposes. Complete Specification. March 12.

3880. E. B. Ellice-Clark and L. Chapman, London. Improvements in apparatus for the obtainment of oxygen and nitrogen gases from atmospheric air. March 13.

3917. R. Anton, London. Improvements in making briquettes or blocks of compressed fuel. March 14.

3950. R. Anton, London. Improvements in making briquettes or blocks of compressed fuel. March 14.

3967. A. Brin, London. An apparatus for the extraction of oxygen and nitrogen from atmospheric air. March 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5519. J. Elliott. Apparatus for effecting the continuous carbonisation of coal. February 25.

5641. J. Broad, J. W. Broad, G. P. Broad, and H. J. Broad. Night lights. February 25.

6239. O. Imray.—From C. A. von Welsbach. Treating Incandescence bodies formed of metallic oxides for increasing their luminosity and resisting properties. February 25.

6421. J. Hall. Machinery for the manufacture of artificial fuels. March 3.

6704. E. Zohrab. Method and apparatus for the treatment of peat. March 17.

6774. J. Lyle. Means of burning oils or other hydrocarbon fluids as fuel in furnaces. March 10.

8697. H. H. Doty. Method and apparatus for generating light and heat from oil. March 3.

11.783. J. Hall. Machinery for manufacture of artificial fuel. March 3.

16,501. L. Wacks. Artificial fuel. March 10.

1888.

1274. T. Settle. Apparatus for relieving gas retorts from pressure. March 17.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

2810. R. B. Tennent, Glasgow. Improvements in the destructive distillation of shale and other minerals, and in retorts therefor. February 25.

3566. R. Dempster and J. Dempster. *See* Class II.

3830. W. H. Pitt and G. H. Van Vleck, London. An improved process of distilling petroleum. Complete Specification. March 13.

IV.—COLOURING MATTERS and DYES.

APPLICATIONS.

2404. A. Ewer, P. Pick, and M. Lange, London. Process for the production of naphthylendiamines and of dyeing or colouring matter by means thereof. February 17.

2563. T. Holliday and E. M. Mundriller, London. Improvements in the manufacture or production of bisulpho acids of beta naphthol. February 21.

2664. H. H. Lake.—From A. Leonhardt and Co., Germany. Improvements relating to the production of colouring matters. February 22.

3016. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, and D. A. Rosenstiehl, France. Manufacture of yellow colouring matters. February 28.

3613. F. F. Jones, London. Improvements relating to the preparation of sulphate of iron and to the manufacture of colouring matters therefrom. March 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

3250. R. Chadwick and J. W. C. Chadwick. Colouring matter for dyeing, painting, staining, &c. March 3.

5953. A. Kern. Preparation of the methylic ether of gallic acid. and manufacture of purple colouring matters therefrom. March 17.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

2391. D. W. Fessey, London. Making sewing threads from lubricated or coated yarns. February 17.

2532. I. Singer and M. W. Judell, London. An improved process and apparatus to be called "The Acme Wool Cleaner," for cleansing wool and other textile products, applicable also to the extraction and recovery of oils and fats. Complete Specification. February 20.

2868. M. Malzac, F. Gaudez, and A. Texier, London. The manufacture of a new kind of felt. February 25.

2965. F. W. Petrie and J. Fielden, Rochdale. Drying textile material in the skein or hank. February 28.

COMPLETE SPECIFICATION ACCEPTED.

1888.

603. C. R. Dames. Preparing fullers' earth for use in manufactures. March 3.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

3232. W. P. Thompson.—From A. Douleeron and E. Van Meerbeeck, Belgium. Improvements in apparatus for washing, cleansing, dyeing, or steeping fabrics, and other like purposes. March 2.

3490. W. Mycock, Manchester. Improvements in dyeing apparatus. March 7.

3559. J. Mycock, Manchester. Improvements in continuous dyeing machines. March 8.

3606. R. Cooper, H. F. Clayton, and G. H. Holroyd, Huddersfield. An improved method of and apparatus for scouring, washing, dyeing, and drying wool, cotton, or other fibrous substances. March 8.

3753. A. Harmel, M. Harmel, and F. Harmel, London. Apparatus for dyeing wool and other filamentous material in bobbins, hanks, and other aggregated forms. Complete Specification. March 10.

4022. H. Ashwell and J. R. Ashwell, Liverpool. Improvements in or relating to the production of blacks, browns, blues, and greys of various shades upon cotton, hosiery, or yarn. March 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2414. J. A. Berly.—From Lombard et Cie. Apparatus for cleansing, bleaching, burling, scalding, drying, carbonising, and dyeing spun textiles. March 3.

6128. F. A. Gatty. Dyeing cotton yarns and fabrics. March 3.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

2495. A. M. Chance and J. F. Chance, Liverpool. Improvements in treating sulphate of lime and other oxidised sulphur compounds of calcium to obtain sulphuretted hydrogen, and in apparatus employed therein. February 20.

2777. F. Trickett and J. Noad, London. An improved process of producing sodium oxide. February 24.

2831. E. W. Parnell and J. Simpson, Liverpool. Improvements in the treatment of sulphide of calcium for the purpose of obtaining sulphide of ammonium and sulphuretted hydrogen. February 25.

2920. F. Maxwell-Lyte, London. Improvements in the production of basic lead salts for use as pigments and for other purposes. February 27.

3122. A. M. Chance, Liverpool. Improvements in treating carbonated alkali waste. March 1.

3124. A. M. Chance and J. F. Chance, Liverpool. Improvements in treating vat waste to obtain sulphuretted hydrogen and carbonate of lime, and in apparatus employed therein. March 1.

3134. A. M. Chance and J. F. Chance, Liverpool. Improvements in treating sulphide of ammonium to obtain sulphuretted hydrogen, and in apparatus employed therein. March 1.

3148. J. S. Rigby. *See* Class IX.

3165. E. B. Ellice-Clark.—From G. Lunge, Switzerland. Improvements in the manufacture of sulphuric acid. March 1.

3166. E. B. Ellice-Clark.—From G. Lunge, Switzerland. Improvements in the manufacture of sulphuric anhydride, and apparatus to be employed therein. March 1.

3182. A. M. Chance and J. F. Chance, Liverpool. Improvements in treating the liquors known as "yellow liquors" draining from alkali waste heaps to obtain sulphuretted hydrogen, and in apparatus employed therein. March 2.

3218. F. H. Gossage and T. T. Mathieson, London. Improvements in the manufacture of sulphide of sodium or of sulphide of potassium from their respective sulphates. March 2.

3428. H. Green, London. Improvements in apparatus for treating ammoniacal liquor. March 6.

3668. A. M. Clark.—From J. B. Daguin, France. An improved process of manufacturing soda by means of ammonia, and producing carbonate of soda, caustic soda, and hydrochloric acid or chlorine. March 9.

3669. A. M. Clark.—From J. B. Daguin, France. A process for facilitating the oxidation of sulphurous acid for the manufacture of sulphuric acid and of hydrochloric acid and chlorine, and for other industrial purposes. March 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4371. A. Delhaye. Manufacture of caustic or carbonated soda and caustic potash. March 10.

4686. H. Gall and Viscount A. de Montlaur. Manufacture of chlorates of the alkalis or alkaline earths. March 3.

5753. T. T. Mathieson and J. Hawliezek. Manufacture of carbonate of soda or soda ash, and apparatus therefor. March 10.

5757. T. T. Mathieson and J. Hawliezek. Manufacture of caustic ash. February 25.

5853. E. W. Parnell and J. Simpson. Utilisation of sulphate of lime and sulphate of baryta in the manufacture of alkalis and sulphuretted hydrogen. February 25.

6107. H. Gardner.—From R. J. Henderson. Separation of carbonic oxide from nitrogen, carbonic acid, hydrogen, &c., resulting from the incomplete combustion of coal or coke by the use of the chlorides of copper and of iron. March 3.

6718. H. Grimshaw and H. Kenyon. Production of zinc and other sulphides, utilisation of the residual products, and apparatus therefor. March 17.

1888.

43. J. Pfeiffer. Process and apparatus for the manufacture of dry calcium hydroxide. February 25.

1082. H. P. Weidig and R. C. Remmey. Absorption towers for manufacture of muriatic or nitric acid. March 3.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

2462. F. H. Williams, London. Improvements in the manufacture of bottles and other articles from glass and other vitreous substance, and in machinery and apparatus therefor. February 18.

2619. O. Hughes. *See* Class IX.

2636. E. P. Evans and T. Sanday, Worcester. Obtaining decorative effects on china, earthenware, pottery, and glass. February 22.

2993. J. T. Creasy and L. Jeyes, London. Improvements for manufacturing glass bottles, jars, and other glass vessels and hollow-ware. February 28.

3127. D. Rylands and B. Stoner, Barnsley. Improvements in machinery for making glass bottles or other hollow glass-ware. March 1.

3263. D. Rylands, Barnsley. Improvements in machinery for the manufacture of bottles. March 3.

3583. J. Holroyd and A. Wilson, London. Improvements in gas-fired kilns for burning or heating pottery, and for other purposes. March 8.

3604. L. E. Keller and A. E. Guérin, London. An improved process for producing designs upon substances having vitrified or enamelled surfaces. March 8.

3743. G. M. Garrard, Westminster. Improvements in roofing and wall or hanging tiles, and in dies and gear of presses for moulding and pressing tiles of these descriptions. March 10.

3857. J. Halfpenny and H. Halfpenny. *See* Class X.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2948. J. Yelland. A pot and tank gas furnace combined for use in glass melting, &c. March 3.

5201. C. J. Heaton. Manufacture of ornamental cloisonné-mosaic work. March 10.

5420. T. W. Hogg and P. J. Jackson. Printing on glass, earthenware, or porcelain, and apparatus therefor. February 25.

5710. J. Armstrong. Manufacture of rolled glass, and machinery therefor. March 17.

5901. J. D. Doulton. Earthenware blocks and tiles. February 25.

6616. L. C. A. Marguerie. Vitreo-metallic material suitable for use in place of glass. March 10.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

2619. O. Hughes, Bangor. Improvements in the utilisation of a waste product, and in the manufacture of cement and porcelain. February 22.

2632. J. Roberton and J. A. Patrick, Glasgow. Improvements in the manufacture of Portland or similar cement. February 22.

2641. W. E. Constable and J. Joseph, London. Improvements in the manufacture of artificial stone. February 22.

2803. J. Brunton and L. Griffiths, London. Improvements in the manufacture of artificial stone. February 24.

2815. M. Fawcett, London. Improvements in the construction of fireproof floors. February 25.

3148. J. S. Rigby, Liverpool. Improvements in the manufacture of cement and the utilisation of the lime-mud residue of the ammonia soda process therefor. March 1.

3237. S. de la Grange Williams, London. Improvements in kilns for burning lime and for other like processes. March 2.

3419. G. Brown, Leicester. Improvements in the construction and arrangement of kilns for drying or burning bricks, pipes, and the like. March 6.

3708. R. B. Lee, Manchester. Improvements in the manufacture of material for use in the construction of fire-proof curtains for theatres, fire-proof ceilings, walls, columns, partitions, panelling, blocks, slabs, girders, doors, floors, roofing, safes, strong-rooms, and other analogous parts, structures and buildings intended to be fire-proof. March 10.

3727. J. Lauder, Glasgow. Improvements in building construction having principally for their object to render edifices fire-proof. March 10.

3752. O. Imray.—From G. S. Lee, United States. Manufacture of composition for the construction of roadways, pavements, and building blocks, and for the manufacture of fire-proof and preservative paint. Complete Specification. March 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5816. T. H. Lodge. Utilisation of the hot waste gases from cement and other kilns for production of steam power. February 25.

1888.

935. S. Turner. An improved roof tile. March 17.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

2476. E. Thomson and J. Sharman, Stoke-on-Trent. Shot lighting in mines, which they name "The Norton shot lighter." February 20.

2384. W. A. Baldwin, London. Process for extracting aluminium from substances bearing alumina and combining the aluminium with other metals directly from such substances. Completo Specification. February 21.

2607. C. J. Dobbs, London. Improvements in annealing kilns for slag blocks. February 21.

2692. N. M. Henderson, Glasgow. Improvements in miners' safety lamps. Complete Specification. February 23.

2778. F. Trickett and J. Noad, London. Improvements in the extraction of gold, silver, and platinum from auriferous and argentiferous materials. Febuary 24.

2872. G. Baron de Overbeck.—From W. Hildwein and V. von Schoenberger, Vienna. Improvements in the manufacture of aluminium direct from alumina. February 25.

2873. G. Baron de Overbeck.—From W. Hildwein and V. von Schoenberger, Vienna. An improved process for making alumina from clay or other aluminous substances. February 25.

2874. G. Baron de Overbeck.—From W. Hildwein and V. von Schoenberger, Vienna. Improvements in the manufacture of alumina from its sulphate and the recovery of the sulphuric acid. February 25.

2896. J. Riley, Glasgow. Improvements in basic-hearth steel making furnaces. Complete Specification. February 27.

2899. J. Riley, Glasgow. Improvements in regenerative furnaces for steel making and analogous operations. Complete Specification. February 27.

2903. P. M. Parsons, Blackheath. Improvements in the manufacture of steel and in apparatus therefor. February 27.

3018. H. W. Buddicom, London. Improvements in apparatus for coating metal sheets with tin or other metals or alloys. February 28.

3071. J. Pearson, London. Improvements in miners' safety lamp. February 29.

3098. C. Davis, London. An improvement in armour-plates. February 29.

3146. H. Ostermann and C. Lacroix, London. The manufacture of a new non-magnetic alloy. March 1.

3179. E. Bowen. See Class II.

3188. W. Hartnell, Leeds. An improved mode of finally treating sheets of iron or steel after tinning or galvanising, and improved manufactures resulting therefrom. March 2.

3228. P. C. Bunn, London. An improved process of and apparatus for extracting gold and other metals from crushed ores and other auriferous materials. March 2.

3317. V. Schmidt, London. An improved metallic compound or alloy. March 3.

3369. A Watt, London. Improvements in the treatment of zinc ores. March 5.

3378. N. Lebedeff and J. Hughes, London. Improvements in the treatment of metallic or materials containing metals for the purpose of facilitating the obtainment of the metal therefrom or for the production of oxidising agents. March 5.

3410. J. F. Hall, Sheffield. Improvements in the manufacturo and treatment of iron or steel. March 6.

3547. L. Q. Brin, London. Improvements in tho method and apparatus for making aluminium bronze. March 7.

3548. L. Q. Brin, London. Improvements in plating iron and other metals with aluminium. March 7.

3549. L. Q. Brin, London. Improvements in the process and apparatus for obtaining alloys of aluminium, and particularly aluminium bronze. March 7.

3601. A. B. Cunningham, London. Improvements in the manufacture of sodium and potassium. March 8.

3602. A. B. Cunningham, London. Improvements in the manufacture of aluminium. March 8.

3660. W. J. Howarth and J. Graham, Manchester. Improvements in the calcination of cupreous and other ores, and in apparatus or furnace therefor. March 9.

3661. A. Brown, London. An improved process of and apparatus for separating the tin from scraps or cuttings of tinned or terne plates, or from old tinned articles. March 9.

3722. W. Muirhead, London. Improvements in or connected with furnaces for the production of steel. March 10.

3730. A. E. Barthel, London. An improved process for the production of fixed or detachable deposits of homogeneous iron in any form, size, or thickness from iron ores, or steel, or iron in any form. March 10.

3741. C. Appleby.—From Rankin, Brayton, and Co., United States. Improvements in ore-concentrating machinery. March 10.

3770. R. Murray, Glasgow. An improved method of producing sound copper castings in sand moulds. March 12.

3793. J. Y. Johnson.—From La Société Anonyme le Ferro-Nickel, France. An improved manufacture of metallic alloys. Complete Specification. March 12.

3806. A. Leslie.—From A. S. Massey, British India. Improvements in cupolas or furnaces for melting or smelting iron and other metals. Complete Specification. March 12.

3822. J. Moss, Liverpool. Improvements in miners' lamps. March 12.

3857. J. Halfpenny and H. Halfpenny, Wolverhampton. Improvements in the construction of annealing furnaces. March 13.

3920. J. Thornton, Redditch. An improved process for coating iron and steel with tin. March 14.

3922. A. E. Tucker and G. Hatton, Smethwick. Improvements in the manufacture of iron and steel. March 14.

3926. G. de Wolf, London. Improvements in the humid method of extracting gold and other metals from refractory and other ores. March 14.

3963. W. Holland, jun., London. Improvements in the method of and appliances for heating, hardening, and tempering metallic wiro for various purposes. March 14.

3965. T. R. Jordan, London. Improvements relating to tho separation or extraction of metals from their ores by amalgamation, and to apparatus therefor. March 14.

4014. C. Sharman, Sheffield. The manufacture of armour-plates for the protection of forts and ships. March 15.

4034. H. F. Taylor and W. P. Struvé, London. Improvements in apparatus connected with pots for coating with tin, lead, or other metals or alloys. March 15.

4038. A. E. Alexander.—From J. E. Craig, United States. Improvements in the manufacture of polished sheet iron. Complete Specification. March 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

1069. W. H. Edwards, C. Britton, and J. E. Williams. Miners' safety lamps. March 3.

3669. C. B. Schultze. Extraction and recovery of metals, especially of tin from tinned iron plates. March 17.

4260. W. S. Sutherland. Heating, mainly for welding, and furnaces therefor. February 25.

4434. J. E. T. Woods. Treating and separating refuse metals. February 25.

4846. A. Gutensohn and E. Cox. Process of coating iron or other metals with tin, &c. March 3.

5622. W. H. Rickard and T. J. Rickard. Method and apparatus for coating plates with tin, lead, and alloys. February 25.

5627. A. Woodhouse. Apparatus for the amalgamation of gold. February 25.

5854. R. Low. Method of hardening or tempering steel projectiles. March 3.

6109. A. J. Maskrey and P. S. Phillips. Apparatus for the manufacture of tin and terne plates. March 3.

6569. J. E. East. Appliances for close annealing iron and steel sheets. March 10.

6916. W. Baker and J. Barton. Miners' safety lamps. March 17.

7047. A. P. Vivian. Manufacture of metallic alloys. March 17.

7139. D. Edwards, R. Lewis, and P. Jones. Apparatus for coating metal plates with tin, &c. March 17.

7563. F. W. Seaman. Manufacture of ingots, bars, and tools of self-hardening steel, combined with other steel. February 25.

9322. J. J. C. Smith. Apparatus employed in casting metals under pressure. February 25.

10,817. J. Y. Johnson.—From La Compagnie Anomyne des Forges de Châtillon et Commentry. Means and apparatus for tempering armour plates and other massive articles of iron or steel. February 25.

14,893. W. Hawdon. Apparatus for removing molten slag, scoria, &c. from furnaces. February 25.

16,491. H. W. Buddicom. Apparatus for dipping or cleansing tin or terne plates. March 3.

16,979. T. Anderson. Tinning hollow ware, &c. March 3.

1888.

686. H. H. Lake.—J. Illingworth. Casting of metal ingots, and apparatus therefor. February 25.

2019. J. Perino. Disintegrating copper pyrites by means of nitric iron salts for extracting copper. March 17.

2071. H. H. Lake.—From E. S. Hayden. Separation and refinement of metals, and apparatus therefor. March 17.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

2411. L. Mond and C. Langer, Liverpool. Improvements in gas batteries. February 17.

2667. J. V. Sherrin, London. Improvements in primary batteries. February 22.

2694. W. F. C. Ward, London. Improvements in batteries. February 23.

3097. B. M. Drake and J. M. Gorham, London. An improvement in holding the plates of secondary voltaic batteries. Complete Specification. February 29.

3149. L. Kayser, London. Improvements in galvanic batteries. March 1.

3223. W. Kingsland, London. Improvements in secondary batteries. March 2.

3312. E. Tyer, London. An improvement in voltaic batteries. March 3.

3498. T. Parker, Manchester, Improvements in and relating to alternating current dynamo-electric machines. March 7.

3517. R. Disher, London. Improvements in primary batteries. March 7.

3550. N. G. Thompson, London. An electrical regenerative battery. March 8.

3614. S. Z. de Ferranti, London. Improvements in dynamo-electric machines. March 8.

3929. T. Parker, E. Scott, G. Rees, and J. H. Woodward, Manchester. Improvements in and relating to dynamo-electric machines. March 14.

3986. B. M. Drake and J. M. Gorham, London. An improvement in plates for secondary voltaic batteries. March 14

3995. H. H. Lake.—From H. Walter, United States. Improvements in and relating to galvanic batteries. Complete Specification. March 15.

4008. H. Ullathorne and C. Gauzentes, Bradford. Improvements in electric batteries. March 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5505. H. W. Ravenshaw, W. T. Goolden, and A. P. Trotter. Dynamo-electric machines.

5562. W. Maxwell. Generating, reproducing, and distributing electricity. March 3.

5709. A. I. Gravier. Dynamo-electric machines. March 3.

5740. W. H. Quarterman. Galvanic batteries. March 10.

5793. G. A. Grindle. Generation and distribution of electricity. March 10.

5867. W. Kingsland. Secondary batteries. March 3.

6294. A. Watt. Electrolytic treatmont of zinc and its ores. March 3.

6681. R. E. B. Crompton and J. C. Howell. Secondary batteries. March 17.

7317. J. Kynoch and W. Habgood. Secondary batteries. March 17.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

2650. E. Johnson, London. A composition for cleaning wall-papers, papered ceilings, and the like. February 22.

3299. W. P. Kelly, London. A new composition for use in lubrication. March 3.

3584. J. Taylor, Leith. A new and improved method of extracting oil from the oil-yielding parts of fish and of mammalia. March 8.

3774. J. L. Wade, Glasgow. The manufacture of lubricating cream—white, brown, and dark (otherwise called solidified oil or grease)—for the lubrication of all kinds of surfaces subject to friction. Complete Specification. March 12.

4037. A. Engelhardt, London. Process and apparatus for ascertaining the quantity or percentage of fatty matter contained in soap. March 15.

COMPLETE SPECIFICATION ACCEPTED.

1887.

6756. T. Turner. Method and apparatus for filtering spent or other oils. March 10.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

2455. F. Crane.—From W. D. Field, United States. Improvements in varnishes and lacquers. February 18.

2509. G. Hand Smith, London. Improvements in the treatment of gums, fossiliferous gums, or gum resins in the manufacture of varnishes and other solutions for coating surfaces, or for other uses. February 20.

2512. G. Hand Smith, London. Improvements in the treatment of gums, fossiliferous gums, or gum resins in the manufacture of varnishes or other solutions thereof, and in apparatus employed therein. February 20.

2514. G. Hand Smith, London. Improvements in the treatment of gums, gum resins, or fossiliferous gums, in order to effect their solution for the manufacture of varnishes or other uses, and in apparatus employed therein. February 20.

2620. S. Washington, Manchester. Improvements in the preparation of black lead. February 22.

2920. F. Maxwell-Lyte. *See* Class VII.

3374. C. Hessel, London. Improvements in the manufacture of zinc white. March 5.

3501. J. Brookbanks, Newcastle-on-Tyne. Composition for ships' bottoms and other ironwork subjected to the action of sea-water or marine matter or life. March 7.

3579. G. J. Geary.—From A. Keiller, Sweden. Improvements in the manufacture of sulphide of zinc for pigment or other purposes. March 8.

3752. O. Imray.—From G. T. Lee. *See* Class IX.

3795. F. de Conninck, London. Improvements in the manufacture and application of incombustible paint. Complete Specification. March 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5586. F. Crane.—From J. Hale. Preparation of lacquers and varnishes and method of applying same. February 25.

5791. F. Crane.—From J. Hale. Compound or varnish for coating metal, wood, &c. February 25.

6582. P. Molyneax. An improved paint or coating. March 10.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

2870. E. Tuthill, London. An extract of oil or tar from the birch tree bark, to be used in the process of tanning or preserving hides, skins, furs, and for destroying moths and insects. Complete Specification. February 25.

3256. A. H. Hobson. *See* Class XV.

3354. T. Thomson, Glasgow. Improvements in compositions or coatings for the manufacture of carriage and other covers, imitation leather, wall decoration, book covers, and the like. March 5.

3393. T. P. Milligan, London. Preparation of glue stock. Complete Specification. March 6.

3895. E. V. Brown, London. Improvements in machinery for working leather, hides, or skins. March 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5741. H. House. Manufacture of artificial leather from leather waste and scraps, and utilisation of same. February 25.

6914. J. S. Hooper.—From J. W. Darrow. Method for treating hides and skins for leather. February 25.

9515. E. Worms and J. Balé. Process and apparatus for tanning by electricity. March 10.

XV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

3013. P. C. Jensen, London. An improved fertiliser. Complete Specification. February 28.

3256. A. H. Hobson, Westminster. Improvements in the treatment of bones for use as manure, and for obtaining from the bones gelatine, glue, or size. March 3.

COMPLETE SPECIFICATION ACCEPTED.

1887.

6632. W. L. Wise.—From E. Solvay. Processes for converting natural and other phosphates into products assimilable by vegetables, and into valuable sub-products. March 10.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

2511. A. Chapman, London. Improvements in apparatus for evaporating saccharine or other solutions or liquids. February 20.

3990. R. Everitt.—From Messrs. Taylor and Lawson, Batavia. Improvements in apparatus for drying sugar. March 14.

COMPLETE SPECIFICATION ACCEPTED.

1887.

7087. W. R. Watson.—From A. Young. Manufacture of sugar, and apparatus therefor. March 10.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

2611. H. Hackmann, London. Improvements in or relating to the filtering or cleaning of wort, and in apparatus therefor. February 21.

2735. W. S. Squire, London. Apparatus for purifying crude spirit. February 23.

2962. T. Bradbury, Bristol. Improvements in brewing beer, porter, and the like, and in apparatus therefor. February 28.

3193. E. Thatcher, Bristol. Improvements in the manufacture of brewers' finings, and in machinery or apparatus therefor. March 2.

3510. E. Manbré, Liverpool. An improved process of, and plant for, treating cereals, starchy or farinaceous substances for making alcohol, vinegar, and other like products. March 7.

3754. B. W. Valentin, London. An improvement in brewing. March 10.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

2426. W. Peacock, London. Apparatus to be employed in effecting the preservation of fruit, vegetables, meat, fish, and other perishable articles of food. February 17.

2856. S. R. White Humphries, London. Improvements in and connected with the manufacture of bread, biscuits, cakes, and farinaceous food generally. February 25.

2857. S. R. White Humphries, London. Improvements in and connected with the manufacture of bread, biscuits, cakes, and farinaceous food generally. February 25.

3161. S. Henderson and A. Henderson, London. A new and improved food compound manufactured in the form of bread and biscuits. Complete Specification. March 1.

3363. M. P. Hatschek, London. A dietetic nutritious food extract. March 5.

3530. Brin's Oxygen Co., Limited, and P. B. W. Goble, London. The manufacture of a carbonated oxygen water. March 7.

3994. C. A. Johansson, London. Improvements relating to the manufacture of butter and to apparatus therefor. Complete Specification. March 15.

B.—Sanitary Chemistry.

2761. R. E. Phillips.—From F. S. Harwood, Portugal. An improved process for softening and purifying water. February 24.

2762. R. E. Phillips.—From F. S. Harwood, Portugal. An improved process for disinfecting and purifying sewage. February 24.

2763. C. F. Newman, Tooting. An improved method of utilising sewage refuse. February 24.

2863. F. Maxwell-Lyte, London. Improvements in the treatment of sewage and other foul waters. February 25.

C.—Disinfectants.

3707. D. Pick and A. J. Scott, Manchester. Improvements in means for destroying vermin, disinfecting buildings or structures, or for analogous purposes. March 10.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1887.

6003. R. Jones. Preserving animal and vegetable substances for the food of man. March 3.

B.—Sanitary Chemistry.

1887.

5661. G. E. Davis and J. B. Aitken. Treating or purifying sewage, waste liquors from manufactories, and other foul liquids, and producing valuable substances therefrom. February 25.

C.—Disinfectants.

1887.

6751. J. W. Hamilton. Compositions for disinfectant, preservative, or remedial purposes. March 10.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

2436. G. Brown, London. An improved material for wall decoration in relief, called "Textile-carton-pierre." February 18.

3107. E. Ingle, London. Improvements in the manufacture of cigarette paper. March 1.

3281. C. H. Roeckner, F. L. Roeckner, and R. L. Roeckner, Tynemouth. Improvements in the machinery for and process of producing and refining paper pulp. March 3.

3321. A. Bensinger, London. An improved process for producing indelible designs on celluloid or like pyroxiline compounds. March 3.

3404. J. Jameson, Newcastle-on-Tyne. Improvements in the preparation of safety paper, affording protection against erasure or other alteration. March 6.

3787. T. J. Pearce and M. W. Beardsley, London. Improvements in the production and manufacture of paper, having waterproof, non-conducting, and other valuable properties and qualities. March 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

3937. A. Wilkinson. Treatment of fibres for pulp and manufacture of paper. March 3.

6548. S. Fisher. Wall or ceiling coverings. March 10.

7090. T. Phœnix and G. Kirk. Manufacture of pottery tissue paper. March 10.

7226. R. C. Menzies and C. M. King. Preparing safety paper for cheques, &c. March 17.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

APPLICATIONS.

2870. E. Tuthill. See Class XIV.

3094. L. Merck and E. Memel, London. Improvements in the production of hydrargyrum compounds. February 29.

3315. E. V. Goad, London. "Rhoga-Sa"—a new nutritious food essence and beverage of various delicious flavours. March 3.

3949. P. M. Justice.—From L. B. Weld, United States. Improvements in the manufacture of hydrochlorate of quinine. Complete Specification. March 14.

COMPLETE SPECIFICATION ACCEPTED.

1887.

13,839. A. G. Salamon. Treatment of benzol sulphonic imide (saccharine). March 10.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

2471. F. D. Blackbee, London. Working a photographic shutter by means of a pneumatic piston to be known as the "Blackbee pneumatic shutter." February 20.

2798. J. M. Elliot, Glasgow. Improvements in and connected with diaphragms and shutters for photographic and other lenses or cameras. February 24.

3103. C. Neve and F. Bishop, London. Improved illuminating apparatus for artificial light photography. February 29.

3658. J. Watson, London. Improvements in producing coloured photographs. March 9.

3779. J. L. Berry, Aberdare. A "camera gun" for using with any description of camera for instantaneous photographs. March 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5923. G. S. Martin. Photographic shutters. March 10.

1888.

1201. A. J. Boult.—From Dr. L. Backelandt. Photographic plate to be developed in water. March 10.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

2602. E. Rubin, London. Improvements in percussion fuses. February 21.

2721. R. H. Heenan, London. Improvements in cartridges for blasting. February 23.

2723. J. Pain, London. Improvements in ships' signal lights and similar fireworks. February 23.

3662. J. L. Didier, London. Improvements in cartridges. March 9.

3759. E. Rubin and A. Siersch, London. An improved manufacture of explosives, especially adapted for use in mines. March 10.

3902. G. F. Rogers.—From W. von Ruckteschell, St. Petersburg. Apparatus for testing explosives. March 13.

3989. C. L. Dresser, London. Improvements in explosive projectiles. March 14.

4010. J. W. Farrar, J. Wildman, and W. Burns, Church. Automatic fog signal. March 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5840. A. V. Newton.—From A. Nobel. Explosive projectiles March 10.

1888.

512. F. J. Shand. Manufacture of safety fuse for blasting. February 25.

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. Ludwig Mond has been nominated to the office of President; and Prof. Jas. Dewar, F.R.S., has been nominated Vice-President under Rule 11.

Sir I. Lowthian Bell, F.R.S., Mr. R. Forbes Carpenter, and Dr. John Evans, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. B. E. R. Newlands and Mr. Alexander M. Chance have been nominated Ordinary Members of Council under Rule 17 in the place of Mr. R. Forbes Carpenter and Dr. John Evans, F.R.S., nominated Vice-Presidents.

The Treasurer has been nominated for re-election, and Dr. F. Hurter has been nominated Foreign Secretary in the place of Mr. Ludwig Mond.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18:—"No such nomination shall be valid, unless it be signed by at least ten members of the Society, who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's office, at least

one month before the date of the commencement of the Annual General Meeting, and the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

Annual General Meeting.

Notice is hereby given, that the next Annual General Meeting will be held in Glasgow on Wednesday, Thursday, and Friday the 18th, 19th, and 20th of July next. Detailed arrangements and the programme of proceedings will appear as soon as complete. Tickets of membership will be issued in time for the meeting, and will form, as heretofore, vouchers for visits to works and excursions.

Notice is hereby given that the numbers for January, 1882, 1883, and 1886, and February, 1886, are exhausted, and no orders for those copies can be executed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January, 1882, and February, 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once with Mr. Cresswell.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

CHANGES OF ADDRESS.

Adriance, J. S., l/o New York; c/o Banning, Bissell, & Co., Huntingdon, Pa., U.S.A.

Bennie, Jno. W., l/o Cubitt Town; Minas de Rio Tinto, Huelva, Spain.

Blundstone, E. R., l/o Regent's Park; Cornwall Lodge, St. James' Road, New Hampton, Middlesex.

Burghardt, Dr. Chas. A., l/o King Street; 35, Fountain Street, Manchester.

Cameron, Ian, l/o Kirkintilloch; Casal das Rolas, Poco do Bispo, Lisbon.

Chaney, Harry, l/o Mexico; 29, Chalcot Crescent, Regent's Park, N.W.

Clark, E. B., l/o Rangoon; c/o Clark & Struthers, 17, Royal Exchange Square, Glasgow.

Cross, C. F., l/o Eaton Terrace; 4, New Court, Lincoln's Inn, W.C.

Dauber, H. jun., l/o "Kenmoro"; 1, Victoria Road, Waterloo, Liverpool.

Dent, W. Y.; Journals to Belle Vue House, Wood Street, Woolwich, S.E.

Foster, H. le Neve, l/o Jarrow; Seaton Carew, co. Durham.

Fulton, H. B., l/o Cyprus; Bellfield, Kirkintilloch, N.B.

Greenway, T. J., l/o Sheffield; Block 14 Mining Co., Broken Hill, near Silverton, New South Wales.

Hodges, J. F., l/o Upper Arthur Street; Derryvolzie, Windsor, Belfast, Ireland.

Ingham, J. W., l/o Leytonstone; 11, New Gravel Lane, Shadwell, E.

Isler, Otto, l/o Marsden Street; 23, Cooper Street, Manchester.

Jackson, R. Valentine, l/o Sydenham; 3, Park Terrace, Queen's Drive, Crosshill, Glasgow.

Kipping, Dr. F. Stanley, l/o West Meadows; 14, Graham Street, Edinburgh.

Kupferberg, Dr. H., l/o Crumpsall; 303, Collyhurst Road, Manchester.

Lee, S. Wright, l/o Church Street; 6—10, Whitechapel, Liverpool.

Leith, J., l/o St. Helens; Lancashire Alkali and Sulphur Co., Ld., Widnes.

Lomas, Thos., l/o Minehead; Seaham Chemical Works, Seaham Harbour, co. Durham.

McGlashan, Jno., l/o Gartcosh; Runcorn Soap and Alkali Co., Ld., Runcorn.

McGowan, J., Ash House, Talke (not Talk-o'-th'-Hill), near Stoke-on-Trent.

Nichols, J. A., l/o Spring Bank; Hurstfield, New Mills, near Stockport.

Paterson, J., l/o Harrington Road; Belle Isle Place, Workington.

Pfeiffer, C. F., l/o Ealing; 63, Queen Victoria Street, London, E.C.

Poynter, J. Edgar; Journals to 72, Great Clyde Street, Glasgow.

Rowley, W. J., l/o Handsworth; c/o Abbott, Anderson, & Abbott, Dod Street, Burdett Road, Limehouse, E.

Scheufelen, Dr. A., l/o Watford; Paper Mills, Oberlenningen u. Teck, Wurtemberg, Germany.

Small, Evan W., l/o The Park; 11, Arthur Street, Nottingham.

Vary, G. M. P.; Journals to 1,319, O'Farrell Street, San Francisco, Cal., U.S.A.

Watson, J. Cecil, l/o Accrington; c/o J. Bennett & Sons, Birch Vale, near Stockport.

Wiggin, Walter W., l/o Harborne; Wiggin Street, Birmingham Heath, Birmingham.

Wilde, Thos., l/o Newport; Penclawdd, near Swansea.

Williams, M. Whitley, l/o Queenwood College; Edison Swan Electric Light Co., Ponders End, London, N.

Wright, J. C., l/o Cargo Fleet Road; 4, Portland Terrace, Redcar, Yorkshire.

CHANGES OF ADDRESS REQUIRED.

James, J. H., l/o Coventry Park, Streatham, S.W.

Rowell, W. A., l/o British Alkali Works, Widnes.

LIST OF MEMBERS ELECTED, 23rd APRIL, 1888.

Brin, Arthur, 59, Brompton Crescent, London, S.W., civil engineer.

Coats, John T., 91, Broughton Street, Edinburgh, manufacturing chemist.

Cook, Jno. J., Atlas Foundry, St. Helens, Lancashire, ironfounder.

Dunn, Wm. Walton, 1, Bessemer Terrace, Mount Pleasant, Spennymoor, Newcastle-on-Tyne, analytical chemist.

Earle, G. Peploe, Brantwood Lodge, Burnt Ash Hill, Lee, S.E., chemical salesman.

Evershed, Henry G., Soap Works, Station Street, Brighton, soapmaker.

Hogg, Quintin, 23, Rood Lane, London, E.C., merchant,

Jackson, Wm. Morton, 9, Range Road, Alexandra Park, Manchester, chemist.

Lennox, Robt. N., Royal Institution, Albemarle Street, W., chemist.

Lister, Simeon, 70, High Street, Great Horton, Bradford, Yorks, chemist.

Meikle, Jno., 4, Woodlands Road, Glasgow, journalist.

Olsen, Olaus E., Sandöen,Boröen, Norway, engineer.

Pearmain, Thos. H., 9, Broad Street, Bloomsbury, W.C., assistant chemist.

Snape, Dr. H. Lloyd, University College, Aberystwith, professor of chemistry.

Stone, Thos. W., Chemical Works, St. George, Bristol, chemical manufacturer.

Sutton, Chas. W., Free Reference Library, Manchester, librarian.

Thomas, S. Percy, c/o A. Boake, Roberts, & Co., Stratford, E., chemist.

Williams, Edward, 8, Silver Street, Blackley, near Manchester, technical chemist.

Wyndham, Dr. Stanley, c/o The American Forcite Powder Manufacturing Co., 55, Liberty Street, New York, U.S.A., assistant superintendent.

London Section.

Chemical Society's Rooms, Burlington House.

Chairman: David Howard.

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C. Graham.
S. Hall.
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R. Messel.
B. E. R. Newlands.
B. Redwood.
T. Royle.
John Spiller.
Wm. Thorp.
C. R. Alder Wright.

Hon. Local Sec. and Treasurer:
Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

SESSION 1887-88.

Prospective Arrangements.

The asterisk * indicates dates other than 1st Monday in the month.

May 7th (1st Monday).—Mr. W. J. Dibdin. "Standards of Light."

*May 14th (2nd Monday).—Mr. Lewis T. Wright. "The present position and prospects of the Coal Gas Industry."

June 4th (1st Monday).—Messrs. B. E. R. and J. A. R. Newlands. "The mode of using Char in Sugar Refining."
Mr. Thos. T. P. Bruce Warren. "The Adulteration of Olive Oil and methods of detection."

Notice will be given in the Journal and other Scientific Papers of other Meetings and papers.

Communications to be addressed to the Local Secretary.

Meeting held March 19th, 1888.

MR. B. E. R. NEWLANDS IN THE CHAIR.

THE POLARISCOPE AND ITS APPLICATIONS TO BREWING.

BY J. HERON, F.I.C., F.C.S.

This paper may be conveniently divided into two parts:—

I. Theoretical, treating of polarised light and the principles upon which the construction of the polariscope, or, more properly speaking, the polarimeter, depend; and for such information I have drawn largely from that classical work of Landolt on this subject, an epitome of which the first part of this paper must be considered.

II. Practical, or the application of the polariscope to the different processes connected with brewing, as well as to the analysis of malt, wort, and beer. For much valuable information in connexion with this part of my subject I am indebted in great part to the researches of O'Sullivan, Brown, Morris, Kjeldahl, and others.

Part I.

If we examine an ordinary ray of light, emitted from any source whatever, we shall find that it exhibits the self-same properties on all sides—it is capable of being reflected or refracted in any position whatever; but if we subject this ray to certain conditions, we shall then find that it is possible to restrict its vibrations to some one particular direction, and such a ray is said to be polarised.

Light may be polarised in either of the following ways:—

1. By reflection from the surface of transparent media.
2. By ordinary refraction.
3. By double refraction.

It is with the last of these methods that we have most particularly to deal.

It is well known that certain crystals have the property, when a ray of light passes through them, of splitting up that ray into two others of equal intensity. Such a phenomenon is known as double refraction, and such crystals are said to be double refracting. In every such crystal there is at least one direction in which no such splitting up of the ray takes place, and this direction is called the optic axis of the crystal. Iceland spar exhibits this phenomenon in a notable manner. In a crystal of Iceland spar the line joining the points where the three obtuse angles meet is the principal or optic axis, and any ray of light transmitted through the crystal in a direction parallel to this axis is not divided. If, however, the crystal be tilted out of this position, the emergent ray is found to be separated into two. The angular divergence of the two rays depends upon the angle through which the crystal has been turned; when this angle amounts to a right angle the separation is at its greatest; and if the crystal be still further turned, the two rays begin to come together again, until, when it has turned through another right angle, they coincide. On examination by a method which we shall refer to presently, it will be found that both of these rays are completely polarised. the plane of polarisation of one being parallel to the principal section of the crystal, that is to say, to a plane passing through the optic axis and the direction in which the ray traverses the crystal, the other in a plane at right angles to that section. The first of these rays follows the ordinary law of refraction, and is called the ordinary ray; but the other ray, which is polarised at right angles to the principal section, follows different laws of refraction, and is termed the extraordinary ray. For polariscopic purposes it is best to give exit to only one of these polarised rays, that, namely, which is parallel with the incident ray, and to throw the other completely out of the field of view. This can be done in various ways, but best by means of what is known as a Nicol's prism. For this purpose a rhombohedron of Iceland spar, double its natural length, Fig. 1,

Fig. 1.

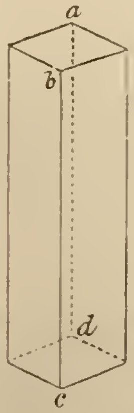
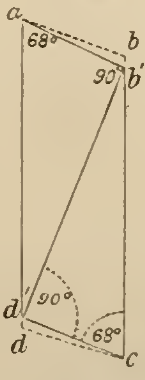


Fig. 2.



of which *a*, *b*, *c*, *d*, Fig. 2, represents a section, is taken, and the terminal faces *a b* and *c d*, which naturally make an angle of 71° with the sides *a d* and *b c*, as at *a c*, are cut obliquely, so as to give the new faces an inclination of 68° to these edges. The whole block is then divided into two by a cut in the direction *b d*, and at right angles to the new face *a b'*. The faces of this cut are then carefully polished and cemented together again in their original position with Canada balsam. Such an arrangement is called a Nicol's prism, as shown in Fig. 3.

Fig. 3.

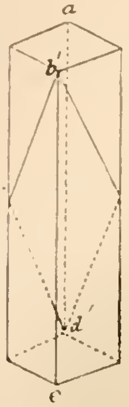
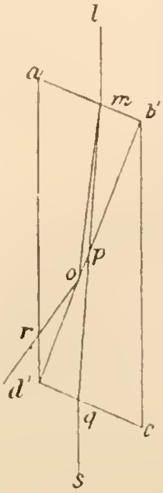


Fig. 4.



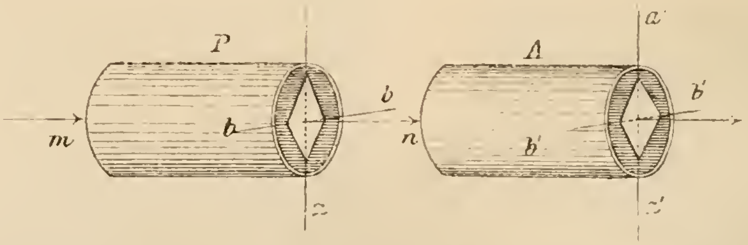
If now a ray of light, *l m*, parallel to the edges of the longer side, fall on the face *a b'*, it is split up into two rays, both of which are polarised, but at right angles to each other. The less refracted or extraordinary ray *m p q* traverses the film of balsam at *p*, and emerges in the direction *q s* parallel to *l m*. The more refracted or ordinary ray, *m o*, meets the balsam at *o*, which, from its being a medium of so much feebler refractive power, causes *total reflection* of the ray in the direction *o r*, whereby it becomes absorbed by the case of the prism. The other ray emerges in the direction of the incident one, but possesses only half its luminous power.

The plane of polarisation of this ray (or the plane in which it vibrates) is at right angles to the principal section, and therefore passes through the longer diagonals of the end faces of the prism.

In order to study the behaviour of a polarised ray we have to make use of a second Nicol's prism so placed that its principal axis is in a line with that of the first. Two such prisms, when thus used together, are respectively called the polariser and the analyser.

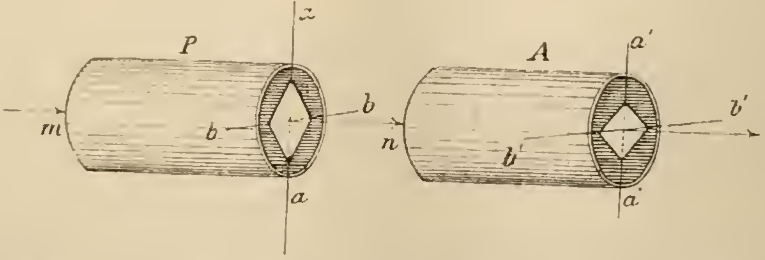
In Figs. 5 and 6 such a combination is shown. In the first case both prisms are arranged so that the plane of polarisation *a' a' n* of the analyser A is parallel with the plane of polarisation *a a m* of the polariser P, and also the principal section *b b m* and *b' b' n* of the two prisms are brought into the same direction. The ray *m* which enters P as ordinary light and emerges polarised at *n* is not decomposed on passing through A, it is merely refracted in the direction of an extraordinary ray *m p q*, Fig. 4, and emerges so at the opposite end of the analyser.

Fig. 5.



The same happens if the latter be turned through an angle of 180°, so as to bring the planes again parallel. If, now, the analyser be turned round so that its plane of polarisation, instead of being parallel is at right angles to that of the polariser, as is seen in Fig. 6, then the ray, after passing through P, when it enters A, will take the direction of the ordinary ray, as represented by *m o r*, Fig. 4, and is eliminated by the film of balsam. No light leaves the analyser, and hence the field of vision appears dark. The same thing happens at a distance of 180°. At all intermediate positions between these two,

Fig. 6.



that is, when the two Nicol's are neither parallel nor at right angles to each other, polarised light, as it enters the analyser, is separated into an ordinary and an extraordinary ray. Varying in intensity with the angle at which the planes of polarisation of the two prisms are inclined to each other, and we get the field of vision more or less illuminated.

In order to understand these phenomena more clearly, I purpose to throw upon the screen, by means of the polarising apparatus I have got here, a beam of monochromatic light, such as is furnished by placing a bead of common salt in the flame of a Bunsen burner. Now, suppose that the two Nicol's are crossed as before, so that no light is transmitted by the analyser. If then, a plate of quartz be interposed, a red light makes its appearance on the screen; and to render the field again dark, it is necessary to turn the analyser through a certain angle either to the right or to the left. Hence it follows that the ray which has traversed the quartz must have had its plane of vibration deflected through an angle equal to that through which the analyser has been turned. The angle through which the analyser has to be turned to bring a recurrence of darkness in the field of vision, and which can be read off on the graduated rim of the disc, is called the angle of rotation, and is the measure of the deflection experienced by the plane of polarisation.

Precisely similar effects are produced with yellow, green, violet, or any other kind of homogeneous light, but the angle of rotation varies according to the nature of the ray, being least for red and greatest for violet light, as shown in the following table:—

Table I.

Rotation Produced by Quartz Plates for different Rays.

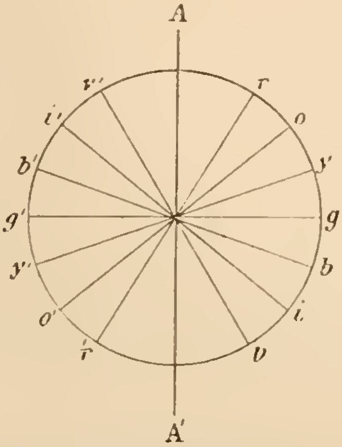
——	Plate, 1 mm.	Plate, 3·75 mm.
Medium red	15°	56·4°
„ orange	19°	71·2°
„ yellow	24	90·0°
„ green	27°	101·2°
„ blue	32°	120·0°
„ indigo	38°	142·5°
„ violet	44°	165·0°

Some crystals of quartz rotate the plane of polarisation to the right, others to the left: the former are called right-handed quartz, the latter left-handed. But in whatever direction the rotation takes place, a plate of quartz of given thickness always produces the same amount of angular deviation for a ray of given refrangibility, and for plates of different thicknesses the deviation for any particular ray increases in direct proportion to the thickness.

This rotation of the plane of vibration or of polarisation is called circular polarisation, and substances which exhibit this power are said to be circular polarising or optically active, and are also distinguished as right rotating or left rotating, whilst those substances which have not this power are said to be inactive. Thus, for instance, if instead of the quartz plate we interpose a tube filled with a solution of cane sugar, it will be found that the ray of light is rotated to the right, whilst the same ray is rotated to the left by a solution of invert sugar. Now, if instead of causing a beam of monochromatic light to pass, we employ white light, as from an ordinary Argand lamp, a system of coloured rings will be observed—red, yellow, green, blue, &c., according to the thickness of the plate. On turning the analyser on its axis the colours in the centre go through the regular prismatic series from red to violet, or the contrary, according to the direction of rotation, but no alteration of colour is produced by rotating the plate of quartz while the analyser remains stationary.

Now let us see how this can be explained. Suppose a beam of white light, polarised by a Nicol's prism, whose principal section is parallel to *a a′*, Fig. 7, to pass through a plate of right-handed quartz 3·75 mm. thick, the vibrations of the several coloured rays composing the beam of polarised light are all at first parallel to *a a′*, but by passing through the quartz their planes of vibration are deflected through the several angles given in the above table, the red ray then vibrating in the line *r r′*, the yellow in *y y′*. Now let the ray be viewed through another Nicol's prism placed with its principal section also parallel to *a a′*; then on resolving each of these vibrations into two others, one parallel and the other perpendicular to *a a′*, it will be seen that the red and violet rays will be transmitted with but slightly diminished intensity, the orange and blue with less, the yellow still less, and the green not at all. The result will therefore be a purple tint. Now let the eye piece be turned from left to right as the principal section passes successively over the lines *r r′*, *o o′*, &c., the red, orange, yellow, &c. will in succession be more fully transmitted than the other rays, so that a series of tints will be produced, agreeing nearly with colours of the spectrum, and following in the same order from red through yellow to violet. If the analyser be turned the contrary way the order of the tints will be reversed. If the quartz were left-handed the phenomena would be precisely similar, excepting that the colours would change from red through yellow to violet when the analyser was turned from right to left.

Fig. 7.



The tint produced with a quartz plate 3·75 mm. thick when the principal sections of the polariser and analyser are parallel to one another deserves particular notice. As already observed, it is a purple, and moreover it changes very quickly to red or to violet when the analyser is turned one way or the other, the change of colour thus produced being, in fact, very much more rapid and decided than in any other part of the circuit: this particular tint is accordingly distinguished by the term "transition tint." And in measuring the rotation produced by various substances this is often taken as the standard instead of the darkened disc used with monochromatic light. It is therefore evident that the rotative power of substances can be measured in two ways, either by means of monochromatic light, taking as our zero a field of either maximum or minimum illumination, or by means of ordinary light with aid of quartz plate interposed, using the transition tint for zero.

Instruments of various forms have been devised for observing and measuring this rotative power, and have hence been termed Polariscopes or Polarimeters.

The simplest of all forms of polariscope consists of two Nicol's prisms, enclosed in brass tubes and fixed one at each end of a metallic bar, along which they may be made to slide to and fro. The polariser is contained in a brass tube, and is made to turn on its axis if required, being fixed in any desired position by means of a small screw. The tube containing the analyser is also capable of rotating on its axis, and has an arm attached to it, as well as a pointer, which measures off the amount of rotation upon a fixed graduated circle of brass. The graduation of this circle is in degrees and tenths from 0° to 360°. The observation tube, which may be made of brass or of stout glass, with brass fittings, is designed to hold the saccharine solution under examination, and is closed at each end by a screw cap having a small circular hole in its centre. Glass discs are placed between the caps and the ground ends of the tube, and washers of cork or india-rubber between the glass plates and caps, so that when the tube is filled with liquid and the whole screwed up, a tight-fitting joint is made at each end. In using an instrument of this kind it will be found best to employ a monochromatic yellow light, such as that furnished by a sodium flame; but this form of instrument is now comparatively little used, if at all, being replaced by much more accurate forms of polarising apparatus.

HALF SHADE INSTRUMENTS.

The distinguishing characteristic of this class of polarimeters is that, for a certain position of the optical parts, the field of vision appears divided into halves, the one being very bright and the other very dark, whilst, for another position, the whole field exhibits a uniform greyish shadow, without any trace of vertical line. Monochromatic sodium light is used with such instruments.

The earliest instrument of this kind was constructed by Jellett in 1860. Other forms have been devised by Cornu and Duboscq, but the one which has come into most general use is that of Laurent.

Fig. 8.

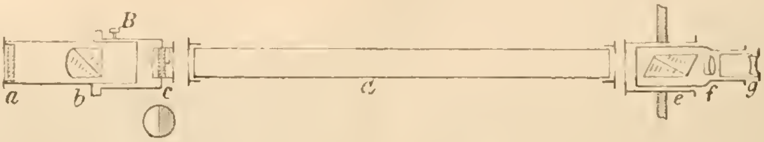


Fig. 9.

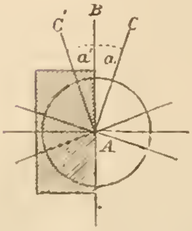


Fig. 10.

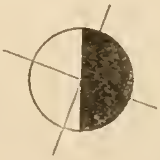


Fig. 11.

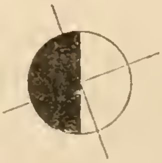


Fig. 12.

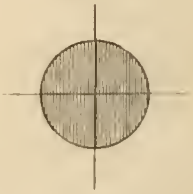


Fig. 8 shows the principle of construction of this instrument. *a* is a plate of bichromate of potassium, or a glass cell filled with a concentrated solution of the same, and which serves to cut off any green, blue, or violet rays, thus rendering the light more fully monochromatic. *b*, the polariser, is a calc spar prism; the face of the prism towards *a* is ground convex, so that light may emerge approximately parallel. These two parts are placed in the moveable brass tube *a b*, which may be kept in any desired position by means of the screw-stop B. *c* is a circular diaphragm covered by a plate of glass, to which is cemented a thin plate of quartz, cut parallel to its axis, in such a manner that only one-half of the circular aperture is covered by it. *d* is the solution tube, *e* the analysing Nicol, and *f* and *g* the lenses of a small telescope.

The theory of this polarimeter is as follows:—If the plane of polarisation of the transmitted ray of light is parallel to the axis of the quartz plate, that is, lies in the direction A B, Fig. 9, the two halves of the field of vision will then appear equally dark or equally bright in every position of the analyser. But if the *polariser* be inclined to A B at an angle α, the plane of polarisation of the rays passing through the quartz plate will undergo deviation through an angle α' in the opposite direction. Therefore, when, in the uncovered half, the plane of polarisation has the direction A C, in the covered half it will have the direction A C'. If now we turn the *analyser* until its *principal section is perpendicular to that of the polariser*, there will be *a total extinction of the light to the right* but only partial to the left (Fig. 10). On the contrary, if the principal section of the *analyser is perpendicular to that which corresponds to the quartz plate*, then there will be *total extinction to the left* and partial to the right (Fig 11). If, finally, the principal section of the analyser is intermediate in position, that is, neither perpendicular to the axis of the crystal or parallel to it, there will be partial extinction both to the right and left and of equal intensity, so that the two halves of the luminous disc constituting the field of the instrument will appear uniformly in shadow (Fig. 12), but a very slight movement of the analyser one way or the other will at once destroy this uniformity. The same phenomena are apparent when the analyser has moved through 180°.

TRANSITION TINT INSTRUMENTS.

The transition tint instruments are specially constructed for determining the percentages of sugar in solutions of known density; but as they have been and are employed in the laboratories of several well-known breweries, a description of them will not be out of place.

The earliest form of these instruments is known as the Soleil Saccharimeter; this has been much improved by Duboscq, and in its present form is called the Soleil-Duboscq Saccharimeter.

The optical principles of the transition tint instruments are based upon the following facts :—

1. That when a polarised ray is transmitted through several media possessing rotatory power in different directions, their separate activities may become partially or wholly neutralised according to the lengths of the media.

2. That the rotatory dispersion of cane sugar is the same as that of quartz.

This latter fact is generally taken for granted by the Continental chemists, but English observers find that there is a slight difference between the dispersion of quartz and that of cane sugar, and quite sufficient to make an appreciable difference in the results of analysis.

In Fig. 13 is shown the apparatus :—

Fig. 13.

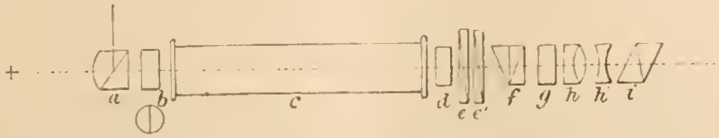
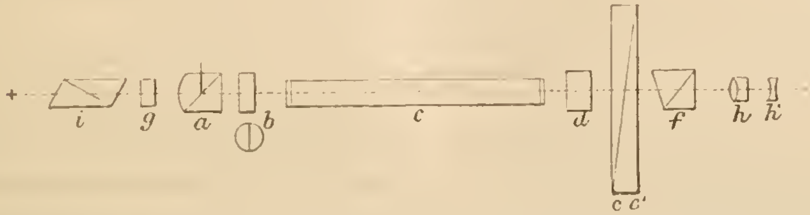


Fig. 14.



a is the polariser, consisting of a calc spar prism; b is a plate of quartz called the plate of double rotation or bi-quartz, and is composed of two halves of equal thickness cut perpendicularly to the axis of crystallisation and joined together so that the line of junction is vertical. These half discs have different rotations, the one being left-handed and the other right-handed. c is the solution tube; d is a quartz plate either right- or left-handed, and of a certain thickness; $e\,e'$ are two wedge-shaped quartz plates, both having the same kind of rotation, but different to that of d. These plates are each fixed in a brass frame, and, by means of a rack and pinion, are made to slide over one another, so that their combined thickness may be made either equal to, greater, or less than that of d. The distance moved to effect any particular adjustment is shown by a graduated scale attached to the brass frame. f is the analyser, which may consist of an achromatised calc spar prism; its principal section must be arranged parallel to that of the polariser a, when the thickness of the bi-quartz b is 3·75 millimetres, and perpendicular thereto when the thickness is 7·5 millimetres.

Soleil introduced an extra Nicol prism, shown at i, and a plate of quartz, g, ground perpendicular to the axis, fixed in a moveable case, and which may be turned at will through an angle of 180°. This arrangement is called the regulator, and is used for the purpose of counteracting, to a certain extent, the influence of the coloration in the liquids subjected to examination, and to restore the sensitive tint, which would otherwise be destroyed when using such coloured liquids. $h\ h'$ is a small Galilean telescope.

In order to understand the action of the several parts, let us first consider that light is passing through the polariser and analyser only. These are arranged with their principal sections parallel so that the field is at its maximum of illumination. Now let the active bi-quartz b be interposed between a and f; the white light coming from a will be rotated and decomposed into its component coloured rays. Of these emergent rays those whose plane of polarisation is at right angles to that of the analyser will not be transmitted, and should these be the yellow rays, the remainder will in transmission combine to a pale lilac tint, which, with the slighest alteration of the plane of polarisation, passes into pure red or pure blue. This intermediate colour is the transition tint.

If now we put the combination $d\ e\ e'$, known as the rotation compensator, in its place, the quartz wedges $e\,e'$ being so adjusted that their combined thickness is exactly equal to that of the plate d, as the rotatory powers of d and $e\,e'$ act in exactly opposite directions they neutralise each other and the sensitive tint still prevails. This position of the wedges corresponds with the zero point of the scale. If now a tube containing a solution, say, of cane sugar, be interposed, the uniformity of colour between the two half discs is immediately destroyed, appearing differently coloured, green and blue predominating in one, red and orange in the other; by sliding the quartz wedges so as to produce rotation opposite to that of the solution, a position may be found where the action of the latter is neutralised, and this will be indicated when the halves of the field of vision again exhibit uniformly the sensitive tint.

This action of the compensator shows not only whether the solution of the substance examined is right or left rotating, but also the degree as measured by the thickness of quartz necessary to neutralise the deviation of the body examined. The latter is measured by means of a graduated scale fixed to one of the slides, while upon the other is a mark serving as an indicator.

The Soleil-Ventzke Scheibler saccharimeter, in the principles of its construction, is identically the same as the Soleil-Duboscq, but the mechanical parts have been greatly improved and the optical arrangement slightly altered.

These alterations were made in Germany by Ventzke, who introduced a different scale, the mechanical improvements being made by Scheibler. The various parts as shown in section, Fig. 14, are lettered respectively the same as the Soleil-Duboscq, so that the description there given will apply equally to the Ventzke.

There are several other forms of polarimeters at present in use in addition to those described, for full details of which I must refer you to Landolt's Handbook of the Polariscope.

Of all the polarimeters that are now in use I prefer those constructed on the Laurent principle to any other. I think such instruments possess many advantages over every other; they are extremely simple to manipulate, easy to determine the exact rotation, can be used by persons who have not a sufficiently keen appreciation of colour to be able to determine accurately enough the transition tint, a highly coloured solution can just as truthfully be read off as one possessing little or no colour, whereas in the transition tint instruments, when dealing with solutions more or less coloured, we have to neutralise the effect produced by the colour by means of the extra Nicol. This has the effect of cutting off a certain amount of light, as well as diminishing the sensitiveness of the instrument to a large extent; and as most of the solutions a brewer may have to deal with are more or less coloured, it is evident that the instrument which gives the most reliable results with such solutions is the one best suited to his purpose.

Physical Laws of Circular Polarisation.

From experiments with plates of quartz of varying thickness, Biot found that:—

1. The amount of rotation is dependent on the thickness of the medium through which the ray of light passes, and, in order to allow comparison to be made with other crystals, he proposed as a standard a plate of quartz 1 millimetre in thickness.
2. That the amount of rotation is dependent on the wave length of transmitted ray, being least for red and greatest for violet.

For ray D, which lies on the border between orange and yellow, the wave length of which is ·0005888 mm., the amount of rotation produced by a quartz plate 1 mm. in thickness =21·67°. This is called the specific rotation of ray D, and is designated by the symbol $\{\alpha\}_D$. The wave length of what is known as the transition tint, that is to say the colour complementary to mean yellow light, is ·00055 mm., and its specific rotation, 24·5°, is designated by the symbol $\{\alpha\}_j$. The wave length of this mean yellow light is less than that of the ray D, which lies on the border between orange and yellow, so that the value of α_j is always less than α_D.

For example, with quartz $\alpha_D = 21\cdot67$, $\alpha_j = 24\cdot5$, so that to express the one in terms of the other we have—

$$\alpha_j = \frac{24\cdot\ 5}{21\cdot67}\,\alpha_D = 1\cdot1306\ \alpha_D.$$

$$\alpha_D\ \frac{21\cdot67}{24\cdot\ 5}\,\alpha_j = \cdot8845\ \alpha_j.$$

Specific Rotatory Power.

When different active substances, liquids, as for instance oil of turpentine, are examined in the polariscope, according as these liquids differ in density, varying masses of molecules will be brought to bear upon the transmitted rays; therefore, before any exact comparison can be made, the observed angles of rotation must be calculated to one common density. If the density 1 be taken, as recommended by Biot, the angle of rotation α of the several liquids must be divided by their specific gravity. The angle of rotation given by a length of 1 decimetre of any active liquid corrected to the standard density 1, is denominated by Biot the specific rotation or specific rotatory power $\{\alpha\}$ of that substance, and may be found from the observed data α l and d.

$$\text{I. } \{\alpha\} = \frac{\alpha}{l.d}.$$

For solid substances, which when dissolved in distilled water exhibit a rotatory power, he proposed to find a formula as follows:—

If P grammes of the substance be dissolved in E grammes of water, and d be the density of the solution, then one cubic centimetre (unit volume) will contain $\frac{P}{P+E}\cdot d$ grammes of substance.

If a solution of the above composition in a tube l decimetres long give an angle of rotation α, then the deviation for a solution containing one gramme of active substance in one cubic centimetre of solution, *i.e.*, the specific rotatory power $\{\alpha\}$ is found by the proportion

$$\frac{P}{P+E}\,d : \frac{\alpha}{l} = 1 : \{\alpha\}, \text{ whence } \{\alpha\}. = \frac{\alpha\,(P+E)}{l.P.d}.$$

If we let $\frac{P}{P+E}$, that is the amount of active substance in the unit weight of solution, $= \epsilon$, then $\{\alpha\} = \frac{\alpha}{l.\epsilon.d}$ and if the proportion of active substance be stated for 100 parts by weight of solution and this proportion (100 ϵ) be indicated by p, we then have

$$\text{II. } \{\alpha\} = \frac{100\ \alpha}{l.p.d}.$$

For the calculation of this formula we must know the percentage, weight, and density of the solution, but, since $p.d.$ equals the concentration c, all we have to do is to weigh out the number of grammes of solid substance, dissolve in water in 100 cc. flask, and dilute the solution to the mark. The equation then becomes

$$\text{III. } \{\alpha\} = \frac{100\ \alpha}{l\ c}.$$

If we take the length of the tube in millimetres = L, the above equations become

$$\text{I. } \{\alpha\} = \frac{100\ \alpha}{L\ d}.\quad \text{II. } \{\alpha\} = \frac{10^4\ \alpha}{L.p.d.}\ \text{ and III. } \{\alpha\} = \frac{10^4\ \alpha}{L.c}.$$

It has been found that a certain amount of variability of the specific rotation of bodies in solution occur, dependent on an increase or decrease of temperature, according as different inactive liquids are employed for solution; also when an active substance is dissolved in a liquid already containing some other inactive substance in solution, or the active substance may be dissolved in a mixture of two different liquids. A peculiar case of this variability occurs in certain sugars. When a freshly prepared aqueous solution of one of these substances is observed in a tube in the polariscope, it is found to exhibit a gradually decreasing rotatory power until after a certain time has elapsed; it becomes constant at ordinary temperature. This occurs after the lapse of 24 hours: heat, however, accelerates the change, a boiling temperature bringing it about in a few minutes.

The specific rotation of any active liquid can be determined directly, and is constant for any given temperature; but when such a liquid, as for instance oil of turpentine, is mixed in different proportions with an indifferent liquid, as alcohol, and from the composition, density, and angle of rotation of the resulting solution, the specific rotation is computed, the values so obtained will differ in a greater or less degree from that of the pure substance. Hence it follows that the specific rotatory power of a substance is in some way influenced by the presence of inactive molecules, so that its value is altered somewhat, in the majority of cases, however, suffering an increase for increased proportions of the volume of solvent employed.

If, however, the active substance be a solid, its rotatory power can only be examined in solution, and then different values for $\{\alpha\}$ will be obtained according to the character of the solvent, none of which is the actual specific rotation of the pure substance but a value modified by the presence of the inactive liquid, and differing from the real value by a quantity unknown when a pure homogeneous liquid is employed as solvent, so that only inactive molecules of one kind are allowed to influence those of the active substance. The variations in specific rotation are best shown by the graphic method, the percentages of inactive solvent q being taken as abscissæ, and the corresponding values of $\{\alpha\}$ as ordinates. The increase or decrease of specific solution will then, in many cases, appear as a straight line, increasing, therefore, in direct proportion to q. Hence it may be expressed by the formula—

$$\{\alpha\} = A + Bq,$$

in which the constants A and B must be ascertained from direct experiment; in other cases it will appear as a curve, usually a portion of a parabola or hyperbola, when the relation between the specific rotation and q is represented by an expression of the form—

$$\{\alpha\} = A + Bq + Cq^2.$$

In these formulæ A denotes the specific rotation of the pure substance. The values B and B and C represent the increase or decrease of A for one per cent. of inactive solvent.

If $q = 0$ the specific rotation is that of the pure substance.

If $q = 100$, $\{\alpha\} = \infty$, hence the active substance vanishes and the solution consists of the inactive solvent alone, the rotatory power will then necessarily be nil.

In such active liquids as are miscible in all proportions with some other indifferent liquid the variations in the specific rotation up to extreme degrees of dilution can be determined by direct experiment, and the complete curve can be drawn from $q = 0$ to $q = 100$.

When, however, the active substance is a solid, the true specific rotation cannot be determined directly, and we can only construct a portion of the curve larger or smaller according to the solubility of the substance, but always commencing at some distance from the origin of the co-ordinates. Hence the value $\{\alpha\}$, calculated from a solution of an active substance, is never the true specific rotation of the substance itself in a state of purity.

It is necessary first to ascertain the law of the variation brought about by the inactive liquid by examining a number of solutions of different strengths, and the true specific rotation may be approximately obtained by calculating the value of the constant A from the above formulæ.

In this way the true rotation constant of cane sugar was determined by Tollens and Schmitz, independently, water being the only solvent; they found the specific rotation of anhydrous cane sugar for the ray D to be 63·90°.

From the experimental results were derived the following interpolation formulæ for the calculation of the specific rotation of any given solution by putting in values for p percentage of sugar and q percentage of water, respectively.

a. For strong solutions containing from 18 to 69 per cent. of sugar:—

$$\{\alpha\}_D = 66{\cdot}386 + {\cdot}015035\,p - {\cdot}0003986\,p^2.$$
$$\{\alpha\}_D = 63{\cdot}904 + {\cdot}064686\,q - {\cdot}0003986\,q^2.$$

b. For weak solutions containing less than 18 per cent.:—

$$\{\alpha\}_D = 66{\cdot}810 - {\cdot}015553\,p - {\cdot}000052462\,p^2.$$
$$\{\alpha\}_D = 64{\cdot}730 + {\cdot}026045\,p - {\cdot}000052462\,q^2.$$

The specific rotation exhibited by an active substance in a solution of given composition is constant, and hence can be employed as a distinguishing characteristic of the substance, but in order that it may possess this value, it is indispensably necessary that along with the value of $\{\alpha\}$ the following data should be observed:—

1. The ray with which the observations have been made.
2. The nature of solvent used.
3. The percentage of active substance in the solution $= p$ or else the number of grammes in 100 cc. of solution $= c$.
4. The temperature of the solution at time of observation.
5. The direction of rotation + or −.

Hence for a mean concentration $c = 14$ grammes Schmitz and Tollens found the specific rotatory power of cane sugar at a temperature 17·5° to 20 C. for ray D to be 66·50, or $\{\alpha\}_D = 66{\cdot}5$, and this number is now, I think, generally acknowledged to be correct for all solutions of cane sugar of concentration from 5 to 15. For the transition tint O'Sullivan finds the value $\{\alpha\}_j = 73{\cdot}8$.

In calculating the specific rotatory power by the equation $\{\alpha\} = \frac{10^4}{l.c}$. if we let $l = 1{,}000$ millimetres and $c = 10$, then this equation becomes $\{\alpha\} = \alpha$, that is to say, the angle observed in 1,000 mm. tube of a 10 gramme per 100 cc. solution is the specific rotatory power of that substance. This O'Sullivan defines as "the angle through which the plane of polarisation of a given ray is rotated by passing through a layer 1,000 mm. in length of a solution containing 10 grammes dry substance in 100 cubic centimetres of distilled water."

In practice it is usual to take observations in a 200 mm. tube, and for $c = 10$.

Equation III. then becomes—

$$\{\alpha\} = \frac{10^4\,\alpha}{200\,c}.$$

$$\text{IV.} = \frac{100\,\alpha}{2\,c}.$$

Hence, in order to find the specific rotatory power of any active substance when in aqueous solution, we only require to know the values of α and c.

Now α is the deflection caused by the solution in 200 mm. tube when observed in the polarimeter, and c can easily be found from the specific gravity of the solution, for when 10 grams of pure dry cane sugar are dissolved in water, and further diluted until the volume exactly measures 100 cc., such a solution has been found to possess a specific gravity of 1038·6 (water = 1,000), hence 1 gram of cane sugar per 100 cc. has approximately a specific gravity of 1003·86, or weighs 3·86 degrees heavier than an equal bulk of water. If then we determine the specific gravity of any solution of cane sugar, subtract from this gravity 1,000, and divide the remainder by 3·86, we obtain the number of grams per 100 cc. of cane sugar contained in that solution. The specific gravity of other carbohydrates in solution has also been determined: thus maltose and dextrin in 10 gram per 100 cc. solution give a specific gravity of about 1039·68. This it will be seen is somewhat higher than that of cane sugar, whilst that of dextrose is on the other hand slightly lower. Hence it is evident that since the densities of the various carbohydrates in solution differ to a certain extent, the determination of the solid matter will be somewhat complicated when two or more such bodies are present in the solution. In consideration of this it has been thought advisable to employ one constant and unvarying divisor for the determination of the solid matter, and to which all specific rotatory powers may be referred. The divisor for cane sugar, 3·86, has been adopted for this purpose, and all the specific rotatory powers given in this paper have been calculated for this constant.

As we have already seen, for instruments where monochromatic light is used, the deviation is read off at once in angular degrees and tenths of a degree; but in the transition tint instruments the scale does not give angular measurements, but is reckoned in divisions, and is constructed thus:—for the Ventske-Scheibler, a tube 200 mm. in length, and filled with an aqueous solution of pure cane sugar, at a temperature of 17·5 C., and containing 26·048 grams per 100 cc., is placed in the instrument, and the point observed giving an exact neutral tint is marked as 100. The space between this and the zero point is then divided into 100 equal parts, and the graduation extended some way on either side.

When the specific rotatory power of a substance is to be determined with this instrument, it is necessary first to convert the reading observed as divisions into angular measurement, and then proceed to calculate the specific rotatory power by means of Equation IV.

Now O'Sullivan finds, taking the value of $\{\alpha\}_j$ for cane sugar as 73·8, that 100 divisions of this scale equal 38·4 degrees $\{\alpha\}_j$, that is to say, that a solution of cane sugar containing 26·048 grams, and which produces a rotation for the transition tint on the Ventzke scale to the amount of 100 divisions, would record on instruments having angular graduation a rotation of the same ray through an angle of 38·4, hence one division on the Ventzke scale equals ·384 degrees angular measurement.

O'Sullivan also finds that 10 grams of cane sugar per 100 cc. when observed in a 200 mm. tube in Ventzke-Scheibler instrument, gives a rotation = 38·4 divisions of the scale, therefore 1 gram = 3·84, and so for similar solutions of the other carbohydrates, 1 gram dextrin = 11·25 divisions, 1 gram maltose 7·81, 1 gram dextrose 2·96, 1 gram levulose — 5·52, 1 gram invert sugar — 1·23.

In the Soleil-Duboscq instrument the scale is so constructed that the 100 point is recorded by a solution in 200 mm. tube, and containing 16·35 grams per 100 cc. of pure cane sugar.

Consequently 100 divisions of this instrument =24 degrees angular measurement, or 1 division, ·24.

Ten grams per 100 cc. of cane sugar in 200 mm. tube give a reading on this scale of 61·5 divisions; and so for the other carbohydrates, dextrin = 18·00, maltose=12·50, dextrose=4·88, levulose= −8·83, invert sugar = −1·96.

From the numbers given above the specific rotatory powers of the various carbohydrates may easily be calculated. These are given in the following table for 3·86 divisor.

TABLE II.

SPECIFIC ROTATORY POWERS OF CARBOHYDRATES.

—	$\{\alpha\}_D$.	$\{\alpha\}_j$.	Readings for 1 Gram per 100 cc. in 200 mm. Tube.		
			Ray D Laurent.	Transition Tint.	
				Soleil-Ventzke-Scheibler.	Soleil-Duboscq.
Dextrin.......	+195·0	+216·0	+3·900	+11·25	+18·00
Maltose.......	+135·4	+150·0	+2·708	+ 7·81	+12·50
Cane sugar....	+ 66·5	+ 73·8	+1·330	+ 3·84	+ 6·15
Dextrose......	+52·88	+ 58·6	+1·057	+ 2·96	+ 4·88
*Levulose.....	−95·65	−105·98	−1·913	− 5·52	− 8·83
Invert sugar..	−21·30	− 23·6	−0·426	− 1·23	− 1·96

* Very recently Herzfeld and Winter (Ann. des Chemie **244**, pp. 274–295) find the value of $\{\alpha\}_D$ for pure crystallised levulose (C = 20) at 20° C. to be −71·4, but this number requires further confirmation, I think.

O'Sullivan in his later researches gives the values of α_j as deduced from actual weighed quantities of substance under examination. They are the real rotations of the given carbohydrates, and are not deduced from the specific gravities of the respective substances in solution referred to a 3·86 divisor. Thus he gives the specific rotatory power of dextrin 222 $\{\alpha\}_j$, but the proper divisor for dextrin already referred to is about 3·97, and if we reduce this to 3·86 we shall find that the specific rotatory power will also be reduced to 216. This is rather an important point to bear in mind, and so prevent any confusion or misapprehension in the calculation of analytical results.

And here I might take the opportunity of drawing your attention to the manner in which the specific rotatory power of the various carbohydrates have been referred to in some text-books and other works in connexion with brewing. In some dextrin is stated to have specific rotatory power $\{\alpha\}_j = 209$; in others several dextrins are stated to exist, all having different specific rotatory powers and cupric oxide reducing powers; whilst other authors mix up the values of α_j and α_D in a most hopeless manner.

Whenever the specific rotatory power of any substance is given it should be clearly stated whether the number given refers to the value for ray D or for the transition tint.

All the researches of English chemists have proved most conclusively that the dextrins, high and low, have, one and all, the same specific rotatory power when in solution, viz., 216 $\{\alpha\}_{j\,3\cdot86}$ and 195 $\{\alpha\}_{D\,3\cdot86}$, and that none of these dextrins of themselves have any influence whatever on Fehling's solution, that is to say, do not reduce alkaline copper solution.

It is sometimes desirable for purposes of comparison to convert the values given in the above table for $\{\alpha\}_j$ into $\{\alpha\}_D$, or *vice versâ*.

The factor for doing this may be found, for cane sugar for instance, thus—

$$\frac{\{\alpha\}_j}{\{\alpha\}_D} = \frac{73 \cdot 8}{66 \cdot 5} = 1 \cdot 1096.$$

for maltose—

$$\frac{154}{139} = 1 \cdot 1079.$$

for dextrin—

$$\frac{222}{200 \cdot 4} = 1 \cdot 10778.$$

We may take as the mean of these 1·108 as the nearest approach to correctness—

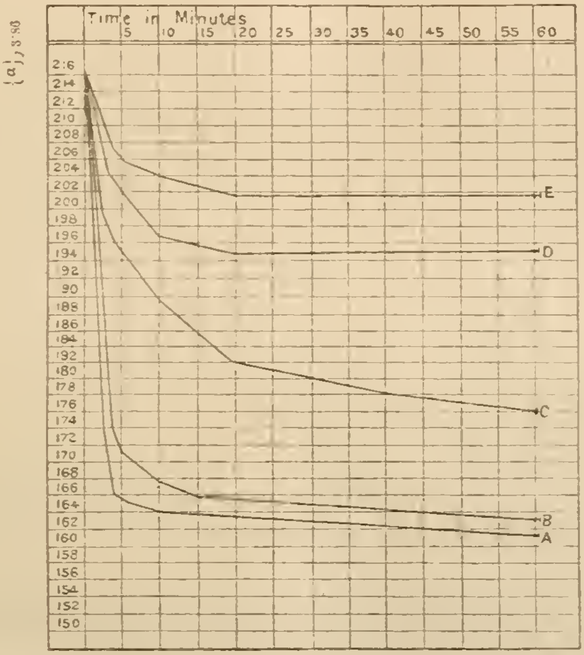
$$\{\alpha\}_D \times 1 \cdot 108 = \{\alpha\}_j.$$
$$\{\alpha\}_j \div 1 \cdot 108 = \{\alpha\}_D.$$

Part II.

Having described the principal forms of polariscope at present in use, and the scientific principles upon which they are constructed, we proceed now to consider the various applications of the polariscope to the different brewing processes, and we shall commence with the very first stage, viz., mashing.

Table III.

Table showing average Curves for Starch Transformations under Different Conditions.



A, transformations with unheated malt extract at 40°—50° C.
B, transformations with malt extract heated to 60° C.
C, transformations with malt extract heated to 66° C.
D, transformations with malt extract heated to 75° C.

In Table III. is given a diagram, taken from Brown and Heron's paper on starch transformations, showing the average curves for starch transformations made under different conditions. We are at once struck with this remarkable fact, that with the exception of the transformation at 66° C., the conversion of starch into dextrin and maltose, and the hydration of the higher dextrins into the lower seem to be almost completed by the end of the first 15 minutes, and for curve C there is a fall of angle of only 10° from 15 to 60 minutes, whilst for the first 15 the fall is three times as great.

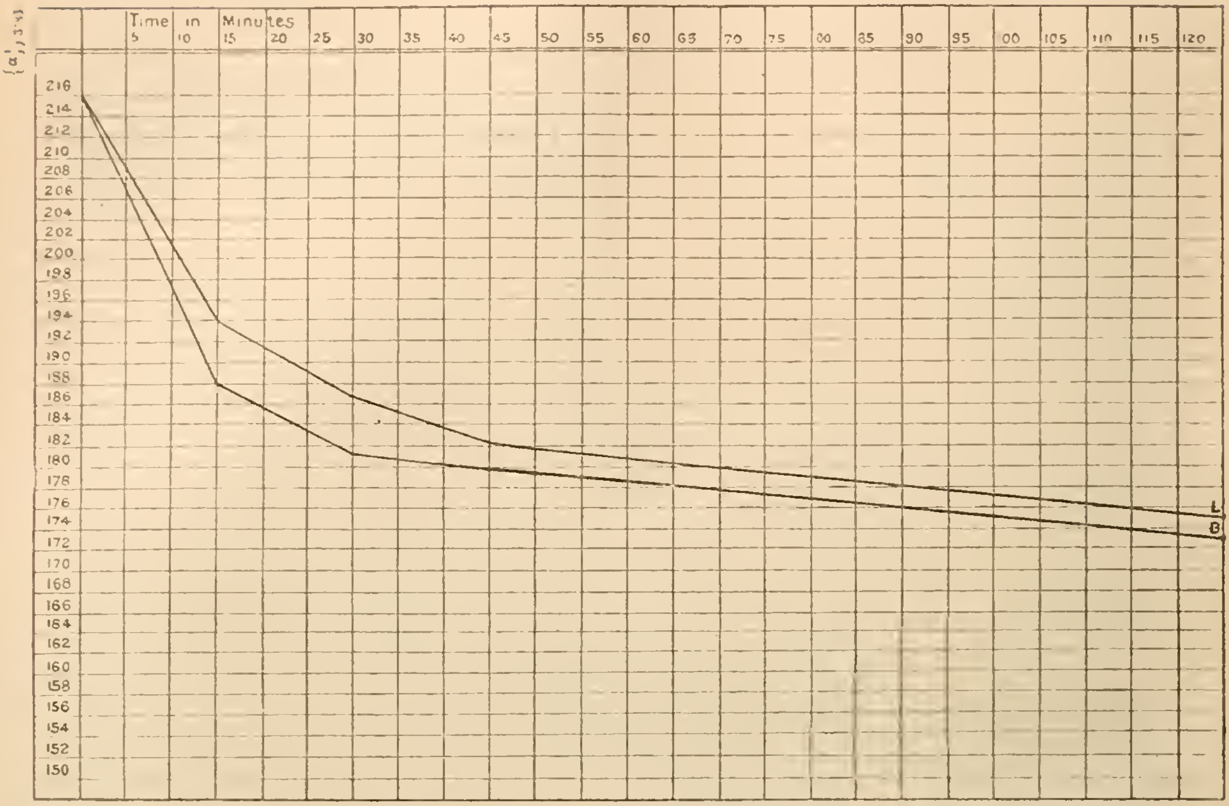
For purposes of comparison a series of polarisations of worts from malt mashed under similar conditions, (*a*) in the laboratory on the small scale, (*b*) in the brewery on the large scale, are given in Table IV. (*See next page.*)

Water at the rate of two barrels per quarter was used. Samples were drawn in both cases every 15 minutes from time of finishing mashing. The curves, as shown in Table IV., for the starch products calculated on 100 parts of dextrin maltose were obtained.

On comparing these with Brown and Heron's curve for starch transformations at 66°, we are at once struck with the great similarity which exists between the two, the nature of the curves are so much alike, a comparatively rapid fall during the first 30 minutes and slow and regular hydration proceeding afterwards, but only to a very slight extent, the difference in specific rotatory power between 30 minutes and 120 being only about 7° in each case, so that I think we may very reasonably conclude that the dextrin maltose ratio that is to obtain in the resulting wort is

TABLE IV.

TABLE SHOWING CURVES FOR STARCH TRANSFORMATIONS DURING MASHING.



L, mash in laboratory. B, mash in brewery.

Time, two hours. Water, two barrels per quarter of malt. Temperature, 66° C.

Temperature of mash 66° C. = 150·8° F.

practically decided during the first 30 minutes of mashing. On comparing the curve in Table IV. at 66° with those at higher and lower temperatures, it would appear curiously enough as if this temperature for mashing (and the one most generally employed) were just on the boundary line as it were, a few degrees higher than this, giving highly dextrinous worts, whilst a few degrees lower would give worts poor in dextrin, but rich in maltose. From this point of view it would appear that too much stress cannot be laid upon the initial temperature of the mash, and I think that the polarisation of samples taken, say, at 15 and 30 minutes from time of "piecing up" or of finishing mashing, would give much information as to the control of operations in the succeeding processes of sparging, fermenting, &c. of such a wort.

But in order to arrive at a more accurate knowledge of the relative amounts of dextrin and maltose in worts, it is advisable to polarise a sample taken from the copper after the wort has been boiling for some time. I am aware that it is or has been the practice with some brewers to polarise a sample of wort from the mash tun taken a certain time after setting the taps, but this cannot be relied on as furnishing constant results, as may readily be seen from the following tables, where are shown a few out of the many series of polarisations taken with a view to learn something of the effects of sparging under varying conditions.

Samples were taken from underback as under:—

TABLE V.

Barrels in Copper.	$\{\alpha\}_j$.	$\{\alpha\}_j$.	$\{\alpha\}_j$.
10	124·9	103·8	101·2
20	109·2	132·8	107·5
30	113·5	110·1	104·8
40	100·5	106·5	102·3
50	101·2	125·4	101·2
60	100·8	127·3	100·0
90	120·4	139·3	86·1
L. R.	101·8	..	89·1

A much more reliable, in fact I might say perfectly reliable result, is to be obtained from the polarisation of the wort after being boiled with hops in the copper. By the time the wort has reached this stage, the diastase has exerted its full force in the mash tun. During the boiling a very large proportion of the albumens have been precipitated, and the dextrins, high or low, in the series have been fixed, so that the wort at this stage will afford a very good index as to the dextrin percentage of the beer produced from it.

Boiling with hops removes a portion of the albuminoids, whilst a small quantity of hop extract is added; at the same time a slight alteration occurs in the carbohydrates other than those derived from the starch, probably being the inversion of a part of the still unacted on cane sugar by the acid of the wort at boiling temperature, but practically the actual composition of the starch products in the wort are unaltered by boiling with hops.

Where some form of glucose or saccharine is used in the brewing, it is obvious that for purposes of analysis the sample of wort must be taken from the copper before such sugar is added

The sample, about one pint, is cooled down to 60° F., a drop or two of finings are added, stirred well up, let lie 15 minutes or more, and filtered. The filtrate is generally bright, but too dark in colour for polarising. This may be got over by diluting to one-half, or one-fourth, with distilled water, or by decolorising by means of lead acetate and animal charcoal.

The tube is then filled with the decolorised wort, placed in the polariscope, and the deviation read off in angular degrees or divisions, as the case may be. At the same time the specific gravity of the wort is taken preferably by means of the bottle, but for all practical purposes the gravity as given by a delicately-constructed saccharometer, such as Long's gravimeter, will be near enough. The specific gravity — 1,000 divided by 3·86 gives the number of grams of solid matter per 100 cc. of wort, and we then proceed to calculate the specific rotatory power by means of the formula—

$$\{\alpha\} = \frac{100\ \alpha}{2\ c}.$$

For instance, a sample of wort, sp. gr. = 1046·1, containing 11·943 grams solid matter per 100 cc., gave a rotation $\alpha_D = 28{\cdot}4$,

$$\text{therefore } \{\alpha\}_D = \frac{100\ \alpha}{2\ c} = \frac{100 \times 28{\cdot}4}{2 \times 11{\cdot}943} = 119{\cdot}0.$$

This is the specific rotatory power of this wort for ray D, or with the transition tint, using a Soleil-Ventzke-Scheibler instrument.

Deflection in 200 mm. tube = 82.

$$\alpha_j = 82 \times {\cdot}384 = 31{\cdot}488$$

$$\therefore \{\alpha\}_j = \frac{100 \times 31{\cdot}488}{2 \times 11{\cdot}943} = 131{\cdot}8.$$

Now this number, looked at by itself, is perfectly meaningless, but if viewed in conjunction with other factors, is capable of throwing a great deal of light not only upon the diastatic activity of the malt, but upon the behaviour of the fermentation as well as the composition of the finished beer. For instance, if we have two worts brewed under exactly similar conditions, but from different malts, and we find that one polarises higher than the other, then we may reasonably conclude that one of these worts contains more dextrin and less maltose than the other, that is to say, the malt from which it was brewed possesses less diastatic power than the other. For example, of two malts A gave $\{\alpha\}_D = 122{\cdot}7$; B, a later malt, gave $\{\alpha\}_D = 115{\cdot}0$. The beers (pale ales) from these malts on being analysed just after racking had the following composition calculated in per cent. on original wort matter:—

	Matter Fermented.	Maltose.	Dextrin.	Undetermined.	$\{\alpha\}_D$.
A	53·7	15·0	20·7	10·6	122·7
B	65·1	12·4	12·1	10·4	115·0

It will be observed that B has a much lower specific rotatory power than A, consequently the beers from B will be less dextrinous than those from A. Analysis shows this to have been the case. During fermentation also, B, the one containing the more maltose, attenuated more rapidly than A, and to a lower degree.

In order, therefore, to produce a beer from B as nearly similar as possible to A, the mashing temperature for B must be raised until we find the worts from copper polarise same as A, when it will be found that the resulting beers will partake of the same character, more or less, as those of A. Hence it will at once be perceived that by means of the polariscope we have perfect control over our mashing heats, and necessarily over the fermentations and the character of the finished beer. This is all very well when we have to deal with the malt in the mash tun or the wort in the copper, but I think a brewer ought not to be satisfied only with the information afforded him by observations in the polariscope at these stages alone. I think he ought to have some idea of the constituents of his malt before ever he begins to mash with it; and not only so, but he ought to know as well what kind of wort and beer that malt is going to turn out. From the many analyses of malts which have come under my notice from time to time I assert that it is impossible to arrive at any definite conclusion as to those required conditions.

And, if you will pardon me for doing so, I shall here make a slight digression and proceed to criticise the present methods of malt, wort, and beer analyses before bringing under your notice a method which I believe will be found to fulfil the necessary conditions, namely, which will show the several constituents of malt and malt wort, as well as give an idea at the same time as to the relative diastatic activity of such a malt.

In a paper on Dextrin-Maltose, read before the Society of Arts by Valentin in 1876, some analyses of malt are there given, made by O'Sullivan, and in which mention is made of certain carbohydrates other than starch as being present in malt, amounting to as much, in some instances, as 20 per cent., and, in a letter which appeared in the *Brewers' Journal* for September 15, 1878, on the analysis of malt worts and beer by means of the polariscope, Valentin says: "Malt appears to yield some products other than the maltose and dextrin yielded by starch alone . . . . These carbohydrates, moreover, have not yet been examined, and until they have been investigated, all attempts at a polariscopic determination of the composition of malt worts would appear hopeless."

This question, although undoubtedly of immense practical importance, appears to have had little attention bestowed upon it up to the present, by public analysts or by the great majority of brewers' chemists; for in most of the analyses of malt and malt worts which have been published I fail to find any reference whatever to the direct determination of any carbohydrates other than maltose and dextrin;

and, indeed, if we may judge from the methods as laid down for the analysis of malt and malt worts in the various manuals or text-books on the chemistry of brewing published within the last few years, the presence of those other carbohydrates seem to be ignored altogether, the polariscope cast on one side as useless, and a method for estimating dextrin and maltose recommended which might certainly have served a useful purpose many years ago, but must be looked upon at the present day as anything but accurate.

The method for the analysis of malt worts, as given in the leading text-books on brewing chemistry to-day, and which I have reason to believe is the method adopted by most brewers' chemists as well as by public analysts, is as follows:—

It is first assumed that no other carbohydrates than maltose and dextrin are present which possess optical activity or reduce Fehling's solution; the reducible sugars are then estimated by Fehling's solution (volumetrically) and stated as maltose; a fresh portion of the wort is then boiled on the sand bath for four hours or longer with considerable excess of either sulphuric or hydrochloric acid; at the end of this time it is assumed that the *whole* of the maltose and dextrin is converted into dextrose, which is then determined by Fehling's solution (volumetrically), and from these numbers the relative proportions of maltose and dextrin are calculated; the sum of these, plus the albuminoids and ash, are subtracted from 100, and the remainder (there generally is a remainder) put down as intermediate carbohydrates.

In the letter already referred to, Valentin points out the great inaccuracy attached to the above method, and refers to several experiments which gave extremely discordant results.

In their paper on the Transformations of Starch, Brown and Heron, in 1879, drew attention to the presence of certain carbohydrates in cold-water malt extract, and from the changes which this liquid underwent when subjected to a temperature of 50° C. for a few hours, they inferred that malt worts, in addition to the maltose and dextrin derived from the starch during the process of mashing, also contained maltose, cane sugar, dextrose, and levulose, and probably other carbohydrates derived immediately from the malt; and, in consequence of those changes brought about in malt extract by heat, insist upon the great importance in all experiments on the transformations of starch of digesting a duplicate sample of the malt extract under identically the same conditions of temperature, and for the same length of time as the transformation liquid itself, and of applying to the latter the corrections obtained by an examination of this duplicate sample. These carbohydrates have been further studied by Kjeldahl (Carlsberg Laboratory Report, 1881, p. 193), and later by O'Sullivan, who, in a paper on the Sugars of some Cereals, read by him before the Chemical Society, December 3, 1885, finds that malt may contain from—

2·8 to 6·0	per Cent.	Cane sugar.
1·3 to 5·0	„	Maltose.
1·5 to 3·0	„	Dextrose.
0·7 to 1·5	„	Levulose.

and in all probability very small quantities of other carbohydrate bodies possessing different cupric oxide reducing and specific rotary powers to any of the preceding.

Now, with a knowledge of these facts before us, it would appear at first sight that a complete and correct analysis of malt wort is an operation well nigh impossible of achievement, and I freely admit that, even with our present knowledge, it is a matter of some difficulty, and for all practical purposes, after it were done, would hardly repay the trouble; but I do maintain that it is absolutely essential that a brewer should have a correct idea of the relative amounts of maltose and dextrin in his worts, as well as the total amount of those other carbohydrates, and if these can still further be differentiated into fermentable and non-fermentable so much the better. And whilst on this subject I may say that a knowledge of the soluble nitrogenous constituents, so far any way as it is possible to distinguish the albuminous from non-albuminous, would also be desirable.

Not only is the present method of analysis inaccurate, but many errors are liable to be introduced in the course of each experiment.

As a general rule the cupric oxide reducing power by means of Fehling's solution is usually determined volumetrically; in my opinion the gravimetric method as described by O'Sullivan is much more accurate, and if carried out implicitly according to his instructions, gives absolutely concordant and reliable results. In this opinion I am confirmed by the later researches of O'Sullivan, Brown, Morris, and others; more recently by E. W. T. Jones, in a paper read by him before the Society of Public Analysts, 1887.

When malt worts, beer, or in fact any liquid containing a small proportion of colouring matter or nitrogenous substances in solution is heated for any length of time with such a quantity of sulphuric or hydrochloric acid as is necessary to convert the dextrin into maltose or dextrose, these nitrogenous and other substances are attacked by the acid and broken up into less complex bodies, giving rise at the same time to brown humus-like substances, which I have every reason to believe exert a certain action on Fehling's solution. But we have also present in malt worts, besides maltose and dextrin, cane sugar, dextrose, levulose, and other bodies, and it is a well-known fact that if dextrose or levulose, but more especially the latter, be heated for any length of time with excess of mineral acid, they are more or less decomposed, being split up into organic acids and humus substances possessing no cupric oxide reducing power or optical activity.

On the other hand, if we do not use enough acid we run the risk of not converting the whole of the dextrin and maltose into dextrose. For instance, Brown and Heron have found that when a solution containing about 5 grams of maltose per 100 cc., to which was added 5 cc. $\frac{1}{5}$th dilute sulphuric acid per every 100 cc., was heated at a temperature not exceeding 80°—90° C., at the end of eight hours not quite one half of the maltose had been converted, and not until the digestion had been carried on for about 50 hours was the conversion complete. Kjeldahl finds that one gram of maltose in 100 cc. of water requires for its complete conversion to be heated for two hours with at least 5 cc. concentrated hydrochloric acid, whilst levulose requires only $\frac{1}{2}$ cc. of acid. It is reasonable to suppose that if one gram of maltose requires 5 cc. of concentrated acid, one gram of dextrin would require more than that quantity.

In order to determine the relative action of the same volume of sulphuric acid on cane sugar, dextrose, and a mixture of maltose and dextrin, I digested with acid on the sand bath for a period of four hours according to the method given by Jones in his paper already referred to, one gram in solution of these substances as under: 10 cc. of each solution containing about 1 gram of solid matter were placed in 100 cc. flasks, 16 cc. standard sulphuric acid added, the bulk made up to about 70 cc. in each case, and the liquid heated on the sand bath until it just began to boil. The digestion was carried on for four hours at this temperature, water being added from time to time to make up for any lost by evaporation. At the end of that time 16 cc. normal sodic hydrate solution were added to each flask, and the volume of liquid, after cooling to 60° F., made up to 100 cc. The CuO was determined gravimetrically, the solutions were also polarised.

It was found on analysis that 100 parts of cane sugar yielded 97·84 per cent. dextrose; theory requires 105·26.

100 parts of dextrose yielded 96·00 per cent. dextrose; theory requires 100.

100 parts dextrin and maltose (17 maltose and 83 dextrin) yielded 98·00 per cent. dextrose; theory requires 110·06.

The results in tabular form are as follows:—

TABLE VI.

	Dextrose.		
100 parts cane sugar yield	105·26,	found 97·81,	loss 8·45
" dextrose	100·00	" 94·00	" 4·00
" maltose and dextrin .	110·06	" 98·00	" 12·06

In the case of the cane sugar and dextrose there can be no doubt about it that the levulose and dextrose have both been acted upon by the sulphuric acid to the extent indicated, being split up into humus and other substances, whilst in the case of the dextrin it seems very probable that the whole of it had not been acted upon in the given time; and it is really those substances, the results of the decomposition of the cane and invert sugars (which are present in all malt worts), that by prolonged boiling with excess of mineral acids give rise to the very vague and rather dubious term "intermediate carbohydrates."

I should hardly have troubled you by referring to this term at all, but that it occurs again and again in published analyses of worts and malt, and as recently as last September I find in the *Brewers' Journal* the following note on this subject.

ANALYSIS OF MALT WORT.

82½ per cent.	of combined sugars (maltose and dextrin).
6½ " "	soluble albuminous matter.
1½ " "	ash, and
9½ " "	intermediate carbohydrates.

Then the writer goes on to say:—

"Now what does such carbohydrate consist of? By common agreement we may say it refers to matter in an intermediate condition of change; it is neither starch nor sugar, nor is it readily hydrated under the influence of acid, while, strange enough to relate, it seems to be readily hydrated under diastatic influences if previously modified under the combined action of air and heat . . . . We are nearly certain that these intermediate carbohydrate bodies not only interfere with spontaneous and artificial clarification of beer, but are apt to subside from solution during the lengthy storage of beer."

With regard to the determination of maltose and dextrin in beer, Bungener (*Moniteur Scientifique, Sept.* 1882) says that "in the present state of chemical knowledge these substances can only be determined approximately. Besides these beers contain ill defined carbohydrates, the reducing and rotatory powers of which are unknown, not to speak of other substances which, in all probability, likewise influence the several reactions. The determination of the above two substances also gives very different results according as the polariscope or Fehling's solution is used."

"Whatever may be the method employed the results are at best inexact, and have a relative value only when the same process is adopted in every case."

Now I first of all object to the term "intermediate carbohydrates," for by this term evidently the writer infers that there result from the transformations of starch by diastase or acid, other bodies than dextrin, maltose, and malto-dextrin, occupying a position somewhere between starch and maltose, but the whereabouts has not yet been determined. I think recent researches, especially those of O'Sullivan and Brown and Morris, have most conclusively proved that no such bodies are or have ever been formed during the transformation of starch.

How, then, such bodies can be present in malt worts, I leave to the originators of that term to explain.

It has been the general custom until within the last few years to heat the wort or saccharine solution with the sulphuric acid in sealed tubes to high temperatures for 3 to 6 hours in an oil bath, and I even find that in certain text-books this method is still recommended.

The experiments tabulated below will show the utter unreliability of this process.

Some white American glucose was dissolved in water, 3 per cent. of strong sulphuric acid added, and the mixture heated under pressure to a temperature of 160° C. Samples were drawn at stated intervals, neutralised with barium carbonate, filtered, and analysed with the following results:—

TABLE VII.

RESULTS of ANALYSIS of HEATING Commercial GLUCOSE with 3 per cent. H_2SO_4 at 160° C.

—	$\{\alpha\}_j$.	K.	Dextrose.	Maltose.	Inert Matter.
Before action ...	86·9	97·3	65·6	32·3	2·1
After 5·0 minutes	59·6	83·1	77·3	9·5	13·2
" 20· "	53·7	85·8	80·0	2·8	17·2
" 60· "	40·5	67·6	63·3	0·7	36·0

If then we take such a liquid as malt wort, containing in solution in grams per 100 cc., maltose 4 to 5 parts, dextrin 1 to 3, other carbohydrates (consisting principally of partially-inverted cane sugar) about 1·5 to 2·0, and having added a certain percentage of acid, heat it for a given number of hours, 2, 4, or 8, as the case may be, either under pressure or not, we shall find, on careful examination, that a certain proportion, if not all, of the levulose originally present has entirely disappeared, and that probably we may have some unaltered dextrin and maltose still present, while the dextrose may or may not have undergone some slight alteration. This is a most unsatisfactory state of things, and the question now arises, is it possible to obtain a more accurate method? I venture to suggest that it is, and that it may be done by means of the polariscope.

To Mr. C. O'Sullivan, who was the first to place scientific brewing in England on a sound basis, belongs the credit of having made it possible by means of his long and laborious investigations on starch and sugars of the cereals, for reliable and trustworthy analyses of barley, malt, worts, and beer, to be made by means of the polariscope, combined with Fehling's solution, and it is my pleasing endeavour to bring before you to-night a method for the analyses of malt and worts founded upon the researches of O'Sullivan, Brown, and others, and which I trust may meet with your favourable criticism.

For the analysis of malt, the method of procedure is as follows:—25 grams of malt are digested at ordinary temperature for three hours with 250 cc. of cold water, shaking well up at intervals. At the end of that time the mixture is filtered, care being taken that the filtrate is perfectly bright. This constitutes the cold-water extract, and 100 cc. of this solution will contain the carbohydrates other than starch, as well as the albuminoids, ash, &c. soluble in cold water, derived from 10 grams of malt. Next, 50 grams of same malt are added to 400 cc. of water at a temperature of 68° C., the temperature of resulting mash being about 61°—63° C., which soon runs up to 65°—66° C., at which temperature the mash is maintained for one hour. At the same time 100 cc. of the cold-water malt extract are digested at the same temperature—66° C.—for the same length of time. For the last 5 minutes the temperature is raised as quickly as possible to 70° C.; the malt mash is then cooled to 60° F., the volume made up to 515 cc., and filtered quickly: 100 cc. of the filtrate contain the extract of 10 grams of malt. 300 cc. of this filtrate are taken and steadily raised to boiling point, and kept gently boiling for 15 minutes, cooled, made up to volume, and filtered. In the mean time the cold-water malt extract which was digested same time as mash at 66° C. is quickly raised up to the temperature of boiling water in the digester, and then boiled for 5 minutes, cooled, and filtered. The filtrate from the hot mash contains the starch products, plus the other carbohydrates, albuminoids, ash, &c. Next, the specific gravity—optical activity in 200 mm. tube (the liquid being undiluted, or diluted one-half if necessary, or decolorised by some means or other), and cupric oxide reducing power by means of Fehling's solution (gravimetrically) are determined for both the hot and cold water mashes after they have been prepared for analysis.

The results of analysis of the hot mash are corrected for the cold-water malt extract bodies, and by this means we obtain by an easy calculation the amount of maltose and dextrin in the hot mash, and hence the amount of starch present in the malt. We also are able to form an opinion of the relative diastatic power of the malt under examination, and from the analysis of the cold-water malt extract to get a very approximate idea of the quantity of cane sugar and other carbohydrates there present. An example will more clearly illustrate this:

MALT.

Cold water mash, 10 grams malt per 100 cc.

Sp. gr. = 1007·79. 1007·79 − 1000 = 7·79 ÷ 3·86 =
Solid matter per 100 cc. = 2·0187.
Optical activity 200 mm. = 1·4 = a.
CuO per 100 cc. = 1·2615.

Hot mash, 10 grams malt per 100 cc.

Sp. gr. = 1028·16.

Solid matter per 100 cc... =	7·2950
Correction for C.W.M.E...	2·0187
Starch products per 100 cc.....	5·2763

Optical activity 200 mm....=	17·3
Correction.................	1·4
Deflection due to starch products....	15·9

CuO per 100 cc.. .... =	6·5125
Correction........... =	1·2615
CuO per 100 cc. due to starch products..	5·2510

1 gram dextrose = 2·205 grams CuO.

Therefore 1 gram maltose = $2{\cdot}205 \times \frac{\cdot 61}{100} = 1{\cdot}345$.

$5{\cdot}251 \div 1{\cdot}345$ or $\times \frac{1}{1{\cdot}345}$ (= ·743) = 3·9015 grams maltose per 100 cc.

And 3·9015 × 2·708 = 10·56 = deflection due to maltose, since 1 gram maltose in 200 mm. tube in Laurent's polarimeter causes a deviation of 2·708 degrees = a.

Total deflection corrected. =	15·9
Deflection due to maltose. =	10·56
Deflection due to dextrin...	5·34

5·34 ÷ 3·9 (deflection for 1 gram dextrin in 200 m. in Laurent's polarimeter = 3·9) = 1·370 grams dextrin per 100 cc.

Therefore 100 grams malt after mashing yield—

39·01 maltose.
13·70 dextrin.

So far so good. Now let us see if we can by any means obtain some idea of the relative quantities of cane sugar, maltose, dextrose, and levulose present in the cold-water extract. I have already referred to the fact that O'Sullivan found that all malts contain these sugars in varying proportions. As the mean of his experiments I find the following percentages for these bodies:—

Cane sugar.........................	4·4
Maltose............................	3·15
Dextrose...........................	2·25
Levulose...........................	1·10
Total......................	10·94

Now we may reasonably suppose that a small portion of the cane sugar undergoes inversion during the mashing process, so that we may assume that the cupric oxide reducing power of the carbohydrates of malt other than those derived from the starch is 75, or thereabouts, and I find the specific rotatory power for the same bodies to be for—

$\{\alpha\}^{D} = 75^\circ$, 1 gram per 100 cc. in 200 mm. tube gives a reading of 1·50 degrees.

Hence if K = 75, 1 gram reduces 2·205 CuO × $\frac{75}{100}$ = 1·146.

So that if we divide the CuO per 100 cc. of the cold-water malt extract by 1·146, or multiply it by $\frac{1}{1{\cdot}146} = {\cdot}606$, we get the amount of sugars present which reduce Fehling's solution. Hence in the present instance—

1·2615 × ·606 = ·7644 grams reducing sugars per 100 cc. C.W.M.E., and

·7644 × 1·5 ($\{\alpha\}_{D} = 75^\circ$) = 1·146, 1·4 − 1·146 = ·254 deflection due to the non-reducing sugar present in C.W.M.E., which must undoubtedly be cane sugar, hence

$\frac{\cdot 254}{1{\cdot}33} = {\cdot}191$ grams cane sugar per 100 cc.

therefore 2·0187 grams C.W.M.E. contain

$\left\{\begin{array}{l}0{\cdot}7644 \text{ grams reducing sugars} \\ 0{\cdot}1910 \text{ grams cane sugar } \ldots\ldots\end{array}\right\} = {\cdot}9554$ grams total sugars.

2·3187 − ·9554 = 1·0633 grams albuminoids, ash, moisture, &c.

Calculating out the above results in percentages on the malt, we have—

100 grams malt contain—

Maltose	39·01
Dextrin	13·70
M.E. carbohydrates	9·55
Albuminoids, &c.	10·64
Insoluble (grains, &c.)	27·10
	100·00

An analysis of the same malt was made by the inversion method.

The total cupric oxide per 100 cc. determined in the hot mash amounted to 6·5125 grams. This calculated out as maltose equals 4·8387 grams maltose per 100 cc. 20 cc. of this wort were then digested for four hours on the sand bath with 16 cc. normal H_2SO_4, after being first diluted to about 70 cc. and kept at that volume during time of digestion. At the end of four hours the CuO was again determined; this gave 15·0728 grams per 100 cc.

Which calculated as dextrose = 6·8279.

The maltose already found = 5·0938 dextrose.

Therefore 6·8279 − 5·0938 = 1·7341 dextrose due to inverted dextrin = 1·5606 grams dextrin per 100 cc. Calculating these numbers as percentages on the malt, we get—

Maltose = 48·38

Dextrin = 15·60.

These numbers calculated in percentages on total wort matter give for—

—	Inversion Method.	Polariscope Method.
Maltose	66·3	53·5
Dextrin	21·4	17·4
M.E. carbohydrates	..	13·1
Albuminoids, &c.	12·3	19·8

It will at once be seen what a marked difference exists between the two results, and I think the inevitable conclusion must be that of the two the polariscope method is the most reliable and accurate.

A mash was made on the large scale in the brewery with this malt, and samples of wort from the copper and of the finished beer were taken and analysed as follows:—

Wort from Copper.

Sp. gr. = 1058·4

Solid matter per 100 cc. = 15·1295

Optical activity 200 mm. = 33·4

CuO per 100 cc. = 12·955

Now in order to obtain corrections for the malt extract bodies so as to arrive at the relative amounts of maltose and dextrin present in these worts, all we have to do is to apply the corrections as for our experimental mash in the laboratory, due allowance being made for increased gravity thus:—

$$15·1295 \div 7·295 = 2·074$$

the factor for multiplying the corrections for M.E. as found in experimental mash.

I am aware that these corrections are not *absolutely* correct, as the saccharine matter of the worts exert a slight solvent influence on the insoluble albuminoids, so that there would be a very slight increase in these bodies in the wort produced in the brewery; but from experiment I find that this does not influence the analysis to any very appreciable extent.

The numbers for calculating the dextrin and maltose after applying corrections, stand thus:—

Opt. act. 200 cc.	33·4
Correction	2·9
Deflection due to starch products	= 30·5

CuO per 100 cc.	= 12·956
Correction	= 2·6163
CuO per 100 cc. due to starch products	= 10·3397

10·3397 × ·743 = 7·6824 maltose.

$$7·6824 \times 2·708 = 20·8. \quad 30·5 - 20·8 = \frac{9·7}{3·9} = 2·4872 \text{ dextrin.}$$

·955 M. E. carb. × 2·071 = 1·9815.

Hence—

Maltose, per 100 cc.	= 7·6824
Dextrin	= 2·4872
Other carb.	= 1·9815
	12·1511

15·1295 − 12·1511 = 2·9784 albuminoids, &c.

Calculated out on percentages of dry matter, we have—

	Per Cent.
Maltose	50·7
Dextrin	16·4
M. E. carb.	13·1
Other matters	19·8
	100·0

Analysis of Finished Beer.

Sample taken from cask two days after racking.

Original Gravity.

Distillate 992·2

Spirit indication = 7·8

Residue 1017·98

Degrees of gravity lost deduced from spirit indication 32·70 = 8·4715 grams solid matter fermented per 100 cc.

Original gravity = 1050·68 = 13·1295 grams solid matter per 100 cc.

Opt. act. 200 mm. = 9·6.

CuO per 100 cc. = 1·7185 grams, as maltose = 1·27684 grams.

1·27684 × 2·708 = 3·45 deflection due to maltose.

9·6 − 3·45 = 6·15 deflection due to dextrin.

6·15 ÷ 3·9 = 1·5513 grams dextrin per 100 cc.

Calculated in per cent. on original wort matter—

Maltose, unfermented =	9·7	Corrected for sugar =	12·9
Dextrin ,,	11·8	,,	15·7
Matter, fermented	64·5	,,	52·7
Undetermined	14·0	,,	18·7
	100·0		100·0

⁂ This method of analysis for beer, which was first introduced, I believe, by O'Sullivan, is an exceedingly neat and accurate method, and is now adopted in a good few laboratories throughout the country.

But as one-third invert sugar was used in this brew, we must correct the figures in the first column for this by increasing them by one-third, when we get numbers which we can compare with those obtained for the analysis of the wort, both brewery and laboratory samples. This is shown in the following table:—

TABLE VIII.

..	Malt.	Wort.		Beer.	
Maltose..........	53·5	50·7	67·1	12·9	81·3
Dextrin..........	17·4	16·4		15·7	
Malt extract ..... Carbohydrates ...	13·1	13·1		None	
	..	..		Matter fermented 52·7	
Albuminoids, &c. .	16·0	19·8		18·7	
	100·0	100·0		100·0	
$[\alpha]_D$ found.......	118·5	110·3		..	
$[\alpha]_D$ calculated...	116·0	109·2		..	

Now, if we add together the maltose and dextrin in column 2, and subtract the sum of these from the sum of the maltose, dextrin, and fermented matter in column 3, the difference ought to equal the malt extract bodies which have fermented, thus:—

$$81·3 - 67·1 = 14·2$$
$$\text{and } 19·8 - 18·7 = 1·1$$
$$\overline{13·1}$$

If therefore we wish to make a complete analysis of malt wort, we can do this in two ways: 1st, by determining the solid matter, optical activity and CuO per 100 cc. of the cold water extract of 10 grams per 100 cc. of malt, the filtrate having first been digested at the mashing temperature for one hour, and using the numbers so obtained as corrections for the malt extract bodies in the worts from copper. By this method we obtain the quantities of maltose, dextrin, malt extract carbohydrates, and albuminoids, &c. present in the wort; 2nd, making an analysis of the finished beer, correcting for sugar of any kind, if such has been added. This will give us approximately the relative amounts of dextrin and total fermentable sugars in the wort, but in practice I much prefer the first method, as we are able to determine sufficiently accurately the starch products and other bodies present.

It is true that O'Sullivan has introduced a most excellent method for estimating starch in barley, malt, and other cereals, but for a brewer's purpose I think it is essential that a knowledge of how that starch splits up into dextrin and maltose during mashing, or, in other words, the maltose-dextrin ratio of each particular sample of malt should be obtained, and if the cold and hot water mashes in the laboratory be always carried out under identically the same conditions, a comparable set of results are obtained from which some very useful information may be gathered, more especially if analyses of the resulting worts and finished beers be also made in the manner laid down.

There are many other determinations to which the polariscope might be applied in connexion with brewing, which no doubt will readily suggest themselves to any brewer who once takes it up; but I feel I have already trespassed far too much on your time and patience. In conclusion, I desire to thank those friends who have helped me in many ways towards the preparation of this paper by experimental mashes in the brewery, the results of a very few of which I have only been able to find space for, as well as those gentlemen who have kindly lent those polariscopes and apparatus which have so usefully helped to illustrate the first part of this paper.

DISCUSSION.

The CHAIRMAN said that several gentlemen were present who had great experience in brewing; and as Mr. Heron's valuable paper opened up a wide field for discussion, he hoped that they would take part in it.

Mr. A. SHEARER wished to ask Mr. Heron within what limits he considered the factors used for converting specific gravity into weight of solid matter to be constants? He could not himself say much about cane sugar factors; but he was led by certain experiments he had made upon glucose and malt extract to consider that a factor could not be considered constant when there was any great difference in the specific gravities. For liquids that did not vary much in specific gravity a factor might be considered approximately constant, but it was really only so for one particular gravity. This constant was always turning up, not only in relation to polariscope determinations, but also in valuations of glucose and of malt. He had found that, with respect to the valuation of glucose, it was not a matter of indifference whether one took, say, 30 grams, and dissolved it up to 100 cc., or 60 grams, and dissolved it up to 100 cc. A very appreciable difference would result; for 30 grams, though half the weight of 60 grams, did not give exactly half the effect in specific gravity: in other words, the specific gravities found were not exactly in the ratio of the weights taken. The same might be said of malt extracts. The determinations of malt extracts would vary in accordance with the dilution. A difference of as much as 4 lbs. per quarter of malt might be found for the same sample, accordingly as it was made from a dilute solution or a concentrated solution. The question of dilution had so far been left to the will of the operator, and had not been dealt with by the text-books. In a brewery the laboratory experiments must necessarily be made on solutions more dilute than in actual practice, and therefore a higher result was usually obtained in the laboratory than in the brewery. The method involving the employment of a factor was much easier to use than direct determinations, but as O'Sullivan had not deduced his latest results from specific gravity factors, but from direct weights, he would like to know whether Mr. Heron had determined within what limits it was possible to use any factor as a constant.

Dr. W. S. SQUIRE had had considerable experience in the use of the polariscope in order to determine the composition of worts. For this purpose he had generally used the Soleil-Ventzke-Schiebler instrument. He had found it impossible to get absolute results, because the factor 3·86 did not apply to anything except a solution of maltose and dextrin prepared from pure starch. In the case of worts a number of other matters went into solution, and affected the specific gravity to such an extent that the factor 3·86 became quite misleading, and rendered anything like an absolute analysis impossible. Mr. Heron had endeavoured to get over this difficulty in a very ingenious way. He first treated the malt with cold water, and he took the specific gravity of that solution, and he deducted that from the specific gravity of the wort obtained by mashing at the usual temperature. The difference was assumed to be due to the maltose and dextrin formed by the action of diastase on the starch gelatinised at the higher temperature. This reasoning would be quite sound if it could be shown that exactly the same quantity of matter (other than the products of the action of diastase on starch) went into the solution, whether the malt was treated with hot or cold water, but this was open to doubt, to say the least. Then it would have to be shown that the cold malt extract was free from starch products. Now Mr. Heron himself, in conjunction with Mr. Brown, pointed out some years back that although the starch granule resisted when unbroken, or ungelatinised, the action of diastase, yet, when the starch granule was broken, it was acted upon in the cold, almost as quickly as gelatinised starch at a higher temperature. In the crushing or grinding of the malt some of the granules would be broken, would be converted even cold into maltose and dextrin, and evidently would affect the results. Even if these difficulties could be overcome, the method could only be applied to pure malt worts, and would be almost useless in the case of distillers' worts. With such worts he had found that the most that could be done was to get comparative results. It did not matter much what factor was used, for none were accurate. In most cases he had used 4·0 rather than 3·86, as being both easier and probably nearer the truth. It had been mentioned that unfermentable bodies, other than dextrin, were formed under certain circumstances. That was so. In those distilleries where acids were used to effect the conversion of the starch, particularly where acids were used in considerable quantity, it might be expected that the fermentation would be very complete. No doubt it would be so, if nothing but dextrose were produced. As a matter of fact, the fermentation was often, indeed generally, very bad. A wort of sp. gr. 1,010 instead of "going to water," *i.e.*, 1,000, would sometimes stick at 1,007 or thereabouts, and this was due to the production of unfermentable starch products by the action of the acid. Obviously these would interfere with the delicate sp. gr. operations on which the determination of maltose and dextrin depended. Although these figures indicated that at least 15 per cent. of the starch had been converted into unfermentable bodies, the produce of spirit by this method was nevertheless very good. He had often observed in the sparges the variation in rotary power exhibited by Mr. Heron's figures on the blackboard. It was due to a certain proportion of starch escaping gelatinisation at the ordinary mashing temperature. At the higher temperature of the sparges it would become gelatinised and be then converted, but the diastase which caused the conversion being also subjected to a high temperature, much dextrin and little maltose would be produced, and the resulting wort would have a high rotatory power.

Mr. A. Gordon Salamon thought that, quite apart from the value attaching to the main portion of his paper, the Society owed Mr. Heron a debt of gratitude for denouncing the analyses of malts which chemists were in the habit of giving to brewers. He had himself in a recent lecture shown that the figures generally given with respect to malt analyses were fallacious and misleading. If, however, the use of the polariscope was to be substituted for the ordinary analyses to which brewers were at present accustomed, it was necessary to be satisfied, first, that the instrument was capable of producing constant results in the hands of the brewer; and, secondly, that it was capable of giving constant results when working upon worts as produced in the brewery. He was somewhat uncertain in his own mind that there existed at present accurate evidence on that point. There was one condition which he thought should be, but had not yet been, taken into account, namely, the influence exerted by certain of the nitrogenous bodies upon polarised light. Not only was that the case with the albuminoids, but also, and perhaps more markedly, with the important class of bodies known as the amides. Taking asparagin as a representative of the amides, that body had a dextro rotatory power of 36 in an acid solution; but that rotatory power would vary with the acidity of the solution. If the solution became an alkaline one, the rotatory power would pass from a right- to a left-handed one. The albuminoids were mostly laevo-rotatory. These phenomena must influence the reading. It might be said that the error thus introduced would be very slight. But when it was considered that solutions were being dealt with in which the figures, as shown by Mr. Heron's analyses, came very high for albuminoid matter, it would be seen that the ratio of this matter to the maltose and dextrine was a factor which should certainly be taken into account. It might indeed vary during the process of brewing one way or the other, thus accounting for the variations which Mr. Heron had shown to occur in the readings taken at different periods of mashing, for it was well known that during brewing the nitrogenous matter underwent change, passing from amides into peptones, and so forth. If the brewer was to use the polariscope with practical advantage, it would only be so that he might continually compare his results so as to ensure uniformity. If an error was made, so long as it was constant from day to day, it did not much matter what it was, as it could be allowed for. He would like to know whether, in working the polariscope according to the most ingenious method described, variation of temperature of the wort made any difference in the reading. It was the experience of most chemists that temperature exerted a great influence in this direction. He desired to know also whether Mr. Heron found it necessary to decolorise worts and beers in order to get a constant reading. If a brewer had to take elaborate steps to decolorise his worts and beer—using first animal charcoal, then acetate of lead, and then sulphuretted hydrogen—he feared it would be difficult to get him to use the polariscope at all. He begged to assure the meeting that he did not raise these objections in a carping spirit, but only with a desire to further elucidate a method which was not only ingenious in itself but which might ultimately solve one of the problems most important to brewers.

The Chairman congratulated Mr. Heron on his lucid and concise description of the polariscope and its application to the analysis of brewing materials. Mr. Heron's clear and simple description would enable everyone to understand how the polariscope worked and how it could be advantageously used in connexion with brewing. The paper had not come a minute too soon, for in one or more books on brewing the polariscope was stated to be a useless instrument, misleading in its results, and altogether unfit for practical purposes. In another book, written by a believer in its use, an analysis of raw sugar was given, which seemed to be a little shaky; the sugar, moisture, and ash added together came to 100, no room being left for organic matters other than sugar. He would like to have an explanation of Mr. Heron's statement that the destruction of dextrose by heating with dilute acid to 150° C. for five minutes was something like 50 per cent.—that is, that 50 per cent. was converted into intermediate bodies.

Mr. Heron replied that he had said 50 per cent. in one hour.

The Chairman, continuing, said his own experience did not confirm so great a change of dextrose into bodies incapable of acting upon light, and he would be glad of more information on that point. He should await the publication of Mr. Heron's paper with great interest, and hoped to derive advantage from the use of his factors.

Mr. Heron, in reply, said that most of the criticisms passed on his paper would be found to be answered in the paper itself. The paper was a long one, and he had not given it in detail. With regard to the variation of the "constant" 3·86 for carbohydrates, if one made a solution of 10 grams per cc. of each pure dry substance, every one of these solutions would be found to have a slightly different specific gravity, and a 30 gram per 100 cc. solution would be very different to that of a 10 gram per 100 cc. solution. It was advisable to bring all the liquids to the specific gravity of 1040·0 or as near as possible to it, and then use the "constant" 3·86 as a divisor. In solutions of only dextrin and maltose a slight error *was* introduced into the calculation, but it did not amount to more than half per cent., and that was very close to the truth. With regard to Dr. Squire's remarks about sparging at high temperature, he had found the same thing to be the case. In some brewery experiments, where the sparging was carried on at high temperatures, the resulting worts showed high specific rotatory powers, and at low sparging temperatures the opposite was the case, namely, low specific rotatory powers.

Mr. Salamon had suggested that some of the albuminoids would be dissolved out at high temperature, and thus influence the specific rotatory powers; but the results of a great number of experiments had convinced him that this high rotatory power was not due to the albuminoids. Mr. Salamon had expressed doubt as to whether the polariscope gave constant results: undoubtedly it did. The results given by it were more accurate and more satisfactory than those obtained by any other method of analysis. As to the influence of nitrogenous bodies on these analyses—that was got over by the correction. It would be seen that the optical activity of the cold-water extract was due to the algebraical sum of all the optical activities of the carbohydrates, and any other optically active bodies which might be present. Any changes produced in the mash tun by heat on the albuminoids would also have taken place in the cold-water malt extract when digested at the mashing temperature, and that was the correction applied to his figures.

Mr. Salamon inquired whether peptonisation would have taken place in the cold-water extract.

Mr. Heron replied that the cold-water extract would have been heated up to 66° C. for one hour, and subjected to the same conditions as the malt in the mash tun, so that any peptonisation happening there would also occur in the malt extract. As to the effect of difference of temperature on the polariscopic readings, a variation of five or ten degrees of temperature would practically make no difference; for the other carbohydrates a difference of temperature certainly did make a difference in the case of levulose and invert sugar, but for all practical purposes it might be taken for granted that there was not a greater variation from the time the solution was introduced into the tube until the reading was taken in the polariscope than five degrees in the temperature of the solution. As to the destruction of dextrose that was mentioned in the paper—and Mr. Newlands would see that the results obtained were fairly accurate—it was impossible to go into every detail in so long a paper, and if it was found that he had omitted any little matter he hoped he should be pardoned under the circumstances.

* * *

Meeting held Monday, April 9th, 1888.

MR. D. HOWARD IN THE CHAIR.

THE ERRORS AND DEFECTS OF THE PRESENT REVENUE SYSTEM OF CHARGING THE DUTY ON SPIRITS, AND THE MEANS FOR REMEDYING THEM.

BY B. DERHAM, M.D.

The present Revenue system of charging the duty upon spirits comprises Sikes' hydrometer, the range of which, with nine weights or poises and as many repetitions of the scale, extends from specific gravity ·8154 to 1·0007; a series of tables, one for each degree of temperature from 30° to 80°, denoting the strengths or relative values of spirits to proof spirit corresponding to the indications of the instrument; and a short specific gravity table giving the specific gravities also corresponding to the indications of the instrument, and said to be determined at a temperature of 62° Fahr. When constructing his tables of strengths, Sikes made the erroneous assumption that any specified quantity of spirit at the temperature of 51° Fahr. retained the same bulk and the same strength whether heated to 80° or cooled to 30°. In practice, however, by the operation of the natural law, a very considerable augmentation in bulk takes place in spirit heated from 30° to 80°, whilst by the arbitrary principle of construction of the tables the strength remains the same. We have, therefore, according to the Revenue system, a larger quantity of spirit of the same strength by merely heating the spirit, which is absurd. The limit of the error in this direction to which the Revenue system is liable will be found in pure alcohol, the strength of which at 51° is 75·3 over proof, and which is assumed not to vary. One hundred gallons of alcohol at 51° Fahr. contract to 98·9 gallons at 32°, and expand to 101·8 gallons at 80°, which, reduced to their equivalent value in proof gallons in the usual manner, are:—

At 32° .... 98·9 × 1·753 = 173·4 gallons of proof.
At 51° .... 100·0 × 1·753 = 175·3 "
At 80° .... 101·8 × 1·753 = 178·5 "

and the results, although we are dealing with the same actual quantity of spirit, exhibit a total discrepancy of over five gallons.

Such incongruous results are sufficient demonstration that the principle of construction of the tables is radically wrong; nevertheless, since it is a common impression that the strength at different temperatures must be the same, seeing that the spirit is identical, we will examine this point a little more closely. We want, in the first place, a definition of the expression "strength of spirits." Spirits are mixtures of alcohol and water in varying proportions, the alcohol alone having any commercial value. The expression "strength of spirits," therefore, must denote the relative proportion of alcohol contained in any specified spirit as compared with that contained in an accepted standard spirit, a definite unit of bulk of the standard strength being employed for the purpose of instituting the comparison.

The accepted standard in Great Britain is called proof spirit, which has a specific gravity of ·9236 at 51° Fahr., and one gallon of which contains 4·553 lbs. of alcohol of specific gravity ·79385 at 60°. Now let us for a moment confine our attention to the consideration of the changes affecting one gallon of proof spirit when the temperature varies from 51°. Should the temperature be raised to 80° the gallon of spirit expands by one-hundredth part of its bulk; a gallon, therefore, at the new temperature no longer contains 4·553 lbs. of alcohol, for there is one-hundredth of a gallon extra, also containing its share of the alcohol. A gallon of a spirit, therefore, which was proof at 51° is evidently under proof at 80°, since it contains less than the prescribed weight of alcohol. By a similar course of reasoning it will be seen that spirit which is proof at 51° is over proof at 30°, and that, of necessity, the strength of all spirits must vary with the temperature, being increased at temperatures below and decreased at temperatures above 51° Fahr. The essential defect of Sikes' tables, namely, that the strength of spirits is assumed not to vary with temperature, is readily shown by reference to Sikes' own tables and to the record of Gilpin's experiments, upon which Sikes' tables profess to be founded. The connexion between Gilpin's specific gravities and Sikes' strengths must be traced through the specific gravity table annexed to Sikes' tables of strengths. To trace the connexion, first find, in the specific gravity table, the indications of Sikes' instrument corresponding to their respective specific gravities, and then in the table of strength, at the appropriate temperature, the strength corresponding to these various indications. I subjoin several tabular illustrations, exhibiting in parallel columns, so that the connexion may be traced at a glance, first, the specific gravities of certain definite mixtures of Gilpin's pure spirit and water at every fifth degree of temperature from 30° to 80°; next, the corresponding indications of Sikes' instrument; and lastly, Sikes' corresponding strengths.

	Spirit = 100. Water = 0.			Spirit = 100. Water = 5.			Spirit = 100. Water = 20.		
	Gilpin's Specific Gravities.	Sikes' Indications.	Sikes' Strengths	Gilpin's Specific Gravities.	Sikes' Indications.	Sikes' Strengths.	Gilpin's Specific Gravities.	Sikes' Indications.	Sikes' Strengths.
30°	·83896	13·8	62·0 O.P.	·84995	20·3	56·0 O.P.	·87585	35·0	40·8 O.P.
35	·83672	12·6	62·0 „	·84769	18·8	56·2 „	·87357	33·7	40·9 „
40	·83445	11·3	61·9 „	·84539	17·7	56·1 „	·87134	32·4	41·0 „
45	·83214	9·9	62·0 „	·84310	16·3	56·1 „	·86907	31·1	41·0 „
50	·82977	8·5	62·0 „	·84076	14·9	56·3 „	·86676	29·8	41·1 „
55	·82736	7·1	62·1 „	·83834	13·5	56·3 „	·86441	28·5	41·1 „
60	·82500	5·7	62·1 „	·83599	12·1	56·3 „	·86208	27·2	41·1 „
65	·82262	4·2	62·2 „	·83362	10·8	56·3 „	·85976	25·9	41·0 „
70	·82023	2·8	62·2 „	·83124	9·4	56·2 „	·85736	24·5	41·1 „
75	·81780	1·4	62·1 „	·82878	7·9	56·3 „	·85493	23·1	41·1 „
80	·81130	0·0	62·0 „	·82631	6·4	56·3 „	·85248	21·6	41·2 „

	Spirit = 100. Water = 40.			Spirit = 100. Water = 60.			Spirit = 100. Water = 80.		
	Gilpin's Specific Gravities.	Sikes' Indications.	Sikes' Strengths.	Gilpin's Specific Gravities.	Sikes' Indications.	Sikes' Strengths.	Gilpin's Specific Gravities.	Sikes' Indications.	Sikes' Strengths.
30°	·90054	48·5	24·1 O.P.	·91847	58·2	10·7 O.P.	·93191	65·3	·2 U.P.
35	·89839	47·1	24·2 „	·91640	57·1	10·7 „	·92986	64·2	Proof.
40	·89617	46·2	24·2 „	·91428	56·0	10·7 „	·92783	63·1	Proof.
45	·89396	45·0	24·4 „	·91211	54·8	10·9 „	·92570	62·1	Proof.
50	·89174	43·7	24·5 „	·90997	53·7	10·9 „	·92358	61·0	Proof.
55	·88945	42·5	24·4 „	·90768	52·5	10·9 „	·92145	59·8	·2 O.P.
60	·88720	41·3	24·4 „	·90549	51·3	10·9 „	·91933	58·7	·1 „
65	·88490	40·0	24·5 „	·90328	50·1	11·0 „	·91715	57·5	·2 „
70	·88254	38·7	24·5 „	·90104	48·9	11·0 „	·91493	56·3	·2 „
75	·88018	37·4	24·5 „	·89872	47·6	11·0 „	·91270	55·1	·3 „
80	·87776	36·1	24·5 „	·89639	46·3	11·0 „	·91042	53·9	·2 „

	Spirit = 100. Water = 100.			Water = 100. Spirit = 70.			Water = 100. Spirit = 45.		
	Gilpin's Specific Gravities.	Sikes' Indications.	Sikes' Strengths.	Gilpin's Specific Gravities.	Sikes' Indications.	Sikes' Strengths.	Gilpin's Specific Gravities.	Sikes' Indications.	Sikes' Strengths.
30	·94222	70·7	9·5 U.P.	·95681	78·2	24·8 U.P.	·96967	84·8	43·5 U.P.
35	·94025	69·7	9·4 „	·95502	77·2	24·2 „	·96840	84·1	42·6 „
40	·93827	68·6	9·2 „	·95328	76·4	24·2 „	·96706	83·4	42·3 „
45	·93621	67·6	9·1 „	·95143	75·4	23·9 „	·96563	82·7	42·0 „
50	·93419	66·5	9·0 „	·94958	74·4	23·6 „	·96420	82·0	41·9 „
55	·93268	65·4	8·9 „	·94767	73·5	23·7 „	·96272	81·2	41·7 „
60	·93002	64·3	8·8 „	·94579	72·5	23·7 „	·96122	80·4	41·7 „
65	·92794	63·2	8·8 „	·94388	71·5	23·7 „	·95962	79·6	41·8 „
70	·92580	62·1	8·9 „	·94193	70·6	24·0 „	·95802	78·8	42·0 „
75	·92364	61·0	9·1 „	·93989	69·4	23·9 „	·95638	78·0	42·4
80	·92142	59·8	9·2 „	·93785	68·4	24·2 „	·95467	77·1	42·7

The resulting strengths, it will be observed, are in one or two of the samples practically uniform, and these examples sufficiently establish the principle underlying the construction of the tables; but when we come to examine more closely the other examples, we discover so many irregularities that we are justified in inferring that Sikes did not proceed on any exact or scientific method, but was compelled to trust to experimental determination with an instrument notoriously unfitted for obtaining accurate results, particularly in liquids approaching the specific gravity of water. It will be observed on examination that some of these variations from the principle of the tables amount to 1 per cent., and that, contrary to what we know to be the facts of the case, the strengths are almost uniformly greater at the higher than at the lower temperatures, consequently their effect will be to augment the discrepancies springing from the fundamental error of the tables.

We will now pass to the consideration of the specific gravity table, which forms part of the Revenue system of estimating the value of spirits. The chief utility of specific gravities to the Revenue official is in ascertaining the contents of casks. One gallon of distilled water at 62° weighs ten pounds, consequently if the specific gravities be multiplied by 10, that is if the decimal point be placed after the first figure on the left, the specific gravity of a spirit expresses the weight in pounds of a gallon of that spirit; therefore if the nett weight of spirit in a cask be divided by the specific gravity, punctuated as described, the quotient represents the contents of the cask in gallons. To be accurate, I should here point out that whilst it is established that one gallon of distilled water weighs ten pounds at 62°, the specific gravities are compared with distilled water at 60°, consequently the specific gravities do not *exactly* represent the pounds weight per gallon; but the difference is so small as to be inappreciable, it certainly does not affect the result in the quantities usually dealt with. The specific gravity table was ascertained by experiment, long after the first promulgation of Sikes' tables, in the following manner:—

A delicate hydrometer was provided on the model of what is commonly known as Nicholson's hydrometer, otherwise the hydrometer of constant immersion, since in employing the instrument it is always sunk by means of weights placed in the little cup at the top of the stem to a fixed point on the stem: the bulk compared, therefore, is constant. It was contrived that the total weight of the instrument and weights in the cup, when floating in distilled water and immersed to the fixed point on the stem, should be 1,000 grains; the instrument itself weighing 700 grains, and the weight in the cup 300 grains. Hence, when floating in other liquids and immersed to the same point, the total weights of instrument and weights in the cup at once represented the specific gravities of the liquids. This instrument and a carefully-adjusted Revenue hydrometer were floated together in samples of spirit, corresponding to the chief divisions of the stem of Sikes' hydrometer, and the specific gravities belonging to these latter thus ascertained. The results obtained were interpolated for the minor divisions of the scale, and the whole arranged in a tabular form. In commenting upon this specific gravity table, I may remark that the experimenters appear to have begun and carried on their operations to a certain point at the temperature of 62°, with the design that the specific gravity of their table, corresponding to the water point of Sikes' hydrometer, should exactly represent ten pounds per gallon, when it suddenly occurred to them, that, owing to the restrictions imposed by the definition of proof spirit, with which Sikes' hydrometer strictly complied, the series should terminate at the specific gravity or pounds weight per gallon of distilled water at 51° Fahr., namely, 10·007 instead of 10, the pounds weight per gallon of distilled water at 62°. Without any regard to consistency or scientific accuracy, the original design of completing the table at a temperature of 62° was abandoned, 10·007 was adopted as the specific gravity corresponding to the water point, and the remaining interval of the gravities arbitrarily interpolated. Now, since they were so solicitous that the gravity at the water point should be 10·007, it was equally incumbent upon them to take care that the gravity at the proof point should be, according to the definition of proof, twelve-thirteenths of 10·007, namely, 9·237, whereas in the table it is given as 9·233.

In fact, to be consistent and true, since the original design of finishing with specific gravity 10 at the water point was abandoned, all the experiments should have been re-performed at the temperature of 51°, but this was not done. In addition to these glaring inconsistencies, since the accuracy of the table ultimately depended upon the fidelity with which the Revenue instrument employed had been copied from Sikes' original model, and since at the best the hydrometer of variable immersion is wholly inadequate to exact scientific determination, for several reasons which I need not dwell upon here, the entire table is incorrect; the specific gravities cannot be reconciled to the theory of any hydrometer, the error sometimes amounting to two subdivisions of the stem. This is not in itself a matter of much moment, still it is worth recording when we bear in mind that if an Excise officer were detected and reported for making a mistake of those dimensions he would incur the severe displeasure of the Board of Inland Revenue. But these errors occurred with an instrument carefully prepared and verified for the purpose of these experiments. What then must we think of the correspondence likely to obtain between the indications of the instruments as ordinarily manufactured for commercial purposes and the specific gravities given in this table?

When I first began the preparation of this paper I intended to touch upon the theory of hydrometers constructed on the principle of the Revenue instrument. I soon found, however, that the subject could not be conveniently comprised within the limits of a paper such as I have entered upon. I must, therefore, refer those who may be curious about this subject to a small work which I have published, where I have entered, in detail, into the theory of Sikes' hydrometer.

The following series of propositions constitute a brief summary of the indictment of the present system:—That Sikes, reversing all scientific method, first provided his hydrometer and then constructed his tables of strengths by experiments with it; that none of the valuable data accumulated by Gilpin in his celebrated experiments were utilised, except at the single temperature of 51° Fahr.; that even at this, the standard temperature, Gilpin's and Sikes' values do not correspond, so that Gilpin's were chiefly serviceable as a means of checking Sikes' own experiments, rather than as furnishing the foundation of his table; that the tables of strengths for all other degrees of temperature were ascertained by the simple plan of heating and cooling carefully-prepared samples of spirits to the requisite temperatures, and then noting the corresponding indications of his instrument, the tables being completed by interpolating the intervals; that in these operations the expansion and contraction of spirit due to variations of temperature were neglected; that the strengths of a spirit at different degrees of temperature were erroneously assumed to be constant, and consequently that the estimate of the equivalent value of a specified quantity of spirit, in gallons of proof spirit, is different at every degree of temperature; and finally that the specific gravity table was also ascertained by experiment with an instrument, a remote copy of Sikes' original model, and that the specific gravities it contains are referable to distilled water at different degrees of temperature, namely 62° and 51° Fahr.

The following features, on the contrary, should characterise a perfect system. (1.) The utilisation of the material afforded by Gilpin's experiments, which are of undisputed authority to this day, and in which the specific gravities of definite mixtures of spirit and water were ascertained by the weighing bottle, the most exact means of determination at our disposal. (2.) The adoption of tables of strengths, derived from such a source, in which the strengths are given corresponding to their natural allies, the specific gravities, and in which the correspondence is absolutely and finally established, and quite independent of the arbitrary and varying indications of an instrument liable to so many defects as the Revenue hydrometer. (3.) The employment, for commercial purposes, of a hydrometer founded upon scientific principles, the indications of which are themselves the specific gravities, and capable of prompt verification at any point of the indicated series.

I will now hasten to give an account of the instrument and tables which I have submitted to the Inland Revenue Department, which will accurately and expeditiously effect what is very inaccurately effected by the Revenue instrument and tables, and which will accomplish the requisite reforms with the least possible alteration of the present mode of procedure.

The best data, and those susceptible of the most accurate determination upon which to found correct tables of strengths, are the specific gravities of the spirits and the percentages by weight of alcohol they contain. Gilpin's celebrated experiments in this field of research furnish us with the necessary data. They were made with spirit having a specific gravity ·825 at 60° Fahr. A series of mixtures containing 100 parts by weight of the spirit and 5, 10, 15, &c., parts by weight of water, and a second series of mixtures containing 100 parts by weight of water, and 95, 90, 85, &c., parts by weight of spirit, down to pure water, were carefully prepared, and their specific gravities exactly ascertained by means of the weighing bottle at every fifth degree of temperature from 30° to 80° Fahr. inclusive. Since his day, what we may regard as pure alcohol, having a specific gravity of ·79385 at 60°, has been prepared, its expansion with heat exactly ascertained, and similar experiments to Gilpin's made with mixtures of the absolutely pure spirit and water in carefully determined proportions. From these data I have ascertained that Gilpin's pure spirit, ·825 at 60°, contained 89·133 per cent. by weight of alcohol, consequently I have been enabled to calculate the percentage by weight of alcohol corresponding to each specific gravity contained in Gilpin's tables. But the specific gravities in his tables are irregular, and not arranged in a form adapted to commercial or even convenient for scientific purposes. The next necessary step, therefore, was to deduce from the preceding the percentages by weight of alcohol corresponding to the series of specific gravities, commencing at ·780, and regularly progressing by equal differences of ·001—thus ·780, ·781, ·782, &c., to 1·000—and arrange them in a tabular form. I exhibit a copy of these tables. The degrees of temperature are arranged in a vertical column at the side of each page, and the specific gravities, progressing as described, each at the head of its appropriate column of percentages, in a horizontal line at the top of the page. But although a table of this description is of some value to the scientific chemist, it is of little or no utility for commercial purposes, since it does not express in the accepted and commonly understood notation what the commercial public wishes to know; it is nevertheless the necessary foundation upon which to construct tables adapted to commercial requirements. In estimating the value of spirits for Revenue and commercial purposes, the standard unit is one gallon by measure of proof spirit; and in the accepted commercial notation the expression "so much overproof" denotes the number exceeding 100 of these standard units to which 100 gallons of a specified spirit are equivalent; and "so much underproof" expresses the deficiency by which the number of standard units *contained in* 100 gallons of the specified spirit falls short of 100. A table of strengths therefore is most accurately described as "a table of percentages by measure of proof spirit in pure spirituous liquors;" and these percentages being once ascertained, the ratio holds true for any quantity of spirit, whether for 1 or 100, or any other number of gallons or fractions of gallons. The standard of proof is fixed at 51° Fahr., and is defined as having a weight equal to twelve-thirteenths of that of an equal volume of distilled water. The specific gravity of distilled water at 51° is, according to Gilpin, 1·00063, twelve-thirteenths of which is ·9236 nearly. Spirit having this specific gravity at 51° contains 49·3 per cent. by weight of alcohol, hence one gallon contains—

$$\frac{9{\cdot}236 \times 49{\cdot}3}{100} = 4{\cdot}553 \text{ lbs. of alcohol.}$$

I may here point out the advantage, at least for all commercial purposes, of limiting our conception of the proof standard to the weight of alcohol it contains. The attempt to combine the additional notion of bulk perplexes the mind in the effort to grasp the endless variations of bulk and strength, degrees of concentration, and dilution of spirit, all ultimately corresponding to a gallon of proof spirit. The idea, for instance, that the greater is contained in the less, the gallon of proof spirit in less than a gallon of a stronger spirit is paradoxical; indeed, if we adhere to the conception of bulk, is impossible; whereas the simple fact that 4·553 lbs. of alcohol at any degree of temperature, and in any state of concentration or dilution, are the equivalent of one gallon of proof spirit, is easily apprehended.

A little consideration will now show that the true percentage by measure of proof spirit is simply the equivalent in gallons of proof spirit of so many pounds of alcohol contained in one gallon of the specified spirit at a given temperature; hence all that is required to convert the table of percentages by weight of alcohol into percentages by measure of proof spirit is to multiply the specific gravities, regarded as expressing the pounds weight per gallon, by the percentage by weight of alcohol, and divide by 100, the result being the pounds of alcohol contained in a gallon of any given spirit; and this value divided by 4·553, the pounds of alcohol in a gallon of proof, gives the number of gallons of proof spirit to which one gallon of the supposed spirit is equivalent. A few examples will better illustrate the process and exhibit at the same time the method of computing the true strengths or percentages by measure of proof spirit, which are synonymous terms, and the change effected in the strength by variations of temperature.

The specific gravity of Gilpin's pure spirit is ·839 at 30°; the weight of one gallon therefore is 8·39 lbs., and its percentage by weight of alcohol is 89·13; therefore one gallon contains

$$\frac{8{\cdot}39 \times 89{\cdot}13}{100} = 7{\cdot}478 \text{ lbs. of alcohol.}$$

One gallon, therefore, is equivalent to

$$\frac{7{\cdot}478}{4{\cdot}553} = 1{\cdot}642 \text{ gallons of proof spirit.}$$

And 100 gallons are equivalent to 164·2 gallons of proof spirit, and the spirit is said to be 64·2 overproof.

The same spirit has a specific gravity ·825 at 60°; one gallon therefore weighs 8·25 lbs., and the percentage of alcohol is 89·13 as before. One gallon therefore contains

$$\frac{8{\cdot}25 \times 89{\cdot}13}{100} = 7{\cdot}353 \text{ lbs. of alcohol, and}$$

$$\frac{7{\cdot}353}{4{\cdot}553} = 1{\cdot}615 \text{ gallons of proof spirit.}$$

100 gallons being equivalent to only 161·5 gallons of proof spirit, the strength of the spirit at 60° has sunk to 61·5 overproof.

Again, the same spirit at 80° has specific gravity ·8153, and one gallon weighs 8·153, the percentage by weight of alcohol still remaining the same.

$$\frac{8{\cdot}153 \times 89{\cdot}13}{100} = 7{\cdot}267 \text{ lbs. of alcohol.}$$

And one gallon is equal to

$$\frac{7{\cdot}267}{4{\cdot}553} = 1{\cdot}596 \text{ gallons of proof spirit.}$$

And since the equivalence of 100 gallons of the spirit at 80° is only 159·6 gallons of proof spirit, the strength has further declined to 59·6 overproof.

I now wish to call your attention to the fact that by the employment of true strengths, rightly understood and computed in this manner, identical results are obtained with the same quantity of spirits at all temperatures. 100 gallons of spirit of specific gravity ·825 at 60°, contract to 98·33 gallons at 30°, and expand to 101·17 gallons at 80°.

Now if we multiply these quantities by the equivalence in proof gallons of one gallon of the respective spirits, we shall have their equivalent values in gallons of proof spirit. Consequently at

30°..... 98·33 × 1·642 = 161·5 gallons of proof spirit.
60°..... 100·00 × 1·615 = „ „ „
80°..... 101·17 × 1·596 = „ „ „

where it will be observed that the diminished bulk of the spirit at 30°, as compared with its bulk at 60°, is exactly compensated by the increased strength at the lower temperature; and the augmented bulk at 80°, as compared with the bulk at 60°, is counterbalanced by the diminished strength at the higher temperature; whence it is evident that by the employment of the true strengths the estimate of the equivalent value of a definite quantity of spirit, in gallons of proof spirit, would not be affected by changes of temperature, but that the result would be always uniform, as it should be.

I exhibit a copy of my tables calculated in this manner, and wish to point out that they are the exact embodiment of the results of Gilpin's experiments, and that the arrangement is identical with that obtaining in the present Revenue tables. The only difference in form is that the significant and useful specific gravities are substituted for the meaningless indications of the Revenue instrument and tables; but even this minute and fanciful difference will be seen to practically disappear when I mention that these specific gravities are themselves the indications of the instrument I have proposed to be substituted for the present Revenue instrument, and that the trader who does not care to trouble himself about specific gravities could still continue, with the new instrument, to speak of "indications" with which he is familiar from long usage.

The indications of a hydrometer intended for use with the preceding tables should themselves be the specific gravities. This is the special merit of the instrument I propose, the theory of which I shall now briefly illustrate.

In order that the indications of the hydrometer should be themselves the specific gravities of the liquids in which it floats, it is evidently necessary that the successive repetitions of the scale should correspond to equal intervals of specific gravity. It has long been known, therefore I shall not trouble you at present with an algebraical demonstration of the fact that this can only be accomplished by making the successive increment to the total bulk for each repetition of the scale equal to the bulk of the scale itself. Bates' saccharometer is a very ingenious mechanical adaptation of this requirement, but it has hitherto escaped the notice of inventors that all the conditions of the problem of the construction of hydrometers on this principle can only be fully satisfied by making the specific gravities of the successive poises bear an exactly defined relation to the initial specific gravity of the series indicated by the instrument to which they belong. When this relation is fully understood and appreciated it will be perceived that we need not be dependent on the assurances of the instrument maker as to the accuracy of our hydrometers, or on a laborious trial with a series of test liquids, themselves liable to inaccuracies; but by the simple examination of the specific gravities of the poises, an operation easily effected, by thus satisfying ourselves that they bear the prescribed relation to the initial specific gravity indicated by the instrument, and by noting that the ratio prescribed by the theory between the weights of the poises and instrument itself is maintained, we can at any time verify the accuracy of our instruments. But to proceed to our demonstration.

The most convenient definition of specific gravity for our present purpose is that—

$$\frac{\text{Weight}}{\text{Bulk}} = \text{specific gravity.}$$

Let W = weight of hydrometer; B = bulk of hydrometer; G = initial specific gravity of the instrument; g = specific gravity of any poise; a = the number of degrees of gravity indicated in the length of the stem; and unity = bulk of the graduated stem; then since the bulks of the poises must be multiples of the bulk of the graduated stem, according to their position in the series—

$$n = \text{bulk of } n\text{th poise.}$$
$$n\,g = \text{weight of do.}$$

By the definition of specific gravity and the construction of the instrument—

$$\frac{W}{B} = G\text{; and } \frac{W}{B-1} = G + a.$$

$$\text{Whence } W = B\,G\text{; and } \frac{B\,G}{B-1} = G + a.$$

$$\text{And } B\,a = G + a.$$

Again, generally, with nth poise attached—

$$\frac{B\,G + n\,g}{B + n} = G + n\,a.$$

Whence, substituting the value of B a, obtained above—

$$g = 2\,G + (n + 1)\,a.$$

To apply this general formula to our purpose. Alcohol at high temperatures touches specific gravity ·780; hence the range of a spirit hydrometer should extend from specific gravity ·780 to 1·000.

This total interval can be conveniently divided into 11 smaller intervals, each corresponding to ·020 of specific gravity; therefore we shall require 10 poises and as many repetitions of the scale, exclusive of the first employment of the scale, which requires no poise. Therefore G = ·780 and a = ·020; and

$$1\text{st } g = 1{\cdot}56 + {\cdot}04 = 1{\cdot}60.$$
$$2\text{nd } g = 1{\cdot}56 + {\cdot}06 = 1{\cdot}62.$$
$$3\text{rd } g = 1{\cdot}56 + {\cdot}08 = 1{\cdot}64, \text{ \&c.}$$

And since generally $n\,g$ = weight of nth poise,

$$\text{Weight of 1st poise} = 1{\cdot}60 \times 1 = 1{\cdot}60.$$
$$\text{2nd poise} = 1{\cdot}62 \times 2 = 3{\cdot}24.$$
$$\text{3rd poise} = 1{\cdot}64 \times 3 = 4{\cdot}92, \text{ \&c.}$$

Again, particularly—

$$\frac{W}{B} = {\cdot}780\text{; and } \frac{W}{B-1} = {\cdot}800.$$
$${\cdot}780\,B = {\cdot}800\,B - {\cdot}800.$$
$$B = 40.$$
$$W = 31{\cdot}2.$$

We have now all the data required for the construction of the following scheme of the hydrometer:—

Bulk of Instrument.	Bulk of Poises.	Weight of Instrument.	Weight of Poises.	Specific Gravity of Poises.	Gravities Indicated at Top of Stem.	Gravities Indicated at Bottom of Stem.
40	..	31·2	..	..	·780	·800
"	1	"	1·60	1·60	·800	·820
"	2	"	3·24	1·62	·820	·840
"	3	"	4·92	1·64	·840	·860
"	4	"	6·64	1·66	·860	·880
"	5	"	8·40	1·68	·880	·900
"	6	"	10·20	1·70	·900	·920
"	7	"	12·04	1·72	·920	·940
"	8	"	13·92	1·74	·940	·960
"	9	"	15·84	1·76	·960	·980
"	10	"	17·80	1·78	·980	1·000

It will be found by trial that if the total weights in the preceding scheme, for any range, be divided by the total bulk for the same range, the quotient is the specific gravity indicated at the top of the stem; and if unity, which is the bulk of the stem, be subtracted from the total bulk, and the operation repeated, the quotient is the gravity at the bottom of the stem. The values given in the scheme are indeed only ratios; but in the calculation of the details of the instrument we have only to substitute real values to obtain all that is necessary for the construction of the hydrometer.

You are now in a position to judge the merits of the system I have proposed in the place of the present Revenue system. The tables give identical results at all temperatures; the strengths therein contained are associated with their natural allies, the specific gravities, and the relations between the two are fixed and immutable, having been conclusively determined by experiments with the weighing bottle, the most exact means of investigation at our disposal. Since the strengths correspond to the specific gravities, the tables can be used directly in conjunction with any instrument or means of ascertaining specific gravities. The indications of the instrument I propose are themselves the specific gravities, which is the value employed by the Excise official in ascertaining the contents of casks; thus an unnecessary and troublesome reference to a specific gravity table is avoided. The instrument also is constructed on scientific principles, and is capable of easy verification. Finally, the necessary reform is effected with the least possible alteration of the present procedure with which the trader is familiar: the established standard, the proof gallon, the accepted notation of overproof and underproof, the present procedure in all its details, are alike preserved; the only perceptible difference being that the trader, instead of speaking, for example, of indications 11·6, 30·0, &c., will say indications 835, 867, &c.

And in brief, to complete and emphasise the contrast between the two systems, Sikes first manufactured his instrument, and then made it with all its imperfections, a peg as it were upon which to hang the rest of his system; whereas I have followed the more scientific method, namely, to first establish and display in the tables the correspondence existing between the strengths and specific gravities, and then to provide a hydrometer which will furnish these specific gravities, which are the natural key to the strengths.

I should not conclude this paper without a reference to the influence of the errors and defects of Sikes' system upon the interests of the Revenue and manufacturers. From what I have already stated, it is apparent that at temperatures above 51° an over-estimate is made of the trader's stock, which results in a gain to the Revenue; and at temperatures below 51° there is an under-estimate, which necessarily occasions a loss to the Revenue. It has hitherto been the opinion of the Revenue authorities that these excesses and deficiencies compensate and balance each other, and that on the whole transactions of the year the Revenue neither gains nor loses. I do not think that this opinion is justified by the facts of the case; and I shall now briefly state my reasons for holding a contrary view. The result of my inquiries and investigations has been to satisfy me that the mean temperature of spirits in warehouse closely corresponds to the mean shade temperature of the locality in which the warehouse is situated. This is only what we would naturally expect. It is true that the temperatures of the warehouse in winter do not fall so low as the external temperatures, neither, on the contrary, do they rise as high in the summer; they are more equable, less liable to sudden and violent fluctuations, but the resulting mean is nearly the same in both cases. Now, the mean shade temperature at Greenwich, which is nearly at the extreme south of the kingdom, is 49° Fahr.; hence, if all the operations of the Excise in charging the duty upon spirits were carried on at Greenwich, the Revenue would incur a loss. But the mean shade temperature of the year at Liverpool and Manchester is about 47°, at Glasgow and Edinburgh about 46°, falling nearly to 45° at Inverness. Further, the consumption of spirits, it is well known, falls off enormously in the summer months, when the high temperatures prevail, upon which the Revenue authorities rely for restoring the equilibrium, which must materially reduce the mean temperature of spirits taken out of bond for consumption below the annual mean shade temperature of the locality where they are stored. The influence exerted by this circumstance in reducing the mean temperature of spirits taken out of bond for consumption will be better appreciated when I mention that the mean shade temperature of Scotland, where the greatest bulk of spirit is stored, is only about 41·5 Fahr. during the nine cooler months of the year, in which probably five-sixths of the annual consumption is effected. Again, from 50 to 60 million proof gallons, or considerably over one year's consumption, are stored in the bonded warehouses of the United Kingdom, from which fact the necessary inference is, that spirits have been, for the most part, lying in warehouse at least 12 months before being taken out for consumption, during which time they will have entirely adapted themselves to the mean temperature of their warehouse. Now approximately two-thirds of the total are stored in Scotland, there being only about seven million gallons in the warehouses in England; consequently, it is probable that the temperatures of a considerable proportion even of the spirits upon which duty is paid in England, rather approximate to those prevailing in Scotland. Neither must we overlook the influence exerted by the evaporation of the spirits in effecting a reduction of their temperature.

Taking all these circumstances into consideration, I think it probable that we are within the mark in assuming that the mean temperature of all the spirits upon which duty is paid in the United Kingdom is 46° Fahr. In round numbers, duty is annually paid upon some 40,000,000 gallons of proof spirit, which we may assume, for the purpose of our calculation, to have an average strength of 25 overproof. Forty million proof gallons are the equivalent of 32,000,000 at 25 overproof. Now, the bulks are proportional to the reciprocals of the specific gravities. The specific gravity of spirit 25 overproof at 51° is ·8907, and at 46°, ·8929; therefore—

$$\frac{1}{\cdot 8907} : \frac{1}{\cdot 8929} :: 1 : \cdot 9975 \left\{ \begin{array}{l} \text{Reduced bulk of one} \\ \quad \text{gallon at } 46^\circ. \end{array} \right.$$

$$\cdot 9975 \times 32{,}000{,}000 = 31{,}920{,}000 \text{ gallons,}$$

showing an apparent deficiency, owing to contraction, of 80,000 gallons. But these are 25 overproof; therefore—

$$80{,}000 \times 1 \cdot 25 = 100{,}000 \text{ proof gallons}$$

upon which the duty, lost by the present Revenue system, is 50,000*l.*

Of course this is only an approximate estimate: possibly the loss is less, probably it is considerably more, seeing that in the above an uniform rate of consumption throughout the year has been assumed, whereas the consumption is much greater in winter than in summer. But I leave you to judge of the validity of the arguments upon which the estimate is founded.

It must not be supposed that this loss to the Revenue is attended by an equivalent gain to the trader. The trader disposes of his stock at the estimate and under the permit of the Revenue official, consequently he also loses to the extent of the under-estimation.

I must not omit to point out that, even if we concede the correctness of the selfish contention of the Revenue authorities, that there is an ultimate equilibrium of excesses and deficiencies in the Revenue accounts, this satisfactory balance would not obtain in the accounts of the trader. For it is evident from the meteorological data I have cited, that it would be nearer the truth to affirm that the boasted equilibrium in the Revenue accounts would be maintained not by compensating the overcharge of the individual trader at one season of the year by a corresponding undercharge at another, but rather that the loss inflicted upon the Revenue as well as the trader at one extremity of the kingdom, would be compensated to the Revenue but not to the same trader, by an excessive estimate at the other extremity.

DISCUSSION.

The CHAIRMAN regarded the subject of specific gravity tables as one which was singularly delusive to beginners in chemistry. To inexperienced chemists it seemed a very simple thing to take certain fixed quantities of substances, make solutions of them, and take the specific gravity bottle, and so on. He could only recommend such reasoners to set to work and try to do it, and they would then gain some idea as to how far apart this apparent simplicity and the actual performance of the operation were. The extraordinary diversities of existing specific gravity tables was a striking evidence of the difficulty of the subject; for instance, it was a fact that men like Dalton and Davy, and other high authorities, differed by 10 per cent. at least in the estimation of the sp. gr. of ammonia. Englishmen might congratulate themselves that though the Sikes tables were not perfection, they were better than any foreign tables he had ever seen They were the results of careful experiments, and had great practical value. It was not surprising to find them defective in certain respects, and it was important that the Government should consider the question of the removal of those imperfections. He was glad to find that no attack was made on the present system of calculating by proof. Some chemists regarded that system with aversion, but he would recommend them to try actual work by any other. The present system was a practical and convenient one, though one might wish that it was not so haphazard, and that it bore some relation to absolute spirit by bulk or volume.

Mr. J. Keene was deeply interested in the subject of Dr. Derham's paper, though while in the service of the Customs he had of course been obliged to follow the usual routine with the Sikes hydrometer. There were one or two points in Dr. Derham's paper which he thought should be modified. The method employed in the Customs for ascertaining the quantity of spirits was by gauging. There were vast numbers of casks, which could not be measured inside: one must therefore measure them outside, and by certain estimations arrive at the quantity contained in them. But seeing that it had become the practice, for economy's sake, to employ men at the lowest pay possible, and without much experience in their work, it would be understood that this gauging was apt to be rather uncertain. In the case of the very strong spirits imported from Germany, a cask nominally held 130 gallons, and an error of $\frac{1}{10}$ inch might make a difference of four or five gallons. This difference was generally in favour of the merchant, and cases had occurred in which spirits, removed to the rectifier's warehouse duty-paid, had been so gauged as to enable him to appropriate four or five gallons out of each cask, and then send the smaller quantity for methylation and get back the duty which had been paid. Such gauging made a greater difference than would be made by a hydrometer capable of accurately showing what should be charged. In practice, however, it was necessary to have an instrument easy to use and not easily damageable. He was inclined to think that Sikes had fixed his proof point at 51° more by chance than design. But although legally a proof spirit was valued at the temperature 51°, it would be found that in practice the estimation was almost always taken at 60° with a gravity of ·9196 or thereabouts in the estimated tables. These tables to which Dr. Derham had referred were not considered part of the principle of Sikes' hydrometer. They were very incorrect, and the ratios of the immersions of the stems showed tests of gravity which did not follow the ratio, while the error was intensified by the variations of the weight of the hydrometer. It was not an instrument of equal immersion at all its weights, but an instrument which grew larger as it got heavier, and therefore its errors went in one groove. But taking the whole error as estimated by Dr. Derham at 50,000*l*., that estimate was based on the assumption that all the spirits were 25 over proof. But that was not the case. Brandy assuredly paid duty at or under proof, rum generally at 30 or 40 over proof. The spirits were put into warehouse at 25 over proof in Ireland, and in Scotland at 11 over proof; but they were not delivered immediately, and very often duty was paid somewhat below proof. Some years ago, before he left the service, he had discovered a source of error which this question of the hydrometer did not touch, viz., the obscuration of the strength of the spirits by soluble matter in them. All brandies and rums had more or less saccharine matter in them, which increased their gravity, and he had found that there was something over three per cent. never charged on all such spirits, which amounted to about 180,000*l*. a year. He had drawn the attention of Mr. Gladstone to the matter, and he allowed an alteration to be made in the method of charging the duty, which resulted in an increase of revenue to the amount he had mentioned. He drew attention to this fact to show that there were other points in the question beyond the accuracy of the hydrometer; and he doubted whether with all the accuracy claimed for the proposed hydrometer a saving would be effected to the extent supposed. The errors which occurred in gauging the casks made the proof quite an unknown quantity which might be over or under. Dr. Derham had remarked that the merchant lost as well as the Government. What the merchant would lose would be the value of the spirit, and that would depend on its quality. In the case of German spirit 67 over proof the value was not much more than 1*s*. 9*d*. per gallon; but with certain brandies of 14, 15, or 20 years old the value ran up to 24*s*. without duty. On the question of estimating the proof the duty only was the question which concerned the merchant, who did not sell it at proof but at whatever strength it might be. These points were difficulties in the way of applying so scientific and accurate a system as that proposed to so crude and rough a mode of assessing duties. Even in regard to the Excise system which had been to some extent adopted in the Customs by taking the content by weight, they got a correct denomination as to the number of gallons a cask contained; but they did not get a correct denomination when they came afterwards to put that cask on ullage. For when they dipped the cask to see how much was short they had to use an instrument, and had gauging rules which varied according to the figure of the cask; and even in such short deficiencies from the full cask as two or three inches, he had known a difference between the amount estimated and the actual amount required to fill the cask up of as much as two gallons. That was a source of error which Dr. Derham had not regarded, and which would operate even if the men had a correct temperature and gravity.

Mr. H. J. Helm said the meeting was indebted to Dr. Derham for a very able paper on a subject which he thoroughly understood. Those who had had experience of the Sikes hydrometer were quite aware that it possessed some, if not all, of the defects pointed out. While, therefore, he was describing Sikes' instrument and his own Dr. Derham was on perfectly safe ground, and nothing could be stronger than the case he had laid before the meeting. But, as Mr. Keene had pointed out, there were other points to be considered besides the mere scientific accuracy of an instrument, and one of those points was readiness of use. No one could compare Sikes' instrument with that proposed by Dr. Derham without being satisfied that Sikes' hydrometer was incomparably superior in regard to simplicity and ease of working. And when one considered that this instrument had to be used by thousands of officers—some of them just entering the service—in all parts of the country, and frequently in the middle of the night, it would be seen that this question of ease of working was of primary importance. Sikes' instrument might be liable to errors in one direction, but those who looked at Dr. Derham's instrument would see that it was liable to errors in other directions. Sikes' instrument was clearly and accurately marked, and could be easily read; Dr. Derham's instrument was not so easily read, and, moreover, the user had one more figure to read. Instead of reading the indication, say 52·2, he had to read a specific gravity, say, 8·598, which was more difficult. Then, too, Dr. Derham's instrument had considerably more wearing surface, and would much sooner wear light and require re-adjustment. And, from the way in which the weights were attached, there was more liability to air bubbles—and those who were familiar with the use of hydrometers knew that this attachment of air bubbles made it very difficult to get accurate results, especially with weak spirits. As had been pointed out, Dr. Derham had gone astray in his figures. In the first place, he had taken it that there were 32 million gallons at 25 over proof annually taken out of bond, and that three-fourths were stored in Scotland. But as had been stated, they did not store spirits at that strength in Scotland, but only in Ireland, the usual degree in Scotland being 11 over proof. Then, too, Dr. Derham had based his calculation of this serious loss of revenue entirely on the assumption that the mean shade temperature of the United Kingdom was 46°, and that the temperature of warehouses might therefore be taken at 46° also. But speaking from practical experience he could say that that was not the case. So far as Revenue officers were concerned, they were perfectly satisfied that with Sikes' hydrometer, standardised at 51°, the Revenue did not lose, and that if there was any discrepancy it was a shade the other way. Of course, when spirits were assessed in warehouses, they had to take the temperature as well as the indication; and he thought Dr. Derham would admit that actual figures were more satisfactory data than assumptions from shade temperatures wherever taken. So far as London was concerned, he might say that the average temperature at which spirits were removed from warehouses was much nearer 55° than 46°, and in such cases there would be (as Dr. Derham had admitted) an advantage to the Revenue. But whenever they were removed at under 51°, as they occasionally were, the advantage went to the trader, or, more remotely, to the consumer; for if, as Dr. Derham had said, both the Government and the trader lost, somebody must gain, and that was the consumer. He thought, therefore, the members should take this estimated loss of revenue with a grain of salt. The Revenue authorities were satisfied that although the instrument which they used and highly prized was not scientifically accurate, it did not involve the nation in this serious loss. As Mr. Keene had said, there were other sources of error in the gauging of imported spirits far more serious than this slight divergence of Sikes' hydrometer. He would conclude by thanking Dr. Derham for bringing so interesting a subject before the Society in so able a manner.

Dr. T. Stevenson did not know whether he ought to speak on the subject before the meeting, for though he had given much attention to the determination of spirits by means of gravity, he had paid no particular attention to Sikes' hydrometer, and in the work which he had published, containing an elaborate table of gravities, he had made no reference to the determination of spirits by the means pointed out by Dr. Derham. It seemed to him that Dr. Derham had made some very pointed remarks upon the imperfections of the present instrument and the present way of determining the strength of spirits; but the subject was involved in so much difficulty that he had very grave doubts whether Dr. Derham's system would result in any immense saving to the Revenue. Under the present system, as Mr. Helm had said, if the Government suffered and the vendor suffered also, someone must benefit; and if this saving were effected, the consumer would have to pay a little more duty on spirits. The difficulty of determining the proof of spirits was always great. The authorities were now permitted to make the determination either by gauging or by measuring or by weight; and he must admit that the Excise system of weighing the spirit was much the more satisfactory. Even scientific men had some trouble in appreciating the immense difficulty of determining the volume of a liquid. The late Prof. Jevons had pointed out the difficulty of estimating the volume of any substance within 1-5,000th of its bulk; whereas by weighing one could determine that very easily. So great was this difficulty that, although in 1826 the Government defined the standard gallon to be so many cubic inches, this had to be abandoned, because it was found that the best experimenters could not agree within ·05 inch of that amount. Therefore the present system of the volume of 10 lbs. weight of water at 62° F., and 30 inches barometer was adopted. Any estimate of what was a proof gallon must be a matter of inference at any particular temperature. A gallon of water weighed 10 lbs. at 62°, but the same quantity at another temperature would be different; and Dr. Derham's figures differed very appreciably from those of other well-known authorities. Taking Dr. Derham's figures, it appeared to him that, considering the kind of men by whom the spirit duty was assessed, an estimated loss of 50,000*l.* only upon so immense an amount of alcohol showed a very satisfactory state of things. It amounted to this, that whereas with the most accurate means at command one could not arrive within 1-5,000th in determining the bulk of a body, the Revenue authorities charged within 1-400th; that was to say, that for every 400 gallons of proof spirit they made a loss of about one gallon. That seemed to him to be a satisfactory result, and therefore—while giving the utmost credit to Dr. Derham for his elaborate study of the hydrometer, and while admitting that Sikes' instrument was imperfect—he thought that the Government should hesitate and wait for clear evidence from the Revenue authorities before departing from their well-known system and introducing another, in order to effect this somewhat hypothetical saving of 50,000*l.* a year.

Professor Dewar said that if he had rightly understood Dr. Derham, his purpose was to point out that it was desirable to use an accurate and scientific method, and the question of gain or loss was quite a secondary one so far as he was concerned. He was advocating a strictly scientific method, and it would be for him to prove whether or not that method was more complicated than it appeared at first sight, and whether his hydrometer was more accurate, and, at the same time, as easily managed and as permanent as the ordinary Sikes instrument. This estimated saving of 50,000*l.* was a matter which should interest the Society indirectly; for although it might be argued that the money must be a gain to certain persons, he would like to see it applied to assisting the poor chemists of this country to obtain a supply of decent alcohol. That would be an exceedingly valuable contribution to science from Her Majesty's Government, and if Dr. Derham had done no more than prove that there was the possibility of a plus or minus of this value he would have done good service. It was only those who knew how grievously scientific work was hampered for want of pure alcohol who could appreciate that want. It was impossible for the English scientist to compete with the German even in the production, for example, of such simple bodies as the diazo-compounds, because their production involved a large employment of pure ether. The result was that English chemists were sadly hampered in the prosecution of research, and he could assure those gentlemen who had spoken so ably on behalf of the Revenue service that a generous supply of that fluid by Her Majesty's Government was what was chiefly required to meet the difficulty. With regard to some of the points raised in the discussion, he would remind the meeting that the whole question of the specific gravity of alcohol and its percentage composition had been laboriously and ingeniously worked out by one of the ablest chemists of the time—Prof. Mendelejeff. He had recently received a large volume in Russian, in which were a great number of tables and curves dealing with alcohols. An abstract of this paper had appeared in the Chemical Society's Journal for November. In that paper Mendelejeff had given definitely the relations between percentage composition and specific gravity, and had pointed out a remarkable general law respecting the specific gravity of alcohol and solutions of salts. The specific gravity being always expressed in Mendelejeff's paper in terms of the percentage composition, it was easy to deduce the variation of the specific gravity in terms of the percentage composition. The relation of the specific gravity to the percentage composition in solutions of salts as well as alcohol and water was shown to be a simple linear function. Mendelejeff deduced from his examination of alcohol this remarkable fact: that the variation of specific gravity to percentage composition must be expressed by a linear function, and when he compared the densities of alcohol and water he had found that instead of one continuous line there were three broken ones. He inferred that this was the range of a definite hydrate partly dissociated in excess of water. If he (Prof. Dewar) remembered rightly, the relation of the amount of combined water in these three hydrates was as $1 : 2^2 : 6^2$. But what was most remarkable was that Mendelejeff had actually succeeded in separating these definite hydrates which he had inferred from this law by cooling the alcohol first to − 20° and then to − 80°. In a similar sense chemists were indebted to Dr. Derham for so ably discussing the importance of that simple instrument, the hydrometer, though he fully agreed with the Chairman that it was a matter which would be properly appreciated only by those who were continually using and thoroughly understood it. In reference to Mr. Keene's interesting remarks about the obscuration of alcohol in spirits, he might mention that some time ago a large sum of money had been offered to the French Academy to be given as a prize for the accurate determination of the alcohol in French wines and spirits. The whole matter was discussed and reported on by Berthelot and others, and was considered of such importance that the decision was reserved till 1892, in the hope that by that time someone would discover a method of eliminating the compounds other than pure alcohol which exist in fermented fluids.

Mr. Helm further desired to ask Dr. Derham whether the principle of his instrument was not exactly that of Bates' saccharometer, or whether he claimed that the principle itself was new. Only that day he had had in his hand a hydrometer made fifty years ago, which was exactly similar in principle to Bates' instrument in the attachment of the weight, and the range went from 800 to 1,000. He presumed that it was on the same principle that Dr. Derham's instrument was based.

Dr. Derham, in reply, said: I will begin by replying to a few of the objections which have been most recently made. First, in regard to the question just asked, as to whether my instrument is identical with Bates' saccharometer—it is not identical with that instrument. In the course of my paper I remarked that Bates' instrument was an ingenious mechanical adaptation of the requirement that the successive increment to the total bulk for each repetition of the scale should be the bulk of the scale itself. But if you examine Bates' instrument you find large poises whose bulks bear no established relation whatever to the bulk of the scale; the utmost that can be alleged is that the successive difference of their bulks may be the bulk of the scale. And further, there is no relation between the specific gravities of his poises and the specific gravities indicated by the instrument.

A Member: But there is!

Dr. Derham: There is not! And further, the specific gravities of his poises vary with the accidental dimensions of the instrument. The only means that he has of determining the bulks of his poises, judging from the specification of his patent, is a simply mechanical one. In fact the scientist has nothing to do with the results, and has to take the word of the instrument maker as to the correctness of the instrument. With respect to the question as to whether I have made allowance for the expansion of my instrument by temperature, I would say that the error of the present system is chiefly in the tables of strengths, and our first object should be to get correct tables, where the relation between the specific gravities and the strengths is properly shown. Where this has been done and all errors due to expansion eliminated, it would be foolish to so calculate tables of strength as to re-introduce that error. But if absolute scientific accuracy is wanted, allowing for the cubic expansion of the instrument, a small table can be provided, showing what allowance is to be made for the varying bulk of the instrument at each degree of temperature. This fault is inherent in all instruments, but it should not affect the indications of the tables. Another point raised was as to the dimensions of my instrument and its awkwardness. Mr. Goschen and his advisers said it was too delicate an instrument. These criticisms are inconsistent. It certainly is a little larger than Sikes' hydrometer. The mechanic to whom I entrusted the work made the instrument just one-eighth of an inch larger than the Revenue instrument. The stem, too, is of a different shape, being round, whereas the Revenue instrument is flat. I adopted that form because I can determine the bulk of the stem much more easily when round than when flat; but if there is any preference for the flat form, anyone can have it. The cage for the reception of the poises is a matter of detail. Mine is safer than Sikes', and there is not so much probability of the collection of air bubbles, as you can see all round mine and drive them off if they are there. But if anyone objects to the present shape, it can be made in every respect the same as Sikes'—except that my instrument must have larger poises if it is to be correct. It seems to me that if accuracy is desired a little inferiority in respect of shape should be overlooked if it existed, but there is no inferiority whatever. A good deal has been said about gauging, and the liability of Revenue officers to make an error of two or three gallons either in favour of the Revenue or against it. But the error which I have pointed out is an additional one hitherto unsuspected, and coming at the end of all these others. It has nothing to do with the gauging. What I object to is the erroneous estimate of the strength of the contents of the casks. Why persist in maintaining error where it is so easy to have the truth? Another objection was made with regard to the standard of proof. I remarked that the only temperature taken is 51°. Sikes' instrument has a specific gravity 10·007 at the water point according to the Revenue table, and when we ascertain the gravity of proof, a little weight, one-thirteenth of the total weight, is put on top, and that, in conjunction with the sixty weight with ninety-two one-hundredths of the stem immersed, marks the proof gravity in distilled water at 51° Fahr. That establishes all I have said with regard to the gravity of proof spirit, and shows that the specific gravity of proof spirit has always been twelve-thirteenths of 10·007. Mr. Keene said something with regard to obscurations, and to a loss so incurred at one time. Of course that improvement has been effected, and it seems to me to form a precedent for the present case. I am proposing to effect an economy of 50,000*l.* a year. The one case is a precedent for the other, and I hope the authorities will follow the good example set so long ago. I did not say that the merchant lost this 50,000*l.* His loss varies from a few shillings to 25*s.* a gallon, but it must in any case be considerable, and probably is not inferior to that accruing to the Revenue. I am told that the mean temperature does not correspond to my "assumption." But it is not an assumption. I have verified it, and have the data in my possession. The average temperature in the Midlands is only 47°; that of Scotch warehouses is 45°. I have no absolute facts to produce with regard to London, but from what I have ascertained I am satisfied that the mean temperature of the locality is the mean temperature of the warehouse. We must remember that this loss of 50,000*l.* is only a difference. It does not represent the whole of the injury inflicted on the trade. One section of the trade has lost much more than 50,000*l.*—80,000*l.* perhaps; another section, at the expense of yet a third, has been compensated to the extent of perhaps 40,000*l.* or 50,000*l.* My estimate represents the difference, but the real loss is the sum of the losses inflicted on different sections, namely 100,000*l.* I have the notes of a calculation based on the assumption that the mean temperature of the kingdom is the mean temperature of the spirits. On that basis I found that the loss to the Revenue on one side was 82,500*l.*, and the gain on the other side 18,000*l.*; so that the difference, representing the net loss to the Revenue, was 64,500*l.*, but the total loss to the trade would be 100,500*l.* It has been objected to my calculation that it was based on a strength of 25 over proof. I took that figure for convenience—some spirits being above, some below. It would have been tedious to have gone into all these details. If I had taken 11 instead of 25 I should have had a much larger number of bulk gallons to deal with. If I had taken proof I should have had 40 millions instead of 32 millions bulk gallons, so that the ultimate result would be nearly the same in every case.

Meeting held April 23rd, 1888.

MR. D. HOWARD IN THE CHAIR.

NOTES ON THE MANUFACTURE OF CHLORINE, WITH SPECIAL REFERENCE TO THE USE OF MAGNESIA IN THAT PROCESS, AND ITS ECONOMY.

BY C. T. KINGZETT, F.I.C., F.C.S.

In course of the discussion which followed the communication to this Section by Professor James Dewar, the President of the Society, of his discourse on the Weldon-Pechiney process for the manufacture of chlorine from chloride of magnesium, I pointed out that the chemical reactions involved in the process did not appear to have been satisfactorily determined. The oxychloride of magnesium as finally treated in that process contains more than 20 per cent. of water, and therefore it is possible that the chlorine which is obtained results not merely from the action of oxygen on the dry chloride or oxychloride, but also in part, and perhaps chiefly, from the oxidation of the vapour of hydrochloric acid which is necessarily generated in the earlier stages of the decomposition. I thought this matter worthy of remark, because if the chlorine results in any considerable proportion from the direct action of air upon the vapour of hydrochloric acid, then Leblanc soda-makers would, as I pointed out, surely have an easy method of utilising their spare hydrochloric acid by means of a permanent quantity of magnesia to be alternately converted into chloride by hydrochloric acid, and decomposition of the product by air at a high temperature, indefinitely; or by the employment of a merely nominal amount of magnesia to effect the inter-action of air and hydrochloric acid vapour which might be passed in admixture in contact therewith. These modifications of the Weldon-Pechiney process would obviate the employment of chloride of magnesium as a substantial feature in the process—a matter which appears to be of much pecuniary importance, particularly to English manufacturers.

In his reply, Professor Dewar made no comment on the questions I had raised, and I therefore determined to test the matter for myself in my own laboratory. I have not been able to devote enough time, so far, to work out the subject to my perfect satisfaction, but the record of some of the experiments I have made will not be without interest and value to the members of this Society.

Experiment No. 1.

The first experiment was conducted with the view of ascertaining if chlorine is produced by passing dry air mixed with HCl gas over pure dry magnesia. For this purpose a combustion tube was filled with a small quantity of MgO admixed with much asbestos, and connected with a flask in which hydrochloric acid gas was generated from a mixture of sulphuric acid and common salt, and through which a current of air was slowly passed, so that the mixture of air and hydrochloric acid gas, after being dried by passage through pure H_2SO_4, was transmitted over the contents of the combustion tube, which was maintained at a bright red heat for one hour. The gases which passed out from the tube were conducted through two Woulff's bottles, containing distilled water, which was subsequently examined for free chlorine and found to contain a total quantity of 0·5964 grm.

It should be mentioned that the gas had the characteristic odour of chlorine, and the quantity which was ascertained to be finally present in the water did not by any means represent the total quantity produced in the experiment, as, by the passage of air, the chlorine was for the most part blown out of the solution, indeed, to such an extent that the gas above the water in both wash-bottles was distinctly green in colour.

The contents of the combustion tube, after the experiment, were rinsed out with distilled water, filtered, washed, and the solution acidified with nitric acid, after which the chlorine present therein was volumetrically determined. The chlorine which was found present, was equivalent to 2·584 grms. of $MgCl_2$. From the presence of combined chlorine in the contents of the combustion tube, it would appear to be possible that not only the following change had taken place—

$$2\ HCl + O = H_2O + Cl_2,$$

but that the chlorine in part, at least, resulted from the following reactions :—

$$MgO + 2\ HCl = MgCl_2 + H_2O, \text{ and}$$
$$MgCl_2 + O = MgO + Cl_2.$$

To elucidate this matter further, the next experiment was made.

Experiment No. 2.

A mixture of dry HCl gas and air was passed through a combustion tube containing asbestos only, which was kept at a bright red heat, as before, for 1¾ hours, the gaseous product being passed through a mixture of 100 cc. of a 10 per cent. KI solution with 100 cc. of 1 : 5 H_2SO_4. Iodine was immediately liberated, indicating the presence of chlorine, and at the conclusion of the experiment the amount of chlorine which had been formed was found to be 0·536 grm. ; it is therefore evident that at this temperature, air decomposes HCl gas and furnishes chlorine in consequence, but that the quantity so obtained is much less than that which results when magnesia is employed as a catalytic agent.

The next experiment was made to ascertain if chlorine is obtained by the direct decomposition of anhydrous $MgCl_2$ by oxygen.

Experiment No. 3.

About 13 grms. of pure MgO was ignited in a platinum crucible and afterwards admixed with about an equal quantity of previously ignited asbestos. The mixture was then placed in a combustion tube, which was heated for some time to remove all traces of moisture. Afterwards, a current of HCl gas, which was dried by passing it through two successive bottles of H_2SO_4, was passed over the mixture (at a dull red heat) in the combustion tube for one hour, with the view of producing the chloride of magnesium. The current of HCl gas was then turned off, the tube was allowed to cool down to some extent, and a current of dry air was passed for a few moments through the tube in order to remove all traces of HCl gas or moisture ; then the temperature was quickly raised to bright redness, and the current of air maintained during five hours, the gases being received in a successive series of tubes containing an acidified solution of potassium iodide.

The iodine liberated in the first receiver was equivalent to 0·9940 grm. chlorine, in the second receiver to 2·130 grms., and in the third receiver to 0·4960 grm., the total amount of chlorine thus produced being 3·6200 grms. After five hours no further chlorine was liberated.

The residue in the combustion tube was rinsed with distilled water into a beaker, in which it was thoroughly extracted, the successive quantities of supernatant liquid being filtered, and the washings and filtrate together examined for chlorine volumetrically. The amount found present was equal to 1·4725 grms. $MgCl_2$.

The experiments of which I have now given an account prove, therefore, that chlorine is obtained when a mixture of hydrochloric acid gas and air is exposed to a sufficiently high temperature, also that chlorine is formed by roasting pure dry chloride of magnesium in a current of air at a sufficiently high temperature, and that both these chemical changes are involved in passing a mixture of hydrochloric acid gas with air over magnesium chloride or magnesia at a suitable temperature.

The chemical reactions, therefore, that are concerned in the Weldon-Pechiney process, must be expressed as follows :—

$$1.\ H_2O + MgCl_2 = MgO + 2\ HCl, \text{ and}$$
$$2\ HCl + O = H_2O + Cl_2.$$
$$2.\ MgCl_2 + O = MgO + Cl_2,$$

whilst the decomposition of the HCl vapour by means of air is, as I have shown, promoted by the presence of free magnesia.

So far then as the decomposition of hydrochloric acid vapour by air is concerned in the Weldon-Pechiney process, I think there can be no doubt that it resembles the so-called "Deacon" process of manufacturing chlorine, in which the decomposition is promoted by the presence of a third substance which also experiences chemical change.

As bearing upon the idea with which I started, namely, the possibility of using a constant and limited quantity of magnesia with a view of manufacturing chlorine from successive quantities of hydrochloric acid, the following further experiment was made :—

Experiment No. 4.

Fifty cc. of fuming commercial HCl containing 18·980 grms. of real HCl (as ascertained by volumetric estimation) was placed in a flask which was so fitted that a current of air could be aspirated through the contents of the flask, which was kept at 70° C. The flask was further connected with a tube containing pumice-stone which had been impregnated with MgO by previously soaking the pumice-stone in a concentrated solution of $MgCl_2$, and then igniting it. The tube was kept at a bright red heat, as in the other experiments, and the gases passing out from the tube were conducted through a second tube (not heated, of course) containing lime, and subsequently through two wash-bottles containing acidified potassic iodide solution. Under these circumstances, the current of air and HCl vapour was maintained during six hours, and at the conclusion of the experiment, the chlorine absorbed by the lime, and the amount of iodine set free in the final wash-bottles, were respectively determined, as also the residual amount of HCl in the hydrochloric acid employed :

	Grms.
HCl at the commencement of experiment	18·980
Residual HCl at end of experiment	15·9687
Used, being difference	3·011

= 2·929 grms. chlorine.

The contents of the lime tube were washed with water into a beaker, an excess of potassic iodide was added, and the whole was acidulated with dilute pure HCl; the amount of iodine thus set free was then determined, and found equal to 1·6028 grms. active Cl. The iodine set free in the acidified potassic iodide solutions was determined, and found equal to ·02982 grm. Cl in the first vessel, and ·02272 in the second vessel. Adding these quantities to the active chlorine present in the lime, we obtain a total of 1·65534 grms. active chlorine which resulted from the decomposition, in the process, of hydrochloric acid containing 2·929 grms. chlorine. It was also proved experimentally that chlorine was present in the form of $MgCl_2$ in the tube containing the pumice-stone, which had been coated with MgO. It thus seems to be tolerably well established that not only chlorine but that bleaching powder may be made directly, readily, and economically by passing a mixture of hydrochloric acid vapour and air, with or without aqueous vapour, over any suitable substance, such as brick or pumice-stone, which has been previously coated or admixed with MgO or a salt of magnesium; and to my mind this process presents great advantages over the so-called Weldon-Pechiney process, which involves the handling of huge quantities of solid material, and the employment of complicated and expensive plant.

In the practical manufacture of chlorine after the method which I have described, it would be possible to concentrate the gaseous product by passing it through successive chambers containing the porous material coated with the magnesium compound.

I may add that, personally, I was not aware, until Professor Dewar called attention in his paper to the statement of Graham, that chlorine could be obtained by roasting pure magnesium chloride in a current of air, and in the earlier experiments which I made for Mr. Weldon about 1870–72, in which we experimented with mixtures of the oxides of manganese and magnesia, I think we always regarded the active chlorine as having been derived from the decomposition of the chloride of manganese exclusively. The function of magnesium compound consisted as we thought only in the regeneration of the oxide of manganese. Other chemists, however, seem to have been more familiar with the true facts of the case, as is evidenced by a perusal of some specifications to which I will briefly direct attention.

From the specification by Henry Larkin and Wm. White, No. 3093 of 1870, for an invention which received provisional protection only, I quote as follows:—

"We obtain chlorine by the reaction of oxygen upon certain metallic chlorides at a high temperature. For this purpose we take any suitable chloride, such as the anhydrous chloride of magnesium or of iron, and spread it loosely over the floor of the furnace chamber or retort, in which it is brought to a red heat. In this state we expose it to the action of a current of oxygen or of dry atmospheric air; or we cause a fused chloride to fall or otherwise pass through a heated chamber containing oxygen. By thus exposing the heated chloride to the action of oxygen, a change of combination is brought about, the oxygen unites with the metallic base, while the combined chlorine is set free."

Evidently, therefore, these gentlemen were acquainted with the decomposition of magnesium chloride by oxygen, or assumed that such a decomposition takes place.

In the description of my experiments I have called attention to the fact that the inter-action of air and hydrochloric acid vapour is undoubtedly *assisted* by the presence of magnesia in the sense that a salt of copper acts in the Deacon process of manufacturing chlorine.

Mr. Joseph Townsend, in his specification No. 3483 of 1874, proposed to use a mixture of manganese chloride and magnesium chloride for saturating bricks or other suitable inert materials, which were then to be placed in any suitable heating chamber or vessel, and exposed to a current of hydrochloric acid and air. He fixes the temperature at which the decomposition is effected at between 200° and 300° Fahr., but preferred to use the higher temperature of about 600° Fahr.

It will be seen that none of these proposals are absolutely identical with the one which I have made, namely, the employment of any suitable porous substance coated or impregnated with magnesia or a salt of magnesium only for the purpose of assisting the decomposition of an indefinitely large amount of hydrochloric acid by the agency of a current of air in admixture. Of course the employment of a porous substance may be dispensed with and a fixed quantity of magnesia or other magnesium compound be alone employed. The hydrochloric acid can be employed in the shape of vapour as generated in the manufacture of salt-cake, or it may be obtained from a solution of the concentrated acid by evaporating it in a current of air or by allowing that liquid to enter the heated chamber containing the catalytic substance, in the form of drops or spray, thus securing also the presence of aqueous vapour, which, according to my experience, appears to materially promote the desired chemical change.

My process, therefore, may prove of special value in works where chlorine may be manufactured in the main by other methods but in which hydrochloric acid is condensed and is available for utilisation otherwise.

In conclusion, I wish to add that I have taken steps to protect the novel features of the process I have herein briefly described.

DISCUSSION.

The Chairman said it was not very long since the important question of the decomposition of hydrochloric acid by magnesia had been dealt with before the Section. Still, Mr. Kingzett's paper raised certain points which had not been considered on the former occasion, and he was therefore glad to see several members present who had made a special study of the subject. He would ask Mr. Mond in the first place to give the meeting the benefit of his experience in the matter.

Mr. Ludwig Mond said: Mr. Kingzett's paper bears undoubtedly upon an important subject, still I cannot but regret that he should not have carried his experiments further before bringing them before this Society. Only in one of his four experiments has he determined the percentage of hydrochloric acid converted into chlorine, and even in this one experiment he has not given us the proportion between oxygen and hydrochloric acid in the gases used, nor the exact temperature at which he worked.

Everybody acquainted with Dr. Hurter's classical research on the decomposition of hydrochloric acid by air by means of catalytic substances, knows that the proportion between the gases and the temperature has a very great influence upon the percentage decomposition. In the absence of these data it is quite impossible for us to judge whether the suggestion of Mr. Kingzett to employ magnesia as a catalytic substance offers any advantage over the well-known process now in use, the beauty, simplicity, and thoroughly scientific character of which, combined with commercial efficiency, will make the names of Henry Deacon and Ferdinand Hurter ever famous in the annals of industrial chemistry.

On the other hand there seems to be no doubt that the use of magnesia will have the same disadvantages as the Deacon process. Both require pure hydrochloric acid gas to produce chlorine fit for bleaching-powder making, and can consequently only utilise a certain portion of the hydrochloric acid obtained in making salt cake by the ordinary process; and even this pure hydrochloric acid is only partially converted into chlorine, the remainder being obtained as liquid hydrochloric acid; so that, in practice, not more than 30 per cent. of the hydrochloric acid produced from a given quantity of salt is obtained as chlorine by this process, and the whole of the rest has to be dealt with by different and less perfect methods. I believe that this has been the principal reason why this beautiful process, which produces chlorine at a less expense than any other process known, has not found wider application. I, therefore, wish to bring under your notice several inventions which have for their object the overcoming of this defect of the Deacon process, and which seem so far not to have received the attention they deserve.

My friend, Mr. Ernest Solvay, patented in 1880 a process for obtaining pure hydrochloric acid gas from impure gas or from liquid acid, by means of strong solutions of chloride of calcium, which have the property, when they have absorbed hydrochloric acid gas, or when they are mixed with a certain quantity of liquid acid, of giving off, on heating, dry hydrochloric acid gas, and of retaining the water. In a subsequent patent, Mr. Solvay proposes to carry out this process by simply mixing a hot concentrated solution of chloride of calcium with a certain quantity of liquid hydrochloric acid, and agitating the mixture by mechanical means or by blowing air through it. This method I have carefully tested on a laboratory scale, and have found it to work very satisfactorily.

Mr. Robert Hasenclever patented in 1883 the use of sulphuric acid in a very similar way. Mr. Hasenclever runs hot sulphuric acid, such as is obtained from the ordinary lead evaporating pans, through a series of vessels into which he also runs a certain quantity of liquid hydrochloric acid in a continuous stream, and he passes through these vessels, in the opposite direction to the flow of the acids, a current of air. In this way he obtains a mixture of dry hydrochloric acid gas and air, such as is required for the Deacon process. The diluted sulphuric acid issuing from his vessels is again concentrated in the leaden pans. This process has been at work for several years in Mr. Hasenclever's excellently appointed works at Stolberg, near Aachen, and, I have every reason to believe, with perfect success.

In 1886 I also patented a process for converting hydrochloric acid gas into chlorine, which is specially applicable to the treatment of impure gases such as are obtained from the ordinary salt-cake roasters, from the Hargreaves process, &c. I propose to pass these gases over certain oxides or salts at suitable temperatures, so as to convert the latter partly into chlorides, and then to treating the product by a current of hot air so as to obtain chlorine and regenerate the original material used. I specially recommend the oxides of nickel and cobalt for this purpose, but I also mention magnesia as one of the oxides which can be used. I may here state that I prefer the oxides of nickel and cobalt, because they allow of a complete conversion of the hydrochloric acid into chlorine, while the magnesium chloride always retains a certain quantity of water, which, on subsequent treatment with air, gives rise to the formation of a certain percentage of hydrochloric acid which contaminates the chlorine gas. This process has given me very good results in the laboratory, but I have had no opportunity yet of trying it on a larger scale.

All these three processes put it into our power to convert practically the whole of the hydrochloric acid gas obtained from chloride of sodium into chlorine, and thus to reduce the quantity of hydrochloric acid required for the manufacture of chlorine to a minimum.

I am not prepared to say which of the processes deserves preference, but Mr. Hasenclever's has certainly had the advantage of having been successfully worked on a large scale for several years.

It is obvious that these processes are also of some importance in connexion with the Weldon-Pechiney process. This process, which has been so ably brought before you in one of those lucid and eloquent lectures for which the President of our Society is so highly distinguished, is essentially (as Mr. Weldon himself repeatedly pointed out in his patents) a process for producing chlorine from solutions of chloride of magnesium. It produces, however, besides chlorine, a very considerable quantity of hydrochloric acid, which can, it is true, be easily reconverted into chloride of magnesium; but it may be that one of the processes I have brought under your notice will prove more economical for the treatment of this acid.

As I was not in England when the Weldon-Pechiney process was so fully discussed by this and the Liverpool Section of our Society, I should like, with your permission, to avail myself of this opportunity of giving you my impressions on this process. Through the kindness of Mr. Pechiney I have had the pleasure and advantage of seeing the process in operation, and examining it carefully in all its details; and like everybody who has had the same privilege, I have been struck with the highest admiration for the inventive genius and engineering skill and knowledge which have been brought to bear upon the construction of the plant for this process by Mr. Pechiney and his able collaborateur, M. Boulouvard. Truly this plant is one of the finest specimens of the art of the chemical engineer, and proves what immense progress this art has made in our times; but Mr. Pechiney and M. Boulouvard have done a great deal more than designing and erecting an admirable plant for Mr. Weldon's important invention. They have got this plant, which looks on paper much more formidable and complicated than in reality, to work with great regularity, and have worked out all the manufacturing operations of the process to such perfection that it can now be safely put into the hands of foremen and workmen skilled in chemical work. They have also carried out the process on a scale quite sufficient to enable the manufacturer inclined to adopt it to erect forthwith large works, with a fair certainty of the results that he will obtain from them. Certainly the process is still in its infancy, and is still capable of considerable improvements. Nobody is more ready to admit this, and to insist upon it more strongly, than Mr. Pechiney himself; but to those manufacturers who produce strong solutions of magnesium chloride as a waste product the process offers such large returns, not only at the present price of chlorine products, but also at considerably lower prices, that they can well afford to work out these improvements themselves, and to adapt their plant from time to time to the experience gained in the course of manufacture. Nor do I think that they need fear that any existing or future process for obtaining chlorine from chloride of magnesium or from hydrochloric acid will produce that commodity at less cost than the Weldon-Pechiney process, after the improvements of which it is still capable have been made, while any such new process, before it could come into use at all, would probably require quite as many years of hard and persistent work, and probably no smaller amount of engineering skill and inventive genius as Mr. Pechiney and M. Boulouvard have brought to bear upon Mr. Weldon's invention.

While admitting all this in favour of the Weldon-Pechiney process, I do not share the fears of others that this country, which does not produce magnesium chloride as a waste product, will in future be compelled to look for its supplies of chlorine products to foreign countries.

I have made very careful calculations of the probable ultimate cost of chlorine by the various processes in various localities, which have led me to the conclusion that, under favourable conditions, we can, by the aid of the processes I have brought under your notice, manufacture bleaching-powder from hydrochloric acid quite as cheap in the North of England as it can be laid down there from Stassfurth or the South of France; and moreover I have the greatest confidence that the sustained efforts of Mr. Ernest Solvay to produce chlorine from the waste chloride of calcium of the ammonia soda manufacture, and my own process for obtaining chlorine direct from ammonium chloride, to which I have devoted my best energies during the last two years, and which I am firmly resolved to carry to a successful issue, will, before long, enable this country to hold its own in the manufacture of chlorine products against the whole world. I am of opinion that probably all these processes will find a useful field in different localities and under different circumstances, and that a great amount of work bestowed upon them by different investigators will prove beneficial to them as well as to the world at large.

Professor **Dewar** felt somewhat diffident in attempting to discuss Mr. Kingzett's communication. Though as a member of such a Society he could not but sympathise with an inventor and be desirous of stimulating novelty, he yet felt it an awkward position—having only a short time ago brought before the Society the results of the application of the Weldon-Pechiney process on the large scale—to have to rise now and contrast with that process the suggestion of a modification founded only on a few laboratory experiments. He should not have dreamed that anyone acquainted with the mere elements of chemistry would doubt that if hydrochloric acid was passed over heated magnesia and chloride of magnesium and water resulted, that if air were one of the constituents employed, chlorine would be obtained. Nor was there any doubt that hydrochloric acid could be partially dissociated in presence of oxygen, yielding water and a certain quantity of chlorine. That, he supposed, was well known to every member of the Society. When, in reading his recent paper on the Weldon-Pechiney chlorine process, he had discussed the elementary reactions involved in it, it was not in the sense in which Mr. Kingzett understood him, but in explanation of his statement that some of the reactions involved in the process were not mentioned in modern text-books, though they were well known to Graham and Davy, and that had led him to the experiments he had brought before the meeting, to prove that the process was a real case of dissociation. But he had pointed out at the time that the evolution of hydrochloric acid took place immediately on charging the oxychloride into the enormous mass of heated brickwork. The hydrochloric acid went off with no evolution of chlorine, and the decomposition of the remaining oxychloride by oxygen occurred subsequently. He did not therefore dispute the reactions described by Mr. Kingzett, but he could not recognise them as improvements on the Weldon-Pechiney process as at present worked. With regard to the history of these processes, he must confess that when he read his paper he had avoided dealing with it as much as possible. He had always understood from Mr. Weldon that even at about the time he brought out his original manganese process he was impressed with the possibility of using magnesium chloride. However, in order to refresh his memory on the subject, he had recently looked through Mr. Weldon's early patents, and had found that in 1868 he had claimed the use of magnesia instead of lime in the old Weldon process, with the object of recovering a large portion of the hydrochloric acid, by the subsequent action of steam and air on magnesium chloride. But in the same year he had disclaimed the use of magnesium chloride for the production of chlorine and hydrochloric acid, because he had found that in 1863 a Dr. Clemm had taken a patent for the action of chloride of sodium on sulphate of magnesia, by passing steam over that mixture to produce hydrochloric acid. In 1869 Mr. Weldon had turned his attention to the idea of economising the chlorine of calcium chloride, to which Mr. Mond had referred as Mr. Solvay's invention. In his patent of 1869 he described two methods of utilising the chlorine of calcium chloride: First, by adding magnesia to the chloride of calcium in solution, and treating the mixture with carbonic acid gas under pressure, so as to obtain carbonate of lime and solution of chloride of magnesium; secondly, by decomposing the chloride of calcium under the influence of heat, by the joint action of silica and steam. This latter method resembled to a certain extent the process of Mr. Solvay. It was clear therefore that as early as 1868 and 1869 Mr. Weldon was endeavouring to utilise the chlorine of both magnesium chloride and calcium chloride; in fact there were sufficient records of these matters to form an interesting paper by themselves. With regard to Mr. Kingzett's proposition, it seemed to him to be, as Mr. Mond had said, a suggestion of a Deacon process, with a basis of magnesia. If he remembered rightly, however, Mr. Deacon had used magnesium salts in his process. He felt sure that sulphate of magnesium was used, whether in combination with copper or not he did not remember, but he knew that both copper and sulphate of magnesium were referred to in the patents. The important point of Mr. Mond's reference to the Weldon-Pechiney process had relation to the economical use of the dilute chlorine produced. The results obtained at Salindres had greatly improved since he read his paper on the process. He held in his hand a letter just received from Mr. Pechiney, which he had not yet had time to digest, in which Mr. Pechiney indicated the effect which this process was likely to have on the manufacture of chlorates alone. He might observe here, that in 1881 Mr. Weldon had taken out, on

Mr. Pechiney's behalf, certain English patents for the only real improvement in the manufacture of chlorates that had taken place for a long time, with the exception of the patent taken by Mr. Weldon in 1871 for the manufacture of chlorates by the use of magnesia. Pechiney's process was to separate out a large portion of the chloride of calcium by means of crystallisation, and the subsequent formation and separation of oxychloride of calcium, the remaining liquor, consisting of a mixed solution containing rather less than one equivalent of calcium chloride per equivalent of chlorate. This solution was treated with potassium chloride in the ordinary way, and gave a large yield of chlorate. In the letter to which he had referred, Mr. Pechiney stated that he was at present working chlorates not entirely by magnesia, but that was simply because he had got the old Weldon plant. But when the Weldon-Pechiney process also came into operation in that manufacture it would enable any manufacturer using it, at once to produce five times the usual quantity of chlorates for a given expenditure of HCl. So that Mr. Pechiney was led to inquire what would be the result if a manufacturer were to use the process for the manufacture of chlorates from the whole of the hydrochloric acid at his disposal; and he says: "What are you going to do? For if you were to allow any large manufacturer of chlorate to employ the process without limit, I could name one firm who would be able to make more chlorate than is at present consumed in the world, and with a very small consumption of hydrochloric acid;" for the present working loss of 20 per cent. in the Weldon-Pechiney process will in all probability be ultimately reduced to 10 per cent. That, he thought, proved that the application of the Weldon-Pechiney process to the manufacture of this one chlorine product was of sufficient importance to make it hard to beat—as Mr. Mond had put it. He liked to see boldness in an inventor, and Mr. Mond certainly seemed to him to assume a position of boldness, in which he wished him all success. Probably what Mr. Mond had suggested would prove to be the case—that each of the processes he had mentioned would be specially applicable in certain localities. It was satisfactory to his mind to find that in his most recent process Mr. Mond had reverted to the use of chloride of magnesium. He had had the pleasure lately of seeing a German patent of Mr. Mond's, in which to his surprise he found that Mr. Mond had returned to the use of chloride of magnesium, so that it seemed clear that Mr. Weldon's attempts of 1868, 1869, and 1871 continued down to 1885, to use magnesia and magnesium chloride for the manufacture of chlorine and chlorates had led other inventors to look to the use of these bodies. For Mr. Mond was not alone in this matter. By a recent patent of Mr. Schlœsing's (of ammonia soda fame), he saw that he also had come to the use of magnesium chloride for the production of chlorine. So that here were three great inventors connected with alkali, viz., Weldon, Mond, and Schlœsing, all using some modification of the same body. He did not say that the inventions were identical, but the foundation was the same; and that was satisfactory as indicating that the original basis was a good one. So far as the Weldon-Pechiney process was concerned, the only remaining point was, would its application to the manufacture of chlorates be prevented? That might seem a ludicrous idea, but it was not so. Within the last few years two distinguished chemists, Messrs. Muspratt and Eschellmann, had taken out several patents for the manufacture of chlorates by means of magnesia. Unfortunately, however, either he could not interpret a patent and his judgment was quite at fault, or the principle involved in these patents had been already proposed by Messrs. Weldon and Pechiney in 1871 and 1881. He did not say that the Muspratt and Eschellmann patents did not contain some subsidiary points of novelty; but he was clear that they could not prevent the use of magnesia in the manufacture of chlorates, and thus the application of the Weldon-Pechiney process to that industry. All he could say to Mr. Kingzett was that he was much indebted to him for his suggested modifications. He did not consider the Weldon-Pechiney process perfect; in fact, Mr. Mond had truly said that it was still capable of great improvement. Whether Mr. Kingzett had hit upon an important method remained to be seen; at any rate he was working on a line of great interest. It was to be hoped that he would continue his investigations, and bring the matter before the Society again when he was making, say, a ton a day, so that his results might be compared with others.

Mr. Mond could not but praise Professor Dewar's endeavours to show that at a very early period Mr. Weldon had called attention to the properties of chloride of magnesium. At the same time he wished to point out—as indeed Mr. Weldon himself had done in the case of Dr. Clemm—that the fact of magnesium chloride being a possible source of hydrochloric acid was known many years before even Dr. Clemm's patent. In fact he could not remember the time when this fact was not known to all those who took any interest in the subject. Professor Dewar, however, had not called attention to Mr. Weldon's most remarkable patent on the subject, which received provisional protection only, in 1872, in which Mr. Weldon had proposed to use magnesia in connexion with recovering the ammonia of the ammonia soda process, and to utilise the chloride of magnesium so obtained for obtaining either hydrochloric acid or chlorine, by the action of steam or air. In that patent was expressed the germ of a good deal that had been suggested by great numbers of people since. By a strange coincidence, a few days earlier Mr. Solvay had patented the same idea, and that was probably the reason why Mr. Weldon had not proceeded with his patent. But after all, even at that time, 16 years ago, it was so obvious to anybody versed in chemistry and knowing what was wanted, that he did not think a great deal of credit was due to either the one or the other inventor for bringing forward this chemical reaction for the end which they were seeking. The difficulty in all these matters did not lie in finding the chemical reactions, but in carrying those chemical reactions out on a manufacturing scale, so that they yielded their products at a price that made it profitable to use them. Professor Dewar had observed that many of those engaged in trying to obtain chlorine as a bye-product of the ammonia soda process had now turned their attention to that body, magnesium chloride, which Mr. Weldon had proposed so many years ago. But surely it was evident to anyone who glanced at the subject, that of all the well-known substances magnesium chloride lent itself most readily to the purpose, and was the substance to which everybody would first turn his attention. The very fact that no one had yet succeeded in making chlorine in connexion with the ammonia soda process proved that it would be done if possible. The simple reason for this was that one could not obtain anhydrous chloride of magnesium by treating magnesia, however anhydrous, with either ammonium chloride vapour or with hydrochloric acid. The chloride of magnesium always retained some moisture, which led to the formation of a certain amount of hydrochloric acid, and this fact constituted a serious bar to the use of that substance.

Mr. Kingzett, in reply, said he thought he was justified in saying that most of the remarks made had no application to the paper he had read. Mr. Mond's remarks concerned rather a number of his own and other persons' inventions to which he was anxious to direct attention. He had, however, described the process under notice as one combining all the disadvantages of the Deacon process. He hoped later on to dispel that illusion. Then he had been charged with having misinterpreted Mr. Weldon's specifications. He was confident that he had not done so. He had known Mr. Weldon intimately from 1869 to 1872, was well acquainted with his knowledge on these subjects, and had followed with great interest up to the day of his death all his further progress. Professor Dewar had also somewhat missed the point of his communication. He had not claimed that there was any novelty in the reactions. Nothing novel in chemical reactions bearing on this subject had been introduced for many years, and, as Mr. Mond had said, it was rather in the application of the knowledge we possess to a definite object that novelty was to be looked for. What he did claim, however, was that he had at least circumscribed the knowledge of these reactions within quantitative limits. He was not aware of any experiments on the subject having a quantitative value, and which had been published in advance of those he had just communicated. He had been led to take up the matter by a doubt in his own mind as to how much of the chlorine of the Weldon-Pechiney process resulted from the roasting of dried chloride of magnesium with air. He did not think that Professor Dewar had got over the difficulty by saying that most of the chlorine went off later than the hydrochloric acid, because he thought the diagrams proved clearly that most of the chlorine was evolved during that stage when the water present with the raw material was liberating hydrochloric acid. Hence his doubt was as to how much of the total chlorine resulted from the action of air upon hydrochloric acid, and how much directly from the action of air upon magnesium chloride. If it could be demonstrated that chlorine could be got just as easily and economically by the use of a fixed quantity of magnesia, surely such a process would have great advantages over the Weldon-Pechiney process, which dealt with such enormous quantities of materials, and necessitated the use of such elaborate and expensive plant. One point of novelty in this process consisted in the use of a fixed quantity of magnesia. No previous inventor had ever demonstrated experimentally that magnesia promoted the decomposition of hydrochloric acid vapour by air or oxygen; and he thought he had satisfactorily proved that point. Without going into the specifications quoted by Professor Dewar, he thought that in 1872 Mr. Weldon was not acquainted with the fact that when magnesium chloride was decomposed by heat it yielded chlorine. He himself had made all Mr. Weldon's experiments at that time, and he did not know it either. He believed that in Mr. Weldon's specifications of that time no mention was made of producing chlorine in that way. They were all based on the knowledge that at a certain temperature magnesium chloride was decomposed into magnesia and hydrochloric acid; and Mr. Weldon had availed himself of that reaction for getting magnesia for use over and over again. By way of confirmation, he might mention that when he was writing his own work on the Alkali Trade in 1872, in order not to injure any susceptibilities of Mr Weldon, he had sent him the MS. of his chapter on chlorine produced by the magnesia process. If members would do him the favour of referring to that chapter, they would find that although he had given the reactions which occurred, no mention was made of the decomposition of magnesium chloride into chlorine and magnesia. Professor Dewar had referred to the use by Mr. Deacon of a magnesium compound. That was true within certain limits, for Mr. Deacon, in his untiring efforts to perfect his process, had resorted to no end of modifications of it. One of the difficulties he had had to contend with was the formation of chloride of copper. He generally employed sulphate of copper, and the difficulty was to get it converted into the chloride, because he had found the latter body more active than the sulphate in promoting the desired reaction. For this purpose only, and only, he believed, on a laboratory scale, had he used magnesium compounds. He found out that magnesium chloride assisted in the formation of chloride of copper, but had no idea that magnesia promoted the obtainment of chlorine from hydrochloric acid. Indeed, as he had said, he did not think that Deacon had ever availed himself of the use of magnesium chloride on a manufacturing scale. Professor Dewar had an advantage which he had not: he could not command at present the means of trying his process on a manufacturing scale, producing "a ton of chlorine a day." But he could go to his laboratory and put his ideas to the test; and if those ideas were substantiated by results, he felt justified in introducing them to the Society and asking attention to a process which he felt confident would be found, if put into practice, not only more profitable, but more available on a manufacturing scale than the Weldon-Pechiney process of manufacturing chlorine.

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THE HERMITE ELECTROLYTIC BLEACHING PROCESS.

A Laboratory Investigation of the Electrolysis of Magnesium Chloride.

BY C. F. CROSS AND E. J. BEVAN.

The subject of the electrolytic production of bleaching compounds having been brought under our notice, and the results obtained appearing to us to be of a character not hitherto attained, we thought them of sufficient interest to lay before the Society. This we did in a paper read on March 7th, 1887, published in the March number of the Journal.

In this paper we confined ourselves to a description of the actual results obtained when working on a commercial basis. The evidence afforded us was of a very extraordinary nature, and was such that we should have hesitated to record it were it not that all due care had been taken to obtain accurate measurements, such, that is, as were possible with apparatus on the scale of that with which we worked.

It will thus be seen that the object we had in view was not that of presenting the members of the Society of Chemical Industry with a scientific exposition of the principles underlying the electrolytic method, but merely of acquainting them with certain facts in connexion with the process which we judged to be sufficiently interesting.

At the same time we were fully aware that a very carefully conducted series of laboratory experiments was necessary in order to elucidate certain phenomena which had been observed during the preliminary investigation.

Since the series of experiments was contemplated, a very severe criticism of our original paper has appeared in the form of a paper read by Dr. Hurter at the Liverpool Section of the Society, and published in the May number, 1887. The results obtained by him were so diametrically opposed to our own, that we were compelled to repeat his work, and, to a certain extent, therefore, the present paper may be regarded as an answer to his.

We alluded briefly to the remarkable results obtained by Ledeboer during an investigation of M. Hermite's process. In his experiments he devoted his attention almost entirely to the determination of the actual bleaching effect produced per unit of current.

By causing the electrolysis to proceed in presence of indigo carmine, he arrived at the conclusion that from 1½ to 2½ litres of chlorine (or rather its equivalent in oxidising work) could be obtained per ampère, a result from three to five times the theoretical.

It will, perhaps, be remembered that we pointed out that an electrolysed solution of magnesium chloride of an equal oxidising strength as shown by the alkaline arsenious acid test, possessed a greater *bleaching* efficiency than one of calcium hypochlorite in the proportion of five to three.

This statement was met by Prof. Armstrong, during the discussion that followed, and subsequently by Dr. Hurter, by what is practically a direct negative, and was dismissed as unworthy of serious criticism. As neither of them has brought forward the very slightest experimental evidence to disprove this, it is, perhaps, unnecessary to do more than emphatically insist upon it, merely remarking that the result has been confirmed by the independent observations of many chemists. Further evidence on this point is given in the account, to which we shall subsequently refer, of a series of experiments on the bleaching of linen yarns.

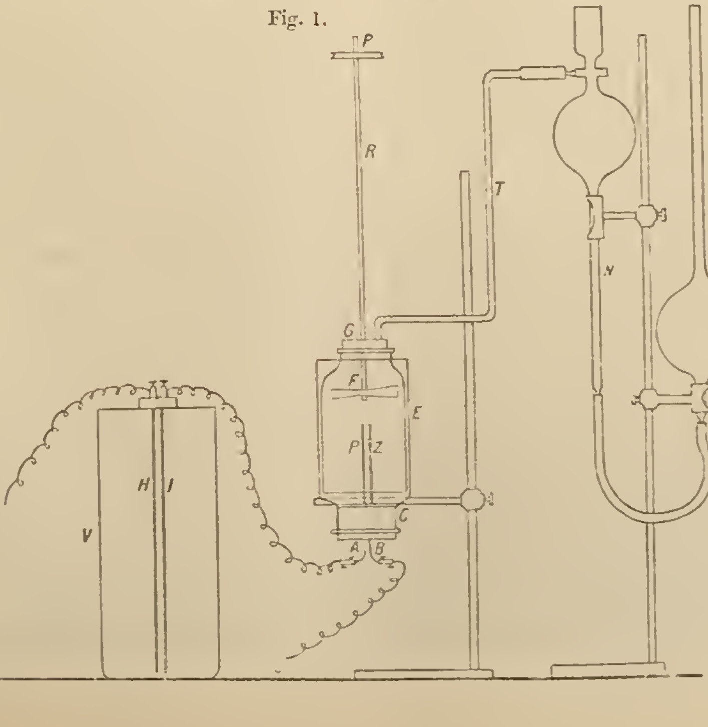
Prof. Armstrong and Dr. Hurter assumed the fallacy of our results by the statement that "if bleaching were oxidation" such results would be impossible. Now we would remind them that bleaching is *not* oxidation in the limited sense implied by them; that it is not in any way an operation comparable with the conversion of FeO to Fe_2O_3, or of As_2O_3 to As_2O_5. The conditions of the bleaching of cellulose are such that the results are profoundly modified by causes which do not act in such simple reactions as we have cited. In proof of this we may mention a somewhat curious phenomenon well known to bleachers, viz., that a solution prepared by passing chlorine into milk of lime has a totally different bleaching effect from a solution of bleaching powder of identically the same strength (arsenious acid). This and numerous other instances which might be referred to show that bleaching is not by any means a simple action.

In the course of our investigation we have had occasion to perform a very large number of experiments, with the details of all of which we will not trouble the Society; we shall only quote those which we think have an important bearing upon the subject.

Briefly, the method pursued was as follows: A current of electricity was passed through a copper voltameter consisting of a glass vessel containing two bright copper plates immersed in a solution of copper sulphate, then through a cell containing magnesium chloride. The copper plates were of such a size that the electrolytic deposit of copper was in the form of a perfectly bright coherent coating. To ensure this result it was necessary, as has been pointed out by Gray (Phil. Mag., Nov. 1886), to have in the solution a slight excess of sulphuric acid. By a large number of experiments we satisfied ourselves that such a voltameter gave an accurate measurement of the amount of electricity passing. This, moreover, is shown by the concordance between the amounts of copper deposited and the products of electrolysis in the magnesium chloride cell.

The apparatus was arranged as shown in Fig. 1. The solution of magnesium chloride was contained

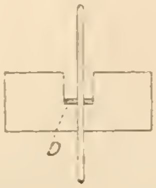
Fig. 1.



in the electrolyser E. This consisted of two bell jars, the one inverted in the other. The solution was poured into the outer vessel and drawn up into the inner until it completely filled it. The inner vessel was connected by means of the bent tube T with a Lunge's nitrometer N. By means of the ebonite fan F, fixed upon the rod R and driven from a pulley by a small electro-motor, the solution was kept in thorough circulation.

The voltameter V contained two copper plates H, I, one of which, I, was carefully weighed before and after each experiment. They were immersed in a solution of sulphate of copper about one-third saturated. The electrodes consisted of two plates, one of zinc, Z, and one of platinum, P, soldered to the wires A and B and firmly fixed into two slits in the india-rubber cork C, three-sixteenths of an inch apart. The rod R worked air-tight in the cork G. The arrangement for securing this is shown in Fig. 2. The cork was perforated through one-half its thickness by a narrow hole into which the rod fitted easily. This hole terminated at the upper side in a much wider hole. A brass washer D was placed at the point where the two holes joined, and the upper one was filled with mercury. In this way a perfectly gas-tight joint was obtained, while allowing free play for the rod.

Fig. 2.



The chief points which presented themselves for elucidation were:—

1. To determine to what extent, if at all, chlorate and perchlorate of magnesia were formed during the electrolysis of the magnesium chloride.
2. To ascertain the yield of bleaching compounds, and to see to what extent the results agreed with those obtained on the larger scale.

The method adopted was as follows: A current of electricity from a five-cell bichromate battery was passed through the copper voltameter into the electrolyser containing a 2½ per cent. solution of magnesium chloride. The gases evolved were collected in the nitrometer and analysed. At the end of the operation a portion of the solution was titrated with decinormal arsenious acid solution: the amount of chlorine so obtained was reckoned as available chlorine. The total oxidising chlorine, *i.e.* chlorine present as hypochlorite and chlorate, was determined by boiling a portion with a solution of ferrous sulphate and titrating with potassium bichromate solution. In several instances the available chlorine was also determined by adding iodide of potassium in acid solution and titrating with decinormal sodium thiosulphate. The numbers thus obtained were in every case identical with those obtained by the arsenious acid method. The results are given in the following table. We have not thought it necessary to give more than one typical experiment. A large number were made with varying conditions, but in all cases the results were comparable with those given.

The electrolysis was conducted in four stages. The gases evolved were analysed each time, but the solution was analysed only at the end of the fourth period:—

Table I.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
—	Copper deposited.	Theory.		Found.		Oxygen retained.	Chlorine = O retained.	Available Chlorine found.	Total Chlorine found.	Total Chlorine Theory.	Efficiency.		Per Cent. of Total Chlorine available.	Time.
		Hydrogen.	Oxygen.	Hydrogen.	Oxygen.						Available Chlorine.	Total Chlorine.		
	grms.	cc.	cc.	cc.	cc.	cc.	grms.	grms.	grms.	grms.				Mins.
1st Period	·3125	110·5	55·2	108·7	7·8	47·4	·3014	1·085	1·333	·3500	72·8	89·4	81·4	45
2nd „	·3760	133·0	66·5	130·9	5·6	60·9	·3873			·4211				48
3rd „	·3170	112·1	56·0	111·4	5·6	50·4	·3205			·3550				45
4th „	·3255	115·1	57·6	117·1	6·8	50·8	·3231			·3645				39
Totals	1·3310	470·7	235·3	468·1	25·8	209·5	1·3323			1·4906				177

Strength of solution after electrolysis, 3·5 grains chlorine per litre. Density of current ·023 A. per sq. cent.

The close agreement between the volume of hydrogen evolved and the theoretical quantity, as calculated from the copper deposited, may be taken as a guarantee, if any were needed, that the amount of the latter truly represented the amount of electricity passing. This receives still further confirmation from the fact that the oxygen retained in the solution and converted into chloroxygen compounds, *i.e.*, the theoretical amount of oxygen minus the oxygen evolved, when calculated into chlorine (column 8) almost exactly equals the total chlorine formed, as shown by analysis (column 10). As a matter of fact, the hydrogen is about ·5 per cent. too low. This may either be due to a reduction of hypochlorite to chloride, or, what is quite as probable, to a reduction of chlorate to hypochlorite.

In any case the discrepancy does not seriously affect the results.

The amount of magnesium chlorate produced can be calculated from columns 9, 10, and 14; it is represented by the difference between the numbers in columns 9 and 10, or by the difference between 81·4 (column 14) and 100.

It may be worth while at this point to compare the results obtained by Dr. Hurter with our own. The relation between the two is shown in Table II. For comparison we have taken the numbers given in the table on page 342 of the Chem. Ind. Society's Journal, 2nd period. We have chosen this particular experiment because it is the one in which the strength of the solution in available chlorine was nearly the same as our own. As a matter of fact, it is somewhat lower, 3·19 per litre as against 3·5, a difference in favour of Dr. Hurter.

Table II.

Strength of Solution grms. Chlorine per Litre.	Current Efficiency.		Percentage of Total Chlorine available.
	Available.	Total.	
Dr. Hurter........ 3·19.....	21·8	47·5	45·9
Cross and Bevan .. 3·50.....	72·8	89·4	81·4

The numbers given in Table I. may be made available for settling the question whether or not, as stated by Dr. Hurter, magnesium perchlorate is formed during the electrolysis of magnesium chloride.

The total amount of copper deposited during the four periods was 1·331 grm., equivalent to 1·4906 grm. of chlorine. The total chlorine produced (column 10) was 1·333; the volume of oxygen evolved 25·8 cc., calculated into chlorine, equals 0·164 grm., 1·333 + 0·164 = 1·497. The total amount of electricity was equivalent to 1·4906 grm. of chlorine; in other words, the whole of the electricity has been accounted for by the total oxidising chlorine and the oxygen evolved. From this it will be seen either that no perchlorate was formed or that the electricity did more work than the theoretical. A careful quantitative analysis of the solution proved perchlorate to be absent.

We have made the comparison with solutions of about the strength of 3·0 grms. chlorine per litre, as it is found that liquor of this strength, owing to the greater bleaching efficiency of the electrolytic chlorine, is amply sufficient for all ordinary purposes. As a matter of fact, the solution can be brought up to a strength of five or more grms. per litre without showing any serious further loss of efficiency. In fact, we have repeatedly obtained such solutions in which 84·0 per cent. of the total oxidising chlorine was present as hypochlorite, with an available efficiency of 72·0 per cent. At this strength the discrepancy between Dr. Hurter's numbers and our own becomes still greater; thus he obtained, with a solution containing 4·17 grms. per litre, an efficiency of only 13·3 per cent. available chlorine and 43·7 per cent. total chlorine.

It may be of interest to point out here that by using a stronger solution of magnesium chloride it is possible to obtain a bleaching solution with a much greater current efficiency. The following are the results of an experiment with a solution containing 14 per cent. of the crystallised salt.

Table III.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
—	Copper deposited.	Theory.		Found.		Oxygen retained.	Chlorine = O retained.	Available Chlorine found.	Total Chlorine found.	Total Chlorine Theory.	Efficiency.		Per Cent. of Total Chlorine available.
		Hydrogen.	Oxygen.	Hydrogen.	Oxygen.						Available Chlorine.	Total Chlorine.	
	grms.	cc.	cc.	cc.	cc.	cc.	grms.	grms.	grms.	grms.			
1st Period	·3155	122·9	61·45	120·2	3·54	57·91	·3688	1·329	1·172	1·582	84·0	93·0	90·3
2nd „	·3605	127·5	63·75	123·6	3·80	59·95	·3816						
3rd „	·3470	122·9	61·45	121·4	3·80	57·65	·3666						
4th „	·3580	126·6	63·30	124·4	3·60	59·70	·3796						
Totals.............	1·4130	490·9	249·95	489·6	14·74	235·21	1·4966						

For certain economical reasons having reference to the amount of $MgCl_2$ that would have to be wasted, it is preferred to use a weaker solution, notwithstanding the lesser yield.

In view of Dr. Hurter's assertion that potassium chlorate was converted into perchlorate by electrolysis, and inferentially that magnesium perchlorate was formed in the Hermite process, we decided to check his results by actual experiment. Instead of using the potassium salt, however, it was decided to prepare some pure magnesium chlorate. A current from a battery of five bichromate cells was passed through a solution containing 1·41 per cent. of magnesium chlorate for 79 minutes. The experiment was conducted in an apparatus similar to that already described, the electrodes being varied in size in order to give currents of varying densities. The amount of chlorate, both before and after the electrolysis, was determined by boiling with ferrous sulphate and titrating with potassium bichromate. The results are contained in Table IV.

Table IV.

—	Strength of Solution.		Copper Deposited.	Hydrogen Evolved.	Oxygen Evolved.	Hydrogen Calculated.	Oxygen Calculated.	Density of Current Ampères per Sq. Cent.
	Before.	After.						
	Per Cent.	Per Cent.						
1	1·41	1·41	·2515	85·2	43·9	88·9	44·4	·0266
2	1·41	1·41	·2430	83·0	42·9	85·9	42·9	·0080

These results prove conclusively that, under the conditions of the experiment, no perchlorate whatever is formed. Being diametrically opposed to Dr. Hurter's observations, we thought it only right to endeavour, if possible, to discover those conditions under which perchlorate *would* be formed. We have found that it is simply a question of current density. By regulating the size of the electrodes to the current passing, it is possible to throw the electrolysis on to the water alone or on to the chlorate as desired. Though we preferred for obvious reasons to use magnesium chlorate, it is worth while pointing out that precisely similar results can be obtained with potassium chlorate.

As a matter of fact, in the first two of Dr. Hurter's experiments no perchlorate whatever is formed, at least the whole of the current is accounted for by other products. Thus :—

—	Exp. I.	Exp. II.
	Chlorine.	Chlorine.
Oxygen evolved	·0488	·0250
Total chlorine found	·1698	·2316
Chlorine reduced by hydrogen	·0278	·0465
	·2464	·3031
Copper deposited equal to	·2420	·2965

It may be of interest, as bearing in a very practical way on the subject before us, to give a brief account of an experimental trial of the process for linen yarn bleaching made at Belfast in the autumn of last year. A strict comparison was made with the ordinary process of bleaching with bleaching powder. A bleaching tank of the usual form was divided into two equal parts: the part set aside for the electrolytic process was arranged so as to contain enough solution for submerging the yarns to the extent of two-thirds their length, as against the few inches dipping ordinarily practised.

By an exhaustive series of trials, in which a 5-cwt. cask of bleaching powder was used up, the consumption of this material, by the several qualities of yarns and for the various shades (cream—one dip, and full cream—two dips) was determined. Taking the numbers for one day's work—4,088 hanks, weighing 1,226 lbs., were bleached in successive portions during a period of 10½ hours in the electrolytic tank. To bleach this quantity with bleaching powder the amount required was 175 lbs.

The mean current employed was 770 ampères at five volts.

The calculations for power expended are based on ½*d.* per horse-power per hour, the usually accepted estimate in Belfast. The total expenditure in money value is as follows :—

—		1st Period.	2nd Period.	3rd Period.
Time		1 h. 40 m.	5 hrs.	3 h. 50 m.
Current		849 amp.	777 amp.	728 amp.
Indicated h.p., *i.e.*, e.h.p. + 20 per cent.		7·112	6·509	6·098
		s. *d.*	*s.* *d.*	*s.* *d.*
Costs	Power	0 6	1 4¼	0 11½
	Interest and depreciation	0 2	0 6	0 4½
	Magnesium chloride	0 1½	0 4¼	0 4
		0 9½	2 2½	1 8

That is, a total of 4*s.* 8*d.*, as against 14*s.* 4*d.* for bleaching powder.

Another important feature in favour of the electrolytic method is the rapidity with which the bleaching is effected. In the above trials the average time during which each hank of yarn was subjected to the bleaching action was 15 minutes, as against 47 minutes by the ordinary method. This result was obtained notwithstanding the fact that the electrolytic solution contained only 2·5 grms. of available chlorine per litre, which strength was constantly maintained, whereas the bleaching powder solution employed contained 15·2 grms. per litre.

We have said very little as to the method of criticism and investigation pursued by Dr. Hurter in his paper. Both have received publicly such high commendation that it would seem out of place, especially for ourselves, to say a word to the contrary. But as we are not likely to be relieved of the task, we proceed to a brief notice of the features to which we take exception.

The results detailed in this paper sufficiently show that he approached the investigation as a pessimist. Having obtained the low yield, described by him as a "*miserable* current efficiency," under conditions eminently calculated to give such a result, and having re-asserted, in opposition to what he called "*mystifications*," the text-book view of the reactions involved, he developes the investigation on indirect lines, viz., by means of observations upon solutions of *calcium* hypochlorite and *potassium* chlorate, and applies the results to account for the waste of current energy at both anode (oxidation to chlorate and perchlorate) and cathode (reduction of hypochlorite).

Allowing the absolute correctness of the author's numbers, we deny their value as a basis for argument, as we have shown that they were under the control of the experimenter.

Ignoring our observations of bleaching efficiency, upon which our communication was essentially based, and on which the economical success of the Hermite process depends, and giving unusual prominence to observations of current efficiency, the author finishes his criticism by multiplying our estimate of cost by a whole number of no small magnitude. His conclusions appeared to us so improbable that we have felt no pressing necessity to vindicate ourselves from their effects.

Apart from numerical results, it is an easy matter to show that Dr. Hurter's interpretation of the phenomena of the electrolysis is wrong, if simple.

His explanation of the electrolysis is, that chlorine gas is formed at the anode, and magnesium hydrate at the cathode, and that "when they have been produced in sufficient quantity and diffused through the solution, they react upon each other in the well-known manner, according to the equation—

$$2\ MgH_2O_2 + Cl_4 = MgCl_2O_2 + MgCl_2 + 2\ H_2O."$$

As a matter of fact there is no evidence whatever to show that in a properly conducted electrolysis of magnesium chloride, free chlorine exists in the solution at any period. Assuming, for the sake of argument, that such is the case, his explanation of the formation of magnesium hypochlorite according to the above equation is a practical impossibility. This equation is never realised. If chlorine gas is passed into water containing suspended magnesium hydrate, less than one-half of the chlorine is converted into hypochlorite, the other going to form chlorate and chloride. This occurs even at 0° C. (Lunge and Landolt. Chem. Ind., 1885, 327—346.)

If Dr. Hurter will pass the current for a few moments through the solution of the salt with careful observation of the phenomena at the cathode, he will find it coated, *not* with magnesium oxide, but with a peroxidised compound. This body, on being washed with water, is continuously decomposed with formation of soluble oxidising compounds.

Dr. Hurter explains the discrepancies between his estimate of the efficiency as calculated from gas analysis (28·34 per cent., Exp. I.), and that deduced from actual titration of the solution, 25·4, by saying that magnesium hypochlorite readily changes into chlorate under ordinary conditions. Such a great difference, 13·9 per cent. of the whole, during the short period of experimenting, induced us to test by actual experiment the amount of decomposition that really does take place. An electrolysed solution was kept in a stoppered bottle and titrated with decinormal arsenious acid from time to time. The results are shown below:—

Date.	Percentage of available Cl.
August 20th, 1887	·177
„ 29th „	·175
October 12th „	·169
January 19th, 1888	·166

In nine days, therefore, the amount of conversion into chlorate is barely appreciable, and in five months it only amounts to 6·2 per cent. The same solution was then exposed in an open beaker for three weeks. Even in these circumstances the loss amounted to only 30 per cent. Much of this loss is due to the escape of chlorine compounds into the air.

With these numbers before us, therefore, we cannot accept Dr. Hurter's explanation of the want of uniformity between his results.

Moreover, as we have already pointed out (*see* Tables I. and III.), the amount of chlorine calculated from the oxygen absorbed (*i.e.*, the difference between the theoretical and that evolved) is almost exactly equal to that obtained by direct titration, viz., 1·332 as against 1·333, and 1·495 as against 1·472, showing that in our experiments the results from gas analysis are practically the same as those obtained by titration.

He accounts for the presence of oxygen in the evolved gases by stating that it is due to the electrolysis of magnesium hypochlorite, and its conversion into chlorate, thus:—

$$3\ MgCl_2O_2 + 9\ H_2O = \underbrace{3\ MgH_2O_2 + H_6}_{\text{Cathode.}} + \underbrace{6\ HClO + O_3}_{\text{Anode.}}.$$

$$6\ HClO = 2\ HClO_3 + 4\ HCl.$$

He further states that "the formation of chlorate exactly corresponds to the oxygen found in the gas."

The following table gives the volume of oxygen observed, and that calculated from the above equation, in Dr. Hurter's experiments and in some of our own:—

TABLE V.

—	Cc. Oxygen Evolved.	Cc. Oxygen calculated from Dr. Hurter's Equations.	Percentage Error.
DR. HURTER'S EXPERIMENTS.			
Exp. 1	7·68	8·48	9·6 −
„ 2	3·93	6·64	40·9 −
„ 3	2·10	2·21	5·0 −
„ 4	6·24	4·60	35·3 +
„ 5	172·50	131·90	30·4 +
CROSS AND BEVAN'S EXPERIMENTS.			
Exp. 1	25·80	19·50	32·3 +
„ 2	14·74	11·24	31·1 +
„ 3	12·70	2·42	424·8 +
„ 4	7·10	0·59	1100·3 +
„ 5	8·80	0·51	1625·5 +

From these numbers it is clear therefore that there is no direct connexion between the amount of chlorate formed and the oxygen evolved.

Again, if Dr. Hurter's explanation were correct, the volume of oxygen evolved should be far greater during the last period of an experiment than during the first, as in the latter case there is little or no hypochlorite which can be electrolysed. As a matter of fact this is not the case in our experiments, and even in Dr. Hurter's the increase in the volume of oxygen is so slight as to be far below that required by the equation.

TABLE VI.

PROPORTION OF OXYGEN EVOLVED.

——	Dr. HURTER.		CROSS and BEVAN.	
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1st period	19·29	7·83	11·13	5·76
2nd „	20·83	8·83	8·42	5·96
3rd „	..	..	10·00	6·18
4th „	..	..	11·80	5·69

We think it is more reasonable simply to regard the oxygen evolved as due to the electrolysis of water, without any reference whatever to the formation of chlorates.

It was a careless mistake in our paper to speak of hydrogen peroxide being *present*, and Dr. Hurter's criticism on this point was fully justified. He will see that we were misled by the appearance of the peroxidised body at the cathode; and this is evidence of the complicated nature of the electrolysis, and explains in some degree the unusual bleaching properties of the solution.

The complete explanation of the course of the electrolysis and the properties of the resulting solution we do not pretend to give in the mean time. The investigation necessary for this involves a series of calorimetric determinations; and the exhaustive study of the decomposition we intend to prosecute, when time permits, on the lines of the well-known researches of C. R. A. Wright and others. (Phil. Mag. 1880.) The value of the "final" E.M.F., representing, *i.e.*, the balance of work done in the electrolysis, must be very considerably affected by the secondary action of negative ions upon the solution.

When we first approached the investigation we worked necessarily on the lines of those who had preceded us, and our results were expressed as the relation of *Ampères* to bleaching work, and in converting this relation into that of cost we took the E.M.F. at the constant maximum of five volts. On this view the mechanism of the electrolysis was of secondary importance.

Now it being evident from our results, as well as those of Ledeboer, that, expressed as the ratio of ampères to bleaching work, we had to do with novel phenomena, and it was incumbent upon us to suggest the explanation; the ratio in question being experimentally determined with repeated and independent verifications, the "new" cause could only be one of two: (1) greater bleaching activity of the electrolytic chlorine, involving an expenditure of about one-half the quantity necessary when employed in the form of bleaching powder; (2) more than the ordinary electrolytic equivalent of chlorine, according to Faraday's second law, being liberated under the conditions of the electrolysis.

Of (1) we have the proof in the scores of bleaching tests which we have made and seen made. The opportunity of making confirmatory tests we offered on the occasion of reading our former paper, but our critics evidently considered this unnecessary. Dr. Hurter dismisses our statements on the point with the remark that they "probably rested on as insecure a basis as our statement of the high yield of chlorine."

To this we reply: "qui vult decipi, decipiatur."

With regard to (2) we confess that the experimental evidence we had upon this point was slender, though we had no reason to doubt the accuracy of our measuring instruments. We must admit, moreover, that our numbers have not been confirmed by those recorded in the present paper, but it must not be forgotten that the conditions of the experiments are different. We would remind our critics that this is only an incidental factor of the system: the fundamental industrial equation—the one to which we drew special attention—is the ratio of "Watts" to bleaching work. We have given the results, and subsequent experience has substantially confirmed the estimate of cost originally propounded.

It may be urged by our critics that we ought to show in what respect Dr. Hurter's conditions of working were wrong. Unfortunately the details he has furnished are not sufficiently precise for us to know exactly what his conditions were.

Though a thorough circulation of the solution in the electrolyser is essential, Dr. Hurter preferred to dispense with it. The effect of circulation is shown by the following details of two experiments identical in every respect save that in No. 2 the solution was stirred:—

——	Efficiency Available.	Efficiency Total.
No. 1	59·6	66·2
No. 2	75·0	89·0

Dr. Hurter has chosen to condemn the process on the result of experiments in the conduct of which an essential detail was omitted.

In conducting the electrolysis of magnesium chloride, the best results are obtained when the size of the electrodes is such that there is a current of about ·02 ampère per sq. cent. Dr. Hurter varied his apparatus so as to include current densities from ·0006 to 0·48 ampère per sq. cent., in every case with the same result, a "miserable current efficiency."

Even the least favourable of the results we have now brought forward shows a current efficiency sufficiently high to render the process commercially successful. We are fully convinced, from experience, that the results obtainable on a large scale are considerably in advance of anything possible in the laboratory.

DISCUSSION.

The CHAIRMAN considered the paper as one of special interest as throwing light upon an obscure subject. The diverging results obtained by different experimenters when working under differing conditions showed the great importance of such researches as those just described by the authors.

Mr. MOND congratulated the authors upon having got well out of a situation in which they appeared to be in conflict with the familiar law known as Faraday's law, by basing their explanation of the extraordinary and unexpected efficiency of the Hermite process on the fact that the electrolysed solution had a greater bleaching than oxidising activity. He saw no reason to doubt this explanation; at the same time it seemed to him to be a matter hardly within the cognisance of the chemist, but rather one which must be left to the practical bleacher to decide. He thought members would take more interest in the matter when Messrs. Cross and Bevan were able to put before them the experience of a practical bleacher, who should have worked the process for a lengthened period on a reasonable scale. Then they would be in a position to judge the facts. A few experiments made on one substance only—linen yarn—were hardly sufficient to supply the necessary knowledge.

Mr. Cross observed that the process was started in America, in January, at a paper mill. It was started without a hitch, and had run without a hitch ever since. He had the testimony of the American company that every one of the guarantees given them had been more than fulfilled. Moreover, the results obtained were on a wide range of substances. He might say, in regard to the apparent conflict with the Faraday law which Mr. Mond had mentioned—and which had been greatly misapprehended—that the number finally adopted in their first paper for the yield per ampère was some 6 per cent. in excess of the usually-adopted equivalent. The number in question was the mean of experimental numbers obtained in a series of observations divided for convenience into periods. They found themselves confronted with a cause of which they had no previous experience, and they were undecided at the time to what to assign it. It must be either that more chlorine was liberated than was shown by the instrument, or that this chlorine had an exceptional bleaching efficiency. When they read their first paper, their desire was simply to bring the matter forward for discussion, hoping to receive help in the elucidation of the difficulty. They had no desire to make any rash assertions, and in the discussion which ensued they were disappointed to find a disposition to ignore facts and treat the question on personal lines. In several prints since published they had been ridiculed as having published an estimate which had turned out to be 30 times less than the true estimate. The position might have been a serious one for them had they not felt that all who knew them would believe that they had performed their work straightforwardly, and were not likely to make so serious a blunder. In fact, they would have regarded criticism indicating an error of 30 *per cent.* as far more serious than was Dr. Hurter's absurdly high estimate.

Mr. T. Christy said that some friends of his had come across from America to inquire into the Hermite process and try the experiments here. Without going into details, it would be sufficient to say that those friends had written him this week to say that they had been working the process on a large scale, and not only were they perfectly satisfied with the results, but the work which they had shown to their neighbours had decided them also to order apparatus. He thought that was the best proof that could be given that the process was a commercial success.

Professor Dewar congratulated Messrs. Cross and Bevan on their admirable paper. He had not had an opportunity of again referring to Dr. Hurter's figures, but from the details given in the present paper he felt no doubt that this was one of those cases which were explained by the natural difficulties of electrolytic methods. No doubt Dr. Hurter was perfectly clear and definite in the conclusions he had drawn from the laboratory experiments he had made, perhaps with antecedent views based on Faraday's law and something else other than practical working. Here was just the difference between practical knowledge and laboratory knowledge. As a matter of laboratory investigation, the authors had substantiated their position; in doing which, no doubt Dr. Hurter's criticism had been a great stimulus to them. However, he could not but congratulate them on the admirable series of numbers they had given.

M. Hermite, having been invited by the Chairman to give the meeting the benefit of his experience, said it was undoubtedly true that the results would vary according to the conditions under which the experiments were made; so much so, that it had taken five years of constant work to enable him to obtain a practical mastery of those conditions. He had just returned from America, where he had started the process for the bleaching of paper pulp. The last work done was on a scale of 4½ tons per day, bleaching with a solution containing a maximum quantity of available chlorine of 1 gram per litre. The solution was simply passed through the electrolyser and run into the pulp. They had also bleached spruce pulp—a pulp which was considered in the mill as entirely past bleaching, as attempts to do so generally resulted in destroying the pulp. He had succeeded in bleaching such pulp with a liquor weaker in chlorine than even 1 gram per litre, and without injuring the fibre at all. They were now putting up plant on a larger scale, and he hoped, in a short time, to be able to show more important results, representing a replacement of about 10 tons of bleaching-powder per day.

Mr. W. P. Thompson (Secretary of the Liverpool Section) said it might almost be inferred from something which had been said at the beginning of the paper that Dr. Hurter had been running away. He wished to state therefore that Dr. Hurter, having heard in March that Messrs. Cross and Bevan desired to read a further paper on the Hermite process, had brought the matter before the Liverpool Section. The result was that he (Mr. Thompson) was directed to invite them to read it at the April meeting of the Liverpool Section, in order that they might have an opportunity of facing the lion in his den and fighting Dr. Hurter on his own ground. Dr. Hurter had arranged to come back from the Continent to attend the meeting in such case. But unfortunately M. Hermite was in America at the time, and Messrs. Cross and Bevan therefore preferred not to give their paper at the Liverpool meeting. That was the reason why the paper was not read when Dr. Hurter would have been present.

Professor Dewar asked M. Hermite whether he had contrasted the efficiency of his chlorine with a similar strength of hypochlorite of magnesium, and if so whether the efficiency was still in the ratio of about 2 to 1.

M. Hermite replied that he had made the contrast and had found the difference not so great as with bleaching-powder.

Professor Dewar: And this is not to be accounted for merely by the hypochlorite efficiency?

M. Hermite: That is so. I may add that with strong solutions of the salt we get some very active form of oxygen. With weaker solutions, on the other hand, the bleaching activity is increased by reason of the diminished proportion of the salt, which, as we know, would retard bleaching action. The chief feature of my process is that the compounds are simply transferred to the substance undergoing bleaching and the carrier is regenerated, so that we have a circulation from electrodes to pulp and are able to avail ourselves of the bleaching compounds in the nascent state.

Professor Dewar: And the substance does not require to be near the electrodes; the nascent condition persists, as it were, after the solution leaves the electrodes?

M. Hermite: Yes; but of course the efficiency is not so great with an old solution as with a new one. For its highest efficiency the solution must be tested when it leaves the electrolyser.

Mr. Mond: Still I understand that the pulp is not absolutely in the electrolyser, but is contained in a separate vessel.

M. Hermite: Yes, but the passage is extremely rapid.

Professor Dewar: I thought so; because you say that the enormous difference between the rotations of the solutions would suggest that in Dr. Hurter's experiments he was getting chlorate. If you assume, as the authors say, that the electrolysis is simply that of water, and that the oxygen at a certain density is simply added on to the magnesium chloride as hypochlorite of magnesium.

Mr. Mond dissented.

Professor Dewar: It is quite as rational as the other view. In Dr. Hurter's experiments, the hypochlorite would remain near the electrode, and would then be transformed into chlorate. Therefore, there is an enormous difference produced by the rotation of the solution. The rationale of the process would appear to be the oxidation of magnesium chloride to hypochlorite.

M. Hermite: If I rightly understand Dr. Hurter's experiments, he obtained so high a resistance that the solution must have been almost boiling. Under such conditions how could he obtain good results? If he had come to us and asked us for further details we could have shown him much better results.

Mr. Watson Smith desired to call attention to an important paper by Dr. Jurisch, late of Widnes, which had appeared in the *Chemische Industrie* (1888, No. 5), since the writing of the paper before the meeting. Dr. Jurisch had electrolysed calcium chloride, which was a much more stable salt than magnesium chloride. The gist of his paper was briefly this: Taking 2 kilos. of coal burnt per horse-power per hour, he arrived at the conclusion that the preparation of 1 kilo. of bleaching-powder by means of electrolytic chlorine from calcium chloride required an expenditure of 18 kilos. of coal. He contrasted this result with the ½ kilo. of coal required for the production of 1 kilo. of bleaching-powder by the Deacon-Hurter process. An abstract of the paper would appear in the next issue of the Society's Journal. (*See page* 327.)

Mr. Cross observed that the experiments described by Dr. Jurisch, though they constituted an interesting contribution to the subject, had no relation whatever to the Hermite method of working. Dr. Jurisch separated his ions, and therefore had to employ a very high voltage, in consequence of the absence of those secondary reactions which made the estimate of power so low in the Hermite system. His calculations, moreover, were based on an unusually large deduction for conversion of steam into E.H.P., viz., 50 per cent., and no account was taken of the chlorine lost in attacking the anode. There was no suggestion in the paper that the difference of potential (8·4 volts.) obtaining in the experiment was unnecessarily high.

Mr. Bevan, in reply, said: Mr. Mond has been already answered by Mr. Cross and M. Hermite, and I need only say, with reference to his remark on the limited nature of our experiments, that if he will refer to our original paper he will find that the efficiency of the chlorine was stated by us as the result of experiments on many different specimens of cellulose. I am much obliged to Professor Dewar for the kind manner in which he has spoken of our work. As something has been said about our being invited to attend the reading of Dr. Hurter's paper, I desire to say that we would have been happy to attend if we had received due notice. The fact was we received the invitation on the Tuesday, and the meeting was to be held on the Wednesday. I wrote at once to Mr. Thompson, the secretary of the Liverpool Section, pointing out that the differences between Dr. Hurter's results and ours were probably due to differences of conditions. I must protest strongly against Dr. Hurter's condemnation of an industrial process on such slender grounds. He states that what we have said is not worthy of serious criticism, and that he can only accept his own estimate of the results. I am glad to find that Professor Dewar takes the view he does of the course of the electrolysis. We have long held that view, because there is not the least scintilla of evidence to show that free chlorine exists, or ever existed, in the solution.

Liverpool Section.

Chairman: Prof. J. Campbell Brown.

Vice-Chairman: Dr. F. Hurter.

Committee:

J. Affleck.
E. G. Ballard.
Ernest Bibby.
H. Brunner.
J. C. Gamble.
D. Herman.
J. W. Kynaston.
E. K. Muspratt.
Jas. Simpson.
A. Norman Tate.
A. Watt.

Hon. Local Sec. and Treasurer:
W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held April 4th, 1888, *at University College, Brownlow Street.*

DR. J. CAMPBELL BROWN PRESIDING.

MISCELLANEOUS COMMUNICATIONS.

Mr. Douglas Herman exhibited a few sample sheets from a letter copying-book which was supposed to require no damping, the paper being impregnated with a solution of glycerine, which kept it permanently moist if not exposed to too high a temperature.

There was nothing particularly new in the idea, a similar process having been patented by Messrs. Vasseurs and Houbigant in 1858; but he was not aware whether it had been practically applied until recently, and would like to know if the members had had any experience of these perennially damp copying-books, as it seemed somewhat strange that, if there were no practical objections, the process had not come into more general use before this.

The samples shown had been kept for a couple of months. To prevent off-setting it was recommended to leave the last four or five pages copied on between sheets of blotting paper. The maker asserted that the book would hold its moisture unless exposed to intense artificial heat, and that in this case it would recover its moisture by exposure to air.

Mr. Norman Tate said that if they did not require damping, it would be a great advantage in office matters, as there was a great difficulty in getting the office boy to understand how to damp properly.

MANUFACTURE OF LIME MUD INTO CEMENT BY RIGBY'S PATENT.

BY J. S. RIGBY.

The question of waste products in the manufacture of alkali has long been a source of trouble to the manufacturer, and any feasible method of disposing of the same must be hailed with satisfaction, especially where such method is at once a means of disposal and at the same time a source of profit.

In bringing this matter before the Society I have been encouraged by some of the largest alkali makers in the trade, who have unhesitatingly adopted my process for the manufacture of Portland cement from lime mud.

Portland cement, as most of you are aware, takes its name from its resemblance to Portland stone. The seat of the manufacture is on the Thames and Medway, where it is made from chalk and mud, both existing in almost unlimited quantities in the same neighbourhood. A comparatively small quantity is produced in North Wales from the carboniferous limestone, and in the Midlands from the lias limestone, which contains from 10 to 20 per cent. of silica and alumina, with a small percentage of oxide of iron. It is ground by the aid of suitable machinery as finely as possible, and mixed with the shale (in the same fine state of division) containing silica and alumina in such proportions that will produce approximately a cement corresponding to the following analysis:—

Lime	62
Alumina and iron oxide	10
Silica	22

It is of the highest importance that the lime should exist in as near the quantity named as possible, a very slight divergence would alter the quality of the cement very materially; an excessive quantity of clay would give a cement of a brown colour having a low tensile strain. Lime in excess is also to be deprecated, for it necessitates the purging of the cement, as it is termed, that is, the cement is spread out on floors so as to admit of the hydration of the lime. In some of the works where the cement is produced from limestone, it is usual to keep it for two months, turning it from time to time, thus entailing considerable expense.

Makers of cement have suffered severe losses through their lack of knowledge in not being able to ascertain the quality, or estimate the component parts of the cement-producing mixture. Some of the large works now employ chemists, and so carry on the business in a scientific manner.

It will be seen from what has been stated that it is essential in the production of cement to have a carbonate of lime in as fine a state of division as possible, either in the form of ground limestone or chalk. Carbonate of lime, as a bye-product, has been produced by alkali manufacturers for the past 30 years, and in a state that will compare favourably with the finest ground limestone, or even chalk. This substance, commonly known as lime mud, has always been a source of trouble to the manufacturer; to use it as a substitute for limestone in the black ash mixing retards the process very considerably, owing to the amount of water the mud contains, the best appliances in the shape of filter beds and pumps failing to reduce moisture to much less than 30 per cent.

Some manufacturers have sent the lime mud away as refuse at a considerable expense, whilst others run it into the river.

When alkali was of far greater value than it is at the present day, there was not the same necessity to study economy so strictly; now we find what have been hitherto waste products, have been utilised with considerable advantage. In the case of lime mud, having experimented with it (some two years ago) with a view to manufacturing Portland cement, I came to the conclusion that by proper manipulation, and by washing the mud as free from alkali as possible, and eliminating the sulphur compounds, the alkali manufacturer had in his hands a substance as valuable for cement making as chalk, with the advantage over the latter substance of being free from flints, and in a state ready for mixing with the least possible trouble.

In the first instance I made a cement from the lime mud without the latter being purified, and found it produced a cement of a very uncertain nature; when made into briquettes and placed in water, they frequently crumbled away, or if they held together at all, a very slight strain caused them to break. The cement had also an unpleasant slippery feel with it when taken from the water; it also evolved sulphuretted hydrogen when treated with an acid. I expected that the sulphur compounds would have been decomposed by coming in contact with the CO_2 evolved in the decomposition of the $CaCO_3$ during the process of making the clinker in the kilns, but in every instance I found sulphides present. Knowing that it was most important that Portland cement should be free from sulphides, I endeavoured to eliminate them from the lime mud. I found, by passing CO_2 through a mixture of lime mud and water, a chalk was produced that quite answered my expectations; the CO_2 can be obtained from the kiln during the decomposition of the slurry (a technical term for the mixture of clay and chalk). It has also suggested itself to me that the CO_2 from the above process could be used in Chance's or Simpson and Parnell's process for the recovery of sulphur from alkali waste, instead of burning limestone especially for that purpose.

I will now give you a brief description of my process for the manufacture of cement from lime mud. It is very similar to the method adopted in ordinary cement works, with the exception that the chalk or lime mud requires purification before being calcined, either before or during the process of mixing the lime mud and clay (say the latter). I take the lime mud direct from the filters after being washed as free from alkali as possible, and mix with a good unctuous clay in such proportions that will produce a cement corresponding to analysis already mentioned. It is highly important that every attention be paid to procuring a reliable clay of regular quality, for upon this depends the success of the operation; an upland clay, containing as it generally does a considerable amount of sand, will not produce nearly so good a cement as that made from river mud, which is an alluvial deposit and free from the impurities contained in the upland clay.

After the lime mud and clay have been thoroughly mixed with a sufficient quantity of water to reduce it to a consistency that will admit of its flowing easily, I run it on to a drying bed to a depth of from a foot to 15 inches (the drying bed consists of a series of flues covered with tiles at the end next to the fire and iron plates at the cool end, so as to utilise the heat as much as possible). Heat is generated in ordinary fire-places and passes through the series of flues to the chimney; the drying operation occupies about four days. The heat causes the mixture to crack, and generally forms pieces of a convenient size for handling.

By using a kiln that was patented some years ago, the drying on the beds mentioned is obviated, and a great saving effected both in fuel and labour. The kiln is so constructed that the heat generated during the calcining process dries the slurry, and is at the same time convenient to the kiln for charging.

Samples of slurry made with upland clay and river mud—the former is ordinary brick clay. The mud can be procured from the Mersey on the Cheshire side, extending from Bromborough to Rock Ferry; it is also found near Hale Head on the Lancashire side of the river.

The slurry, as you now see, is a mechanical mixture of lime and clay; cement is supposed to be a silicate of alumina and calcium, but as yet we have no decided authority upon the matter. To effect the decomposition of the mixture it is placed in kilns with alternate layers of coke until the kilns are filled. The kilns now being used by the Widnes Alkali Company, at their Seacombe works, are the ordinary dome kilns, and will contain when filled 30 tons of slurry, and will produce about 20 tons of clinker; a very high temperature is attained during the process of decomposition, which occupies on an average about three days.

The eyes or openings in the kiln, which have been loosely built up with bricks and plastered, are now opened and the clinker allowed to cool; one or two bars are then removed from the bottom of the kiln, and the clinker, with a very little assistance, is discharged on to the floor, to be loaded into barrows and conveyed to the crusher. Any pieces that have not been decomposed are put aside to go into the next kiln.

It is an easy matter to judge what quality of cement the clinker will produce by its appearance as it leaves the kiln.

A clinker produced from a slurry containing an excessive quantity of clay, upon coming into contact with the atmosphere, will gradually disintegrate, forming a fine powder or dust utterly valueless.

A clinker containing lime in excess is of a very dark colour and very difficult to grind; the resulting cement has a rough, gritty feeling, and must be allowed to remain in the house until the uncombined lime has become hydrated. Good clinker possesses a bronze-greenish appearance.

The crusher mentioned is an ordinary Blake's crusher, the clinker when passed through it is broken to one inch size and deposited into a recess, from which it is elevated to a large hopper placed over two pairs of stones; it is gradually passed through the latter to be again elevated and deposited into a shute containing a worm that conducts the ground cement to a screen varying in fineness from 2,500 to 3,600 holes to the inch. Particles that have not been ground sufficiently to pass through the screen, are by a suitable appliance caused to pass through a small pair of stones situated near the screen, where it is rendered sufficiently fine to pass into the store.

Cement made from lime mud, which, as you are aware, is a carbonate of lime in a most finely-divided state, is equal in every point to that manufactured from any other source; it is capable of standing a high tensile strain, as will be seen from the following results obtained by an old firm of cement makers in this neighbourhood, who adopted my process over six months ago.

Briquettes (similar to these) stood the following tensile strains. Two briquettes, after being made seven days, six of which they were immersed in water, showed a breaking strain on, in the area of 2¼ square inches—

No. 1	1,053 lbs.	7 days on the 2¼ in.
No. 2	1,210 lbs.	
	1,326 lbs.	14 days.
	1,475 lbs.	39 days.
	1,612 lbs.	61 days—not broken.

These tests, made by independent cement makers, are satisfactory evidence of its quality. As regards the sp. gr. it is equal to standard requirements, a bushel weighing 118 lbs.

This sample of concrete was made by mixing six parts of limestone to one of cement; it was sawn through to show adhesive power of the cement some few weeks ago.

The Widnes Alkali Company have been manufacturing about 50 tons of cement weekly since the beginning of the present year, and to obtain that quantity they mix about 70 tons of lime mud with 20 tons of clay.

After carefully going into the prices of material, carriage, &c., the cement can be produced at much less cost than Portland cement has hitherto been manufactured for. This, of course, is obvious, it having been manufactured from a waste product.

DISCUSSION.

Mr. Muspratt wished to know whether the whole of the alkali had to be washed out, or might about 1 per cent. be left in? Was there any difficulty in getting the proper proportions, so as to secure uniformity in the cement, or did the author get a perfect cement at one time and a cement not so perfect at another time, on account of the ingredients not being properly mixed?

Mr. A. Norman Tate asked what was the composition of the lime mud as regarded alkaline compounds? He should have thought that so much as 1 per cent. of alkali would interfere with the use of the mud for cement purposes. He could see that the process could be made practically valuable for the manufacture of cement of a very good quality, but the alkaline constituents required careful attention. He would like to have heard something more respecting some of the impurities in the mud, and the effect they had on the manufacture. He thought there was an advantage in the mud being in a very finely-divided condition. A large number of artificial cements were being made in which the lime and other constituents were in such a coarse condition that it was totally impossible for the requisite chemical changes to take place. It was interesting to note the use of river mud for the manufacture of cement. Attempts had been made to use it in several localities, and, of course, the success of its use depended to a great extent upon its composition; and as Mr. Rigby had spoken of Medway mud, he should like to know whether Mr. Rigby had found any difference between the mud deposited in the Medway and that deposited in the Mersey? With regard to the alkali, again, he would like to know whether in roasting the slurry, if the temperature rose to a high point, an excess of alkali caused too much fusion, so as to interfere with the setting of the cement?

Mr. Simpson wished to know what would be the cost of plant for producing, say 100 tons per week? Would the variation of 1 or 2 per cent. in the proportions very much affect the quality?

The Chairman (Dr. J. Campbell Brown) said there was no doubt that the state of fine division of the lime mud and clay would be in favour of the chemical action that took place in burning the cement. He presumed that the combination of the alkali depended to some extent on the proportions of the ingredients. If there was not an excess of silica, it was more probable that a compound salt—silicate of alumina and soda and lime—would be produced. The question of the condition of the alumina in Portland cement was not by any means settled by chemists and engineers. He would like to know what class of people used the cement. The process was one likely to be useful in the Liverpool district, and they were always glad to hear such papers read before the Society.

Mr. Rigby, in replying, said the cost of plant for producing 100 tons per week would be about 2,500*l.* at the outside, but that in alkali works there was always a quantity of plant and materials on hand that could be utilised, so that the total cost should be much less. The samples shown would speak for themselves—they had as high a tensile strength as the produce of any of the London makers, with as much adhesive power. The sample (exhibited) showed how that when some of the cement was placed on a smooth tile to set it was impossible to remove it without breaking the tile. Good cement could not be made from carbonate of lime in a roughly-ground state. They had attempted to make it from ordinary limestone, but failed to get the standard tensile strength regularly, such as the exhibited samples gave: they could not grind it fine enough. He thought that the samples of cement spoke for themselves, seeing that a well-known local firm of cement manufacturers had been making it for six months, and were selling it as fast as they could make it. Supposing that they had a cement that contained 60 per cent. of lime with maximum amount of clay, 2 per cent. would alter the quality very much, and 4 per cent. would make it almost worthless. They tested it as it came from the mixer. The Manchester Ship Canal had used about 25 tons, and some 50 tons had been shipped to the East. In making these samples four tons had been mixed at the same time. Clay was put in first in the samples shown. The clay was not of the best quality, and contained a quantity of sand, yet he got a test of 1,188 lbs., or as high as his testing machine would go. Another sample (shown), which had been made in January, broke at 1,120 lbs. That was not so high a test as it should be. The average seemed to be about 1,000 lbs. The cement would not be uniform unless the mixing was attended to properly. Every day's mixing should be tested. At first he had had considerable trouble in the mixing. They put a given quantity of clay and of lime mud in the mixer, and as the mixture ran out at the other side he found that it varied very much. Then he tried putting the clay in first, thoroughly mixing it with water in the mixer. If for instance he put in a ton of clay, then he put 3½ tons of lime mud, and mixed both for 20 minutes. He had tested it from time to time, and could not detect the slightest difference. If it was properly attended to the result was always the same. Lime mud did not vary much in its composition; it sometimes might contain more water, but of course that would have to be guarded against, so as to get it all of uniform quality. Having a good clay was a great help. The ordinary clay was of a pretty regular quality, and would answer the purpose. He had never had a fused kiln.

NOTE ON RAVE'S PROCESS FOR THE UTILISATION OF THE ACID TAR RESIDUES OF PETROLEUM MANUFACTURERS.

BY W. P. THOMPSON, F.C.S., M.INST.M.E.

Making some experiments at an oil works near Manchester in 1885, the proprietor showed me an enormous quantity of a peculiar acid tarry material formed by treating petroleum with sulphuric acid in the process of refining. The production of this material was equal to about one-fourth of the entire amount of petroleum refined, and for a long time he had paid a shilling a ton to get rid of it, and even then was giving it away gratis. Many attempts have been made to utilise this product. It is no good as bitumen, as it will not harden, and always remains soft and corrosive. It will not pay to extract the sulphuric acid from it, owing to the low price of said acid. If neutralised with lime, mixed with slack, and burnt, it is a very poor fuel; if treated with caustic soda or carbonate of soda and washed, the products were supposed not to pay for the chemicals employed, while, if neutralised with lime, an utterly unworkable mass resulted. As far as I am aware, the chemical constitution of the hydrocarbonaceous matter of the waste has not yet been determined.

The following note on the utilisation of this substance by the Société Oléo Graisse has been compiled from data supplied by Mr. Rave, the inventor of the process employed by them.

The acid tar above described is kneaded with iron borings or filings, copper or zinc or other metallic cuttings, the material preferred being iron cuttings or borings. The iron is preferably somewhat in excess of the theoretic quantity required to neutralise the sulphuric acid. After more or less prolonged contact, dependent upon the basic material used, and its degree of fineness, the sulphuric acid will be found to have combined with the metallic base. The mass is now introduced into heated receptacles, and water (preferably boiling) is added. The metallic sulphate dissolves and separates from the black mass, and the latter melts and rises to the surface. It is withdrawn from the receptacle, and is found to have all the mechanical properties of the best purified soft bitumen, well washed with hot water to remove all trace of salts, and the washing waters are used to dissolve out fresh quantities of salts in a succeeding operation. The uncombined metal falls to the bottom.

The watery solution containing the metallic sulphate and other salts, is now drawn off from the aforesaid receptacle into reservoirs, where the salts crystallise out.

The black mass or bitumen, being too soft for many purposes, is placed in a still, and heated till it assumes the required degree of hardness. The hydrocarbons given off in this operation are collected and used as naphtha. The resulting bitumen is very pure, and can be used for almost all purposes for which the purest native bitumens are used, while at the same time it is so elastic and malleable as to strongly resemble india-rubber; hence it is largely sold by the company under the name of "mineral caoutchouc-bitumen." A specimen will be handed round. One ton of acid tar produces about 10 cwt. of this purified bitumen. If the bitumen be further heated in the still, till a large part of the volatile matter is expelled, and only about six-tenths of the original soft bitumen is left, a material soluble in naphtha, but nearly as hard and tough as ebonite, is obtained. This material is an extremely good non-conductor of electricity, is unacted upon by acids or alkalis, and is therefore admirably adapted for making galvanic batteries, for coating acid tanks, conducting wires and cables for insulation plates, and the like. It can be made of various degrees of hardness by stopping the distillation at different points, and in the heated state can be pressed into moulds so as to assume any required form. It can thus be used as a substitute for papier-maché, and if required to be still more unbreakable, can be moulded round a canvas or wire or other metallic skeleton, or have fibrous matter pulped up with it. Specimens of insulating plates and of wires coated with the softer variety are here exhibited.

If the mineral caoutchouc-bitumen be mixed with about 40 per cent. of sawdust, and a little lime heated in an iron vessel, and pressed into moulds, it makes an admirable fuel, burning well in a fireplace without melting, and with little ash. It will probably come into much use in Southern Russia and on the Caspian, and in other places where petroleum is abundant and solid fuel dear. The purified bitumen submitted to destructive distillation in a gas retort is stated to equal the best qualities of coal as a gas producer.

The "mineral caoutchouc-bitumen" dissolves readily in petroleum, naphtha, and other light hydrocarbons, and forms an excellent tough black varnish, samples of which are shown on the table. The varnish is waterproof, and adheres very tightly to metal, not chipping or scratching off so easily as Brunswick black, or Japan varnish. The bitumen also forms compounds with rosin, wax, pitch, and other like materials, with qualities intermediate between those of their constituents. If the bitumen be heated in a still, it gives off about half its weight of liquid hydrocarbons. These have not been thoroughly examined, but like the distillation products of raw petroleum, the first products are light naphthas, then come good burning oils, then heavy oils resembling the higher members of the paraffin series. The light naphtha-like products and the illuminating oils form about one-third of the original weight of the bitumen, the heavy oils another sixth, and a bright metallic-looking carbon, samples of which are herewith shown, the remaining 50 per cent. This carbon is singularly pure, very hard, so that it will scratch glass, and strongly resembles metal in appearance. It is a remarkably good conductor of electricity, and is an excellent material for plates for batteries, electric arc carbons, microphones, and other like electrical requisites, while being nearly pure carbon, and therefore burning without ash, it will be found very useful as a fuel in various chemical processes. To sum up: at the expense of the requisite quantity of iron cuttings or oxide, the entire sulphuric acid in the material is obtained as green vitriol. One-half the weight of the original acid tar is utilised as soft bitumen, or this is still further differentiated, and this 50 per cent. is converted into—

17	per cent.	light naphtha and burning oils,
8	,,	heavy lubricating oils,
25	,,	metallic carbon,

or about 15 to 20 per cent. oils, and 30 to 35 per cent. insulating compounds.

The cost of the products at the works of the Société Oléo Graisse is, per ton:—

BITUMEN.

	Frs.
Two tons original waste, purchased at 6 frs.	12
Cost of manufacture	10
Share of rent, interest on capital, &c. and sundries	4
	26
Less half original waste debited to the green vitriol manufacture	6
Total cost	20
Selling price	100

THE VARNISH.

	Frs.
Cost of bitumen, plus that of the light hydrocarbons (a waste product), estimated at	20 per ton.
Selling price	100 ,,

EBONITE SUBSTITUTE.

	Frs.
Cost of bitumen, 1 ton 10 cwts.	30
Cost of manufacture into articles, about	166
Sundries	4
Total cost	200
Selling price	1,500

ROUGH ELECTRIC INSULATING MATERIAL.

	Frs.
Bitumen, 1 ton 6 cwts.	26
Cost of manufacture, say	10
Sundries	4
Total	40
Selling price	500

DISTILLATION COMPOUNDS.

Value not ascertained.

CARBON.

	Frs.
Cost of bitumen, less distillation compounds, and plus labour and cost of sorting, say	20
Selling price, choice samples	1,000

Ordinary, 500 frs., at present, per ton.

Profit on 1 ton of waste, cost 6 frs.:—

If producing bitumen:	Frs.
Green vitriol, beyond cost of iron and labour	5
Crude bitumen, half ton	40
Total	45

Or if producing ebonite substitute:	Frs.
Green vitriol	5
Ebonite articles and pitch, 6 cwts.	290
Oils, about 4 cwts.	25
Total	320

It will thus be seen that whichever mode of utilising be adopted, there is an enormous profit. The raw material is practically inexhaustible, it being estimated at about three million tons per annum in the United States alone, while probably a hundred thousand tons could be obtained in Great Britain at the present time. The utilisation, too, of this hitherto waste product would make it more profitable to import the raw petroleum into this country, instead of having it partially refined on the other side of the Atlantic. In this way the supply of raw material would be largely increased. The demand for most of the manufactured products is equally inexhaustible. The Société Oléo Graisse are the sole firm at present engaged in this new industry, and they have only been a few months at work.

Newcastle Section.

Chairman: P. P. Bedson.

Vice-Chairman: J. C. Stevenson, M.P.

Committee:

Alfred Allhusen.
G. T. France.
John Glover.
John Morrison.
John Pattinson.
J. B. Payne.
H. R. Procter.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
C. T. Richardson.
T. W. Stuart.

Hon. Local Secretary and Treasurer:

J. T. Dunn, The School, Gateshead.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the Durham College of Science, April 11th, 1888.

MR. JOHN PATTINSON IN THE CHAIR.

A VOLUMETRIC METHOD FOR THE RAPID ESTIMATION OF SULPHUR IN BURNT PYRITES.

BY JOHN WATSON, F.I.C.

PELOUZE's method, as described in the text-books of quantitative analysis, consists in the heating of a weighed quantity of the ore with weighed portions of sodium carbonate and potassium chlorate, the three having been intimately mixed in an iron spoon or platinum crucible. On allowing to cool the mass is soaked with warm distilled water, the crucible is washed out, the residue boiled with water, filtered and washed until all soluble matter is removed; the filtrate is then titrated with standard acid. The volume of standard acid required for the soda originally used, minus the volume now required to neutralise, is calculated into percentage of sulphur present. This method is said to be tolerably accurate, the greatest variation from the truth being 1 or 1·5 per cent. with careful manipulation.

During the year 1879 it was found by Messrs. W. Russell and F. Scurfield, in the laboratory of the Newcastle Chemical Works, that for burnt ore containing under 10 per cent. total sulphur the use of potassium chlorate was not necessary, and that excess of sodium carbonate (or what answers even better, sodium bicarbonate), mixed uniformly by stirring with the burnt pyrites, was sufficient to fix the sulphuric anhydride (from the oxidation of the sulphur of the pyrites over the Bunsen flame) as sodium sulphate. Bicarbonate of soda has been found to be constant in its alkalinity when kept in a dry stoppered bottle, even when this is opened daily for use.

On heating it splits up according to the well-known equation—

$$2\ NaHCO_3 = Na_2CO_3 + H_2O + CO_2.$$

The use of potassium chlorate was considered objectionable, as the heated mass in the crucible requires stirring with a wire poker, and it was found that, owing to the viscous condition of the mass, part would always adhere to the end of the stirrer. It was also more difficult to wash out the mass from the crucible.

A standard solution of hydrochloric acid was in use in the laboratory, of which 1 cc. = ·50 grain soda or ·258 grain sulphur.

By weighing off 25·80 grains of a sample of burnt ore, and treating as hereafter described, one was enabled to read off percentages and thus save calculation. The results by this volumetric method were checked by the ordinary gravimetric method by Mr. F. Scurfield in 1879. They were sufficiently near to warrant the use of the volumetric method for testing the daily samples which, about that time, were greatly increased in number. Since then the method has been in daily use in the laboratory of the Newcastle Chemical Works.

For over two years we have been sending part of a sample to another chemist who uses the gravimetric method, retaining part ourselves and testing for soluble and total sulphur, exchanging results by posting on the same day. The results usually agree very well. For example:—

TOTAL SULPHUR IN BURNT PYRITES SMALLS.

Gravimetric Method.	Volumetric Method.	Taking Gravimetric Estimation as Standard.	
		Difference.	Difference per Cent. Sulphur Present.
2·50	2·44	– ·06	– 2·40
2·63	2·52	– ·11	– 1·18
2·44	2·40	– ·04	– 1·64
2·04	2·02	– ·02	– ·98
2·19	2·22	+ ·03	+ 1·37
Average 2·36	2·32	– ·04	– 1·57

The above are a fair sample of our weekly tests. In a few exceptional cases the difference has been as high as ·40 per cent., but on repeating tests and investigating the matter such differences are oftener found to be the fault of the manipulator than of the method. When we commenced comparing results with the other chemist we diluted our standard hydrochloric acid two and a half times, making it 1 cc. = ·20 grain Na_2O, we also took twice our former quantity of burnt ore, viz., 51·60 grains.

Our object in making these two changes was to get a more accurate reading, any error being now divided by five, as division by this number was necessary to read percentages.

We could read the burette to ·05 cc., thus there was never a remainder beyond the second decimal figure on dividing.

ESTIMATION OF TOTAL SULPHUR.

The following is the method now in use for the estimation of total sulphur, describing those details found by practice to be important :—Place 20 grains of bicarbonate of soda, of known alkalinity, in a nickel, porcelain, or platinum crucible ; to this add 51·60 grains of the powdered sample of burnt ore and mix uniformly with a glass stirring rod which has been flattened out at the end in a transverse direction by fusion and pressure. Now place the crucible and contents over a rather low Bunsen flame and heat gently for five to ten minutes, when the mass must be broken up with the end of a wire stirrer, taking care that none is spilt.

The gentle heating serves to drive off a molecule of CO_2 from the bicarbonate and prevents the too hard caking of the mixture, which takes place when a rather high proportion of sulphur is present. The stirring opens out the mass and does not allow a kernel of unoxidised sulphide to remain. A convenient form of stirrer for this purpose may be made of copper wire, with a wooden handle.

After stirring, the heating must be increased and continued for 10 or 15 minutes, when the oxidation should be complete ; then wash out with warm water into a beaker (No. 5 or 6).

In the case of iron pyrites the oxidation process may probably be represented by the following equation :—

$$2\ FeS_2 + 15\ O + 4\ Na_2CO_3 = Fe_2O_3 + 4\ Na_2SO_4 + 4\ CO_2.$$

In works where a large number of samples are to be tested a combustion furnace is very convenient, as a long row of crucibles can be ignited, containing the portions for total sulphur, whilst the portions for soluble sulphur are being boiled over single Bunsens.

After washing contents out of the crucibles, rinse with moderately hot water from a wash bottle, also using a glass rod covered at the end with india-rubber tubing. Add hot water to the beaker, and boil for 15 minutes over a Bunsen flame, then filter through an ordinary filter paper into a 20-oz. flask, wash four or five times with hot distilled water, add a few drops of methyl orange as indicator, and titrate with standard hydrochloric acid solution (1 cc. = ·20 grain Na_2O). Suppose 20 grains of the bicarbonate originally required 37·50 cc. acid, and that we now require 28·00 cc., deducting this and dividing the difference by 5 we get the percentage of total sulphur, which, in the case assumed, would be 1·90 per cent.

Where gram weights are used, a convenient strength of standard solution would be 1 cc. = ·020 gram, Na_2O = ·0258 gram S. 2·00 grams bicarbonate and 5·16 grams burnt ore could be weighed.

Thinking that the sulphur contained in coal gas might cause an error, I first determined the sulphuric acid in the bicarbonate, then heated two portions (of 50 grains each) of the same over double Bunsen flames, turned full on, for 30 minutes. The gain of sulphuric acid in each portion was only equal to ·010 grain sulphur, = ·02 Na_2O, or ·1 cc. of our standard acid. The gas used was that of the Newcastle and Gateshead Gas Co. This error may, I think, for practical purposes, be neglected.

ESTIMATION OF SOLUBLE, OR UNAVAILABLE, SULPHUR.

It is often useful to a sulphuric acid manufacturer to know what proportion of the residual sulphur in burnt ore exists as sulphide which should have been available for acid making with perfect combustion. This knowledge can be indicated with sufficient accuracy for works purposes by estimating the soluble sulphur and deducting this from the total sulphur estimated by the volumetric method just described. The difference is the insoluble, or available, sulphur which will exist as sulphide.

A convenient method of estimating the soluble sulphur is by boiling a weighed quantity of burnt ore with a known quantity of standard solution of sodium carbonate.

In this process the changes are probably represented by the following :—

$$2\ FeSO_4 + 2\ Na_2CO_3 + 3\ H_2O + O\ \text{(from air)} = Fe_2(HO)_6 + 2\ Na_2SO_4 + 2\ CO_2.$$

$$2\ CuSO_4 + 2\ Na_2CO_3 + 2\ H_2O = CuCO_3 \, . \, Cu(HO)_2 \, . \, H_2O + 2\ Na_2SO_4 + CO_2.$$

On boiling :—

$$3\ (CuCO_3 + Cu(OH)_2 + H_2O) = 2\ Cu(OH)_2 + 4\ CuO + 8\ CO_2 + 4\ H_2O.$$

$$CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4.$$

After boiling, filter, wash, and titrate the filtrate with standard acid. We weigh out 51·60 grains of burnt ore into a beaker, add 5 cc. of solution of sodium carbonate (1 cc. = ·50 grain Na_2O), dilute with hot distilled water, boil for 15 minutes, filter into a flask, wash the insoluble residue three or four times with hot water, and titrate the filtrate with standard acid.

$$\frac{\text{Cc. s. acid originally required for 5 cc. soda solution} - \text{cc. s. now used}}{5} = \text{per cent. soluble sulphur present.}$$

I have recently tested two samples of burnt pyrites (Mason's dust) by the volumetric methods here described, also by the gravimetric method, the total sulphur being estimated as described in Lunge and Hurter's "Alkali-makers' Handbook," the soluble by boiling with dilute hydrochloric acid (1 strong hydrochloric acid P.B. : 4 water) for 15 minutes. The tests were all done in duplicate, with the following results :—

Method.	Soluble Sulphur.		Total Sulphur.	
	Volumetric.	Gravimetric.	Volumetric.	Gravimetric.
SAMPLE B2.				
Test I.	1·12	1·19	1·31	1·41
„ II.	1·12	1·12	1·42	1·36
Mean	1·12	1·15	1·36	1·38
Difference	− ·03	..	− ·02	..
Difference per cent. sulphur .	−2·60	..	−1·45	..
SAMPLE C1.				
Test I.	1·04	1·15	1·42	1·53
„ II.	1·04	1·10	1·44	1·55
Mean	1·04	1·12	1·43	1·54
Difference	− ·08	..	− ·11	..
Difference per cent. sulphur .	−7·14	..	−7·14	..

These results, though not sufficiently close for strictly scientific work, will probably be considered accurate enough by works managers, for whom this method is essentially of use.

In a communication to the Journal of this Society in 1885 (*see* p. 449), Prof. G. Lunge writes:—

"My reason for rejecting any dry process for the estimation of sulphur in pyrites is that in this way we estimate also the sulphur of galena (which is nearly always present) and of the sulphates of barium and calcium, none of which are of the least use to the consumers of pyrites, whilst in the wet process nearly the whole of that useless sulphur is left behind in the insoluble residue."

This objection may apply in the case of green ore containing appreciable quantities of the above constituents, but does not apply to our method to any considerable extent, so long as Mason's pyrites is used, because—

1st. Out of three analyses of our burnt ore (Mason's) only one shows an estimable quantity of lead, viz., PbO ·50 per cent., and assuming this lead to exist as PbS, we should have PbS ·535 per cent. containing only ·071 S. per cent., a quantity too small to make a practical difference.

2nd. Calcium sulphate is decomposed on boiling with sodium carbonate, and, according to experiments which I have made, by boiling mixtures of burnt ore with 1 per cent. and 2 per cent. calcium sulphate (specially prepared), it was found that 97·4 per cent. and 96·3 per cent. (respectively) of the sulphur of calcium sulphate was estimated by the method given for soluble, or unavailable, sulphur.

3rd. Regarding barium sulphate, we have never found appreciable quantities of this in analysing pyrites, though I have seen occasional lumps of a mineral very like heavy spar among Mason's pyrites smalls.

Probably the best proof that the above objections of Prof. Lunge do not apply to our method of testing burnt pyrites, is that the difference between the total sulphur estimated weekly by us and that got by another chemist, using the gravimetric method, was only ·04 per cent. more sulphur by the volumetric method over a period of 28 weeks.

In large works, especially where shelf burners are in use, foremen and managers sometimes wish to know in a short space of time how a set of burners is working. Under such conditions we have found the above method to be the only one available. I have weighed, treated, and tested a sample of burnt ore (and sometimes more than one) for soluble and total sulphur, within an hour, the result being afterwards confirmed by the barium method.

In addition to its rapidity, the method may be commended for the absence of acid fumes.

It has been in daily use at the Newcastle Chemical Works for about nine years, and, during that time, has been introduced into other works, where it appears to displace the gravimetric method for estimating sulphur in burnt ore.

For green ore it is not a satisfactory method, though various modifications have been tried by us.

In conclusion, I thank the Newcastle Chemical Co. for the facilities afforded in carrying out the above experiments.

DISCUSSION.

The Chairman spoke of the advantage of having rapid methods of this kind, which had been tested by daily use in works, published. He drew attention to the ease and completeness with which sulphur compounds were oxidised in an alkaline mixture or atmosphere to sulphate.

Mr. Martyn had used the method, and found it to give good results as a rule, but under certain conditions the results were much too low.

* * *

ON A NEW METHOD FOR THE ESTIMATION OF NITROGEN.

BY JOHN HENRY SMITH, PH.D., F.I.C.

(*Read, Jan. 6th*, 1888.)

The author has had in view a modification, for purposes of water analysis, of his method of estimating organic bodies by oxidation with potassium permanganate.*

He has not yet completed the method, but communicates results already obtained. The method consists in attacking the nitrogenous body with a large excess of permanganate and a small amount of potassium bromide; bromine is alternately liberated by the permanganate, and reduced to hydrobromic acid while oxidising the organic body and liberating or further oxidising its nitrogen, a small amount of bromide thus serving to oxidise a relatively large amount of the organic body.

At first the substance was heated with the author's standard acid permanganate and a small quantity of bromide, and the excess of available oxygen determined by adding excess of ferrous sulphate and titrating back with permanganate, loss of bromine during heating being prevented by a tube filled with broken glass and kept moistened with water, and the bromide being precipitated with silver nitrate just before the final titration. The author insists on the importance of parallel blank experiments where the materials are fresh. Results of experiments are given showing the amount of error introduced by omitting the guard-tube and the precipitation of the bromide. Alkaline solutions of permanganate do not decompose the bromide.

Oxidation of Ammonia.

The author gives experiments to show that bromine water oxidises ammonia, either in acid or neutral, but more easily in neutral, solutions (62½ per cent. of the ammonia present in one case). Chlorine acts similarly, but less energetically, and its action is more easily interfered with by such bodies as sodium sulphate. On applying the bromide-permanganate method to ammonia, the loss of oxygen was greater (114 : 100) than that corresponding to complete oxidation of the ammonia to water and nitrogen. The author considers this probably due to the oxidation of the *nascent* nitrogen (he shows that *free* nitrogen is not affected by the bromide-permanganate solution) to nitric acid, since the error is greater when the amount of bromide present is diminished, and the slowly-liberated nitrogen therefore longer exposed to the action of the oxidising solution. He has hoped to obtain a complete oxidation to nitric acid, and by diminishing the bromide and increasing the time of heating has obtained results which show (supposing his hypothesis to be correct) an oxidation of 72 per cent. of the total nitrogen from the ammonia to nitric acid.

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* This Journal, 1887, p. 271.

Oxidation of Cyanides.

Results with commercial cyanide were very unsatisfactory, with crystallised cyanide less so, but the author bases his conclusions chiefly on results with the more stable cyanogen compounds. The acid bromide-permanganate solution oxidises cyanides to carbonic and nitric acids (in one experiment 99·7 per cent. of the cyanide completely oxidised corresponded to the oxygen used up), and the author considers that this is direct, and that nitrogen as an intermediate product is not formed. With acid permanganate alone, in large excess, the first action on alkaline cyanide appears to be its oxidation to free cyanogen ($2 KCN + O = K_2O + C_2N_2$) ; and the author concludes that differentiation among the molecules of cyanogen then results in the oxidation of some at the expense of others—

$$(9\,C_2N_2 + C_2N_2 + 9\,H_2O = 18\,HCN + 2\,CO_2 + N_2O_3)$$

He queries whether this cause does not lie at the bottom of the well-known instability of cyanogen compounds. Results of experiments with different amounts of permanganate and different lengths of heating show losses of oxygen corresponding to complete oxidation of from 20·1 per cent. to 40·9 per cent. (no bromide), 97 per cent. to 100·2 per cent. (with bromide) of the cyanide, on the assumption that the salt used contained 91·5 per cent. of cyanide, which was approximately verified by analysis. From the fact that in the experiments without bromide the oxidation is very slow, and increases steadily with the time, the author concludes that not permanganate, but free cyanogen, must be the agent, as stated above. In the case of ferrocyanide and ferricyanide, using permanganate alone, 49 per cent. and 49·2 per cent. respectively of the total possible oxidation was recorded, with bromide permanganate 99·8 per cent. and 99 per cent., and with bromide added after one hour's heating with permanganate alone, 81·5 per cent. and 80·6 per cent. Permanganate alone, added by direct titration in acid solution, appears to oxidise sulphocyanate to cyanide, and sulphuric acid bromide-permanganate (35 per cent. of *total* oxidation) to carbonic, nitric, and sulphuric acids (102 per cent.).

Oxidation of Urea.

In acid bromide-permanganate solution, urea is first oxidised as in the well-known alkaline hypobromite reaction, and then the nitrogen oxidised as in the case of ammonia (98 per cent. to 133 per cent. of the oxidation to *nitrogen* in different experiments). The author draws attention to the parallelism between the results here and in the case of ammonia. Sodium chloride appears to be here more effective (128 per cent. to 160 per cent.) than potassium bromide.

In conclusion, the author expresses his belief that this oxidation of nitrogen may vitiate determinations of "organic matter" by permanganate, and states his intention of further pursuing the matter.

Glasgow and Scottish Section.

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Hon. Local Secretary :
G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Fifth Meeting for this Session was held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, March 6th, 1888.

MR. J. J. COLEMAN IN THE CHAIR.

DISCUSSION ON MR. ROWAN'S PAPER ON THE ESTIMATION OF THE CALORIFIC VALUE OF SOLID AND LIQUID FUELS.

(*See* March Number, pp. 195—200.)

Professor Dittmar contended that it would never be possible to calculate the calorific value of a fuel from its elementary composition, because it depended on its *constitution* as well. CH_4 = 16 grams of marsh gas gave *less* heat (*i.e.*, contained less energy) than 12 grams of charcoal and 4 grams of hydrogen gas. On the other hand, C_2H_2 = 26 grams of acetylene gave *more* heat than 24 grams of charcoal and 2 grams of hydrogen gas.

This example alone was sufficient to show that the discrepancies between calculated and actual combustion heats could not, as Mr. Rowan seemed to think, be removed by substituting the combustion heat of "gaseous carbon" for that of charcoal, or that of solid hydrogen for that of hydrogen gas.

In the absence of any great new discovery on the matter the only way, in his opinion, for finding the calorific value of a fuel, was to determine it directly by means of a calorimeter.

He would avail himself of this opportunity for drawing attention to an ingenious invention of the late Professor Bolley. Bolley's calorimeter measured a heat evolution by the weight of water of 100° C. which it was capable of converting into saturated steam of 100° at 760 mm. pressure. The values 100° and 760 mm. of course were only examples for the $t°$ corresponding to the existing p. mm. of atmospheric pressure. He believed that Bolley's instrument might be brought into a form in which it could be used by any intelligent engineer to determine what combustion heat he wanted with promptitude and without committing a greater error than, say, 1 to 2 per cent. of the quantity to be determined.

Professor Mills said there was not the slightest doubt that liquid fuel would be very much more employed when its great value, in many ways, was understood, and he thought it would be admitted by all that liquid fuel had a great future before it. As to the theoretical matters alluded to by Mr. Rowan, there was extreme difficulty in putting the ordinary practical numbers in a defensible theoretical condition. The theory of the combustion of fuel was one that required still the profoundest mathematical study. Taking even the simple chemical equation $H_2O + C = CO + H_2$, we were confronted at once by a theoretical difficulty. It might be pertinently asked was it true or was it not that C burnt at first, in this case, to CO_2 or CO? If the former were the case—as it seemed to be—then the equation could no longer represent what actually occurred in the combustion of carbon by means of superheated steam, as we should then have to build up carbonic dioxide—a tripartite substance—and then split it up again, which amounted to undoing work already done. There were, moreover, three theories on the disassociation of gases under the combined influences of heat and pressure, and these did not exactly agree. On the whole, a very difficult task lay before anyone who attempted to throw light on the combustion of fuel, although Mr. Rowan had, by means of his paper, drawn attention to points of practical importance in connexion with the theoretical work done on them, which would be of great service both locally and generally.

Mr. Rowan had hoped to have brought before the Section a practical example, on a small scale, of the use of liquid fuel in two different ways, which illustrated the important part played by gas in the combustion of fuel. A paper was read before the Philosophical Society of Glasgow some time ago by Mr. Hannay, on a method of using liquid fuel for illuminating by burning a spray produced by compressed air. Subsequent to that Messrs. Braby and Co. produced a lamp in which use was made of a jet of steam to produce the oil spray. It had been found that with the spray lamps some portion of the oil was deposited unconsumed on the surrounding ground or buildings, but the most recent development of this use of oil was an apparatus produced by Mr. Luther (manager to Messrs. Braby and Co.). It consisted of a steel retort in which the oil was simply gasified by the application of heat. The gas was led from the retort under considerable pressure by a pipe to the burner and was there ignited, with the result that the oil used in this apparatus gave about three times the light as compared with the same quantity of oil burned as spray by steam or air jets. This illustrated the advantage gained where the oil was turned into gas properly and completely, by which the full benefit of its heat-giving or light-giving properties was obtained.

Mr. Gray mentioned that he would be glad to show any member of the Section steam boilers working with liquid fuel at the works at which he was engaged. There were five large steam boilers working at 50 lbs. pressure with liquid fuel alongside of other five boilers working on solid fuel (coal).

Professor Mills asked if the previous speaker could give an idea of the duty that the oil did in the boiler furnace?

Mr. Gray, in reply, stated that the oil used was not ordinary mineral oil, but a waste tar recovered from mineral oil refining, and his experience was that the boilers worked very effectively. The furnace gases coming from these boilers (burning liquid fuel) were very much lower in temperature than the gases coming from the other boilers.

Mr. W. Thorp inquired if Mr. Gray had noticed any difference in the action of the fuel on the boilers over the seat of the fire? It was said that oil flames were very severe on boilers; and as regards the question of smoke, he fancied from the appearance of the chimneys in Glasgow that that was not considered of importance there, but in London it was a very much more serious question.

Mr. Gray, in reply, stated that so far as he had seen there was no serious affection of boilers by the action of liquid fuel; in fact, it did no more harm to them than ordinary coal firing.

Mr. Rodger said he was struck with one remark that Mr. Rowan made, in referring to Hannay's method—that a portion of the oil fell unburned on the surrounding objects. It appeared to him that if that took place in burning the oil in boilers it might account for the loss of the missing energy.

Mr. Rowan, replying to the previous speaker, said he had no doubt that this was the case, but that in consequence of the high temperature of the furnace the unutilised oil did not appear as oil, but was found as deposited coke, which went to show that the oil had not been properly decomposed by the aid of the steam. He had hoped that the experiments carried out at the Steel Co.'s works would have been the means of giving them some information on this subject, because the apparatus there employed was one of the few which provided for a primary gasification of the oil by heat and the use of superheated steam. He did not believe, however, from his own study of the form of apparatus used in these trials, that it was likely to be a durable one.

He understood from Professor Dittmar's remarks that he agreed that the calorimetrical method must be unreliable on account of its dealing only with small quantities, and the examples of ethylene and acetylene to which he had referred proved that calculations of calorific power from the ultimate analysis of fuel could only give partial information of the heating value of fuel, whether in the form of coal or of liquid fuel.

Professor Dittmar was, however, mistaken in thinking that he had proposed merely to substitute the combustion heat of gaseous for solid carbon, or that of solid hydrogen for hydrogen gas. What he had proposed was, that the thermic values of the various hydrocarbon gases produced by the action of heat on coal or liquid fuel (in the latter case along with steam) should form the basis of the calculation of the combustion value of the fuel which might be under examination.

Meeting held Tuesday, April 10th, 1888.

MR. J. J. COLEMAN IN THE CHAIR.

ON THE PHOTOCHEMICAL ESTIMATION OF GRADED TINT.

BY EDMUND J. MILLS, D.SC., F.R.S., AND J. BUCHANAN.

In the estimation of differences of degree of the same tint, it is customary to depend upon eye estimations, and in many cases to use colorimeters as a means of instrumental comparison. Quantitative determinations can thus be made on amounts of matter so minute as to be altogether unamenable to gravimetric investigation. Numerous instances, however, might be adduced in which our ordinary resources fail, or can be applied only in, at best, a very circuitous manner. Our attention has been in particular directed to the comparison of tinctorial effect upon dyed goods; and for this we have devised an artifice which we believe may be useful in many other directions of experimental inquiry. The artifice consists essentially in photographing on an isochromatic plate, and at one operation, equal-sized pieces of tissue, exhibiting different degrees of the same tint. A negative is thus obtained from which any number of prints can be produced on "gelatino-bromide" paper, and each impression represents definitely in terms of silver the original grade of tint. All that is necessary is to make a sufficient number of impressions to enable the silver to be determined either volumetrically or gravimetrically.

In our experiments pieces of cashmere of known weight were dyed in "vats" of known strength and constant temperature, the proportions of colouring matter or mordant being varied.

These pieces were mounted side by side on cardboard, and over all of them was mounted a second cardboard, pierced with round apertures of equal diameter. From the photographic negative a large number of prints were taken on "Eastman Bromide Paper, A." These prints were each exposed for the same length of time, and were, as far as possible, developed under the same conditions. The exposure was so timed as to produce but a slight effect only, where a slight tinctorial effect had to be represented. They were allowed to remain a much longer time than usual in the fixing-bath, to make certain of the complete removal of silver salts, and were then washed all night in running water. After drying, all the discs of one tint were cut out, incinerated in a porcelain crucible, and the ash treated with nitric acid free from chlorine. The nitric solution was evaporated completely to dryness, the residue dissolved in distilled water and again evaporated to dryness. The silver salt was then redissolved in distilled water, washed into a small flask, and made up to about 20 cc. with water. A few drops of a solution of neutral potassic chromate, free from chlorine, were then added and the solution was titrated with centinormal sodic chloride. On reaching the point where the colour of argentic chromate disappeared, the solution was titrated back with centinormal solution of argentic nitrate, and the mean of the two results was taken.

First Series.

In the first series of experiments the specimens photographed illustrated the effect of varying the quantity of mordant (potassic bichromate) in dyeing wool with logwood.

The composition of the "vat" used was—

Wool	100 parts.
Logwood Extract	8 „
Water	10,000 „

Temperature 90° C. Time, 1 hour.

The quantity of mordant ranged from ·25 to 3·00 parts.

The discs used were seven in number, and had a uniform diameter of nearly 25 mm.

The size of the discs on the recipient plate was very nearly 7·02 mm. From this negative 250 prints on "Eastman Paper, A." were taken; the time of exposure being 45 secs. at 4 ft. from a No. 4 burner burning about 22-candle gas.

The prints were then treated as already stated, and the following quantities of silver were obtained:—

A.	B.	C.	D.	E.	F.	G.
3·13	2·50	1·72	1·08	·65	·54	·166 m. grm.

The corresponding values of mordant were—

A.	B.	C.	D.	E.	F.	G.
3	2	1·5	1	·5	·375	·25

These numbers agree fairly well with the equation—

$$y = \frac{\beta (x - c)}{1 + \gamma (x - c)},$$

where y = silver deposited, x = mordant, $\beta = 1·7890$, $\gamma = ·21354$, $c = ·15660$.

TABLE I.

y		y calc.
3·13	....	3·17
2·50	....	2·37
1·72	....	1·87
1·08	....	1·28
·65	....	·57
·54	....	·37
·166	....	·16

Probable error of a single comparison, ·09 m. grm.

When x is very large, $y = \frac{\beta}{\gamma} = 8·3778$. The amount of silver actually present on the paper was 22 m. grm. It is evident that c represents the amount of mordant necessary in all cases before any tinctorial effect is produced.

Second Series.

In this series the number of different tints photographed was 10. Here the weight of the mordant was constant while the logwood extract was varied. The "vat" employed in mordanting was—

Wool	100 parts.
Potassic bichromate	3 „
Water	10,000 „

Temperature 90° C. Time, 1 hour.

The quantities of logwood extract ranged from 0 to 8 parts. The size of the discs was 25 mm., and their size as photographed 7·02 mm. very nearly. The time of exposure of the points in this case was one minute, the other conditions being as in the first series. 250 prints were taken in this case also. The following quantities of silver were obtained:—

	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.
Silver......	3·02	2·92	2·37	1·62	1·4	1·08	·59	·32	·27	·11
Logwood ext.	10	8	6	4	3·5	3	1	·5	·25	0

As the quantity of silver obtained in J was due to the colour produced in the wool by the mordant, this number (·11) was subtracted from the others, giving—

A.	B.	C.	D.	E.	F.	G.	H.	I.	J.
2·91	2·81	2·26	1·51	1·29	·97	·48	·21	·16	0

These numbers, in most cases, agree pretty closely with the equation—

$$y = \frac{\beta x}{1 + \gamma x}.$$

Where y = silver deposited, x = logwood ext., $\beta = ·513$, $\gamma = ·07778$.

TABLE II.

y.		y calc.
2·91	....	2·89
2·81	....	2·53
2·26	....	2·10
1·51	....	1·57
1·29	....	1·41
·97	....	1·25
·48	....	·48
·21	....	·25
·16	....	·13
·00	....	·00

Probable error of a single comparison, ·08. We have satisfied ourselves that this is very nearly the probable error of the volumetric method. When, in the second equation, x is very large, y reaches 6·5955 as its ultimate limit.

[The original dyed goods and corresponding photographic prints were exhibited.]

ON THE ESTIMATION OF PHOSPHORIC ACID WITH NITRATE OF SILVER.

BY JOHN CLARK, PH.D., F.C.S., F.I.C.

In 1881 Eug. Perrot (Compt. Rend., Vol. 93, p. 495) published a process for the estimation of phosphoric acid existing as phosphate of lime or magnesia, based on the precipitation of the phosphoric acid as phosphate of silver. For this purpose he dissolved the phosphatic material in nitric acid, precipated the phosphates of iron, alumina, lime, and magnesia with ammonia, then dissolved out the phosphates of lime and magnesia with acetic acid, neutralised with ammonia, and added a known quantity of nitrate of silver to precipitate the phosphoric acid. The whole was then made up to a known bulk. The excess of silver in a portion of the solution was determined volumetrically, and the balance assumed to exist as phosphate of silver Ag_3PO_4. Mons. Perrot does not give any results to indicate the accuracy of his process; and those who are aware of the difficulty of dissolving precipitated phosphate of lime in acetic acid will, I think, agree with me that the process in this form is not of much practical value.

Shortly after the publication to which I have referred, Drs. Kratschmer and Sztankovanzky (Zeits., Vol. 21, page 523) made a number of experiments on pure phosphates of lime, magnesia, and soda, and proved conclusively that Perrot's process was capable of yielding good results with pure materials in the absence of iron and alumina, but they do not indicate what modifications are necessary when these impurities are present.

The objections to Perrot's process when applied to manures and natural phosphates are—

1st. The chlorides which may be present will be estimated as phosphates.

2nd. The method of separating the phosphates of lime and magnesia from the phosphates of iron and alumina is inaccurate, as it is practically impossible to dissolve out the whole of the phosphate of lime in the manner indicated.

I have repeated some of the experiments made by Drs. Kratschmer and Sztankovanzky, and can confirm generally their statements as to the accuracy of this process for the estimation of phosphoric acid in pure substances; but a process of this kind is of very little value unless it is suitable for impure materials, and I have therefore devoted my attention more especially to the modifications which are necessary in applying the nitrate of silver process to the valuation of manures and mineral phosphates.

The modifications which I would recommend are—

1st. The solution of the phosphate of silver precipitate in nitric acid, and titration of the silver with sulpho-cyanide.

2nd. The neutralisation of the acid solution with caustic soda instead of ammonia, to avoid the presence of an excessive quantity of ammoniacal salt, which affects the results.

3rd. The previous precipitation of the iron and alumina as phosphate with acetate of soda containing free acetic acid.

The following is an outline of the process:—

The manure or mineral phosphate is dissolved either in water, nitric acid, or sulphuric acid, the greater portion of the free acid neutralised with caustic soda, and to the cold solution acetate of soda containing free acetic acid is added in excess. If the addition of the acetate of soda produces a precipitate, this must be filtered off, re-dissolved, and re-precipitated with acetate of soda, as before. The filtrate and washings are added to the previous filtrate, then excess of nitrate of silver, which will give an immediate precipitate of phosphate of silver, Ag_3PO_4, which is easily recognised by its yellow colour, and the free acetic acid is neutralised with caustic soda till there is only a faint acid reaction to litmus paper. The slightest excess of caustic soda will cause a brown precipitate of oxide of silver if there is not too much ammoniacal salt present; but this oxide of silver dissolves easily on the addition of a few drops of dilute acetic acid. The precipitate of phosphate of silver, which will contain any chloride which may have been present, is thrown on a filter, thoroughly washed with water, then dissolved off the filter with hot dilute nitric acid, mixed with a little ferric sulphate, and the silver titrated with sulpho-cyanide, as described by Volhard, and calculated to phosphoric acid.

The precipitate of phosphate of iron and alumina is dried, ignited, and weighed, then dissolved in acid, the iron determined volumetrically, calculated to phosphate of iron, and the balance assumed to be phosphate of alumina; or the oxide of iron may be separated with caustic soda and the alumina in the filtrate weighed as phosphate of alumina, using the precautions recommended by Robert T. Thomson (Journal of the Society of Chem. Industry, No. 3, Vol. V.).

The following experiments, which were made for the purpose of testing this process, give a fair idea of its accuracy:—

I.—Bone Charcoal.

	Per Cent.
(*a.*) Phosphoric acid by silver process	30·16
Equal to phosphate of lime	65·85
(*b.*) Phosphoric acid by silver process	30·15
Equal to phosphate of lime	65·83
(*c.*) Phosphoric acid by Molybdic process............	30·11
Equal to phosphate of lime	65·74

II.—Fish Guano.

	Per Cent.
(*a.*) Phosphoric acid by silver process	10·45
Equal to phosphate of lime	22·82
(*b.*) Phosphoric acid by silver process	10·55
Equal to phosphate of lime....................	23·05
(*c.*) Phosphoric acid by Molybdic process (Mr. Tatlock)..	10·58
Equal to phosphate of lime	23·11

III.—Superphosphate.

——	*a.*	*b.*
	Per Cent.	Per Cent.
Soluble phosphoric acid (silver process) ..	13·59	13·48
Equal to soluble phosphate	29·68	29·45
Soluble phosphoric acid (Molybdic process)	13·55	13·52
Equal to soluble phosphate	29·60	29·53

IV. — Rock Phosphate containing, according to Dr. Wallace, 4·07 per cent. of Alumina and 1·62 per cent. Oxide of Iron.

——	*a.*	*b.*
	Per Cent.	Per Cent.
Phosphoric acid by silver process	24·68	24·52
Do., calculated from phosphate of iron and alumina precipitate	6·85	6·99
Total phosphoric acid......................	31·53	31·51
Equal to phosphate of lime.............	68·85	68·82

	Per Cent.
Phosphoric acid in rock phosphate, Molybdic process (Dr. Wallace)	31·43
Equal to phosphate of lime	68·60

When the proportions of iron and alumina in a phosphate is very small (say about ½ per cent.), it is not necessary to add acetate of soda, because they do not, in this proportion, materially affect the result, as about three-fourths of the phosphoric acid, which would be precipitated as phosphate of iron and alumina, is converted into phosphate of silver. Experiments made with native phosphate of alumina, containing neither lime nor magnesia, fully bears this out. In such cases excess of nitrate of silver may be at once added to the solution of the phosphate in sulphuric acid or nitric acid, and caustic soda added till the precipitate of phosphate of silver becomes brown, then acetic acid till the reaction is acid, and the precipitate is filtered off, dissolved in nitric acid, and titrated as already described.

Ignited Rodonda phosphate (native phosphate of alumina), containing 41 per cent. of phosphoric acid, gave the following results by this method.

——	*a.*	*b.*
	Per Cent.	Per Cent.
Phosphoric acid	33·20	29·04

I had hoped, by some modification of the above process, to be able to precipitate the whole of the phosphoric acid as phosphate of silver, but as yet my efforts have not been successful.

Journal and Patent* Literature.

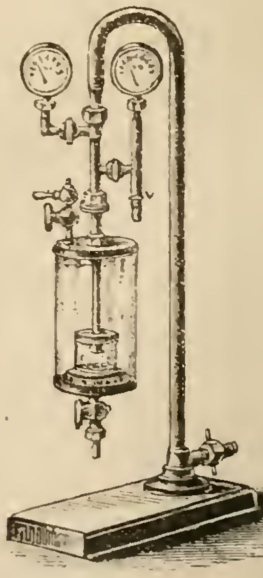
I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Fires in Benzene Works. F. Fischer. Zeit. f. angew. Chem. 1888, 138—140.

In establishments where benzene is used for cleaning woollen goods, &c., fire may break out by spontaneous combustion, by electricity, or through a fire-place at some distance. As to the first the author does not consider it at all probable that a conflagration would arise from the benzene itself, but only by the heating of greasy goods lying in heap. Electricity may be generated in the washing machine, on the one hand by friction of the wool, and on the other hand on the surface of the metal lining of the vessel. Such a source of danger may be averted by connecting the interior of the machine with the earth by means of copper wire. The third source of danger may be obviated by constructing the room in which the benzene is used with both windows and doors opening to the outside air, and in no wise communicating with a building in which fires are used.—J. W. L.

Combined Suction and Pressure Apparatus. R. Muencke. Chem. Zeit. **24**, 392.

In construction and size this apparatus is similar to the author's older hydrostatic blast, and differs from it only in that the cylinder case is of glass, which thus renders the inner arrangements visible. An inverted U-shaped iron tube, carrying a manometer to show the water pressure, conveys the water from the supply-tap to the pump. The pump is connected with a second manometer to indicate the pressure of air in the vessel undergoing exhaustion,



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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*.	½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*.......	1*d*.
„ 1*s*. 6*d*., „ „ 2*s*. 4*d*.......	1½*d*.
„ 2*s*. 4*d*., „ „ 3*s*. 4*d*.......	2*d*.

between which and the pump itself is a back-pressure valve to prevent any flow of water into the tubes of the exhausted receiver. Beneath the pump is screwed on the glass cylinder provided with an outlet cock for the water in the bottom plate, and one for air (when a blast is required) in the top plate. (*See this Journal*, 1887, 73, *Fig.* 26.)

—W. G. M.

PATENTS.

Improvements in Apparatus for Purifying Water for Steam Boilers. G. W. Allen, Manchester, and H. J. A. Bowers, London. Eng. Pat. 7772, May 28, 1887. 8*d*.

The scum plate and separating vessel for the purpose of removing the "scum" from the surface of the water in a steam boiler, and for which letters patent, No. 12,810, October 26, 1885, were granted to H. J. A. Bowers, have not been found efficient in dealing with such waters as river or canal waters. The present specification describes a U- or V-shaped trough applied to the scum plate, and through which the water passes on arriving in the interior of the boiler. The heavy deposit which falls from the water is thereby conducted to the scum plate, which then operates in the manner described in the specification above-named.—C. C. H.

An Improvement in Refrigerating Apparatus. J. Imray, London.—From La Compagnie Générale pour la Production du Froid, Paris. Eng. Pat. 3793, March 12, 1887. 8*d*.

In a former specification, Eng. Pat. No. 2387 of 1885, an improved refrigerating apparatus was described, in which two sets of coil pipes with suitable valves and cocks were so arranged as to cool air passing through the apparatus by utilising the variations of temperature produced by alternate vaporisation and condensation of a volatile liquid. This was effected so that while the air was cooled by the refrigerating action of one coil, distilled water was produced by the heat developed by the compression of the vapour in the other coil melting off the "rime," which has been formed upon it in the first-named portion of the process. The present invention adds a third coil, so that the air which exists in the one, acting as a refrigerator, and which has finally attained a temperature nearly that of the air supplied, is passed through the other coil, serving to melt off the brine. The air which has been refrigerated is also passed over the third coil, and having already deposited its moisture becomes cooled to a much lower temperature.

—C. C. H.

An Anti-incrustation Preparation for Steam Boilers R. M. Bryant, Bristol. Eng. Pat. 12,357, September 12, 1887. 4*d*.

Valonia, three parts; Aleppo galls, two parts; African clearing nut, one part; gum arabic, one part, are boiled in distilled water and concentrated in vacuo. The dry extract is re-dissolved, and after the addition of dextrine, two parts, and glucose, one part, is concentrated to a specific gravity "of about 90"; the product is used for the purpose described.—C. C. H.

A Special Powder for Preventing and Removing the Incrustations in Steam Boilers. P. Alfieri, Naples. Eng. Pat. 12,169, September 8, 1887. 4*d*.

The "disincrustant" contains 16 ingredients: nine of these are salts of the alkalis and ammonia; the remainder, gelatine, carbon, and various kinds of powdered wood.

—C. C. H.

An Improvement in Filter Presses. E. A. Cowper, London. Eng. Pat. 15,238, November 8, 1887. 4*d*.

The patentee claims the construction and use of filter press plates, constructed of thin plates of wrought-iron or steel, domed or dished to give them stiffness. The chambers are formed by distance frames or rings in the usual way.—C. C. H.

Improvements in Filter Presses. L. A. Enzinger, Worms, Germany. Eng. Pat. 5982, April 25, 1887. 8*d*.

The main object of the invention is to afford greater facility for the escape of the air contained in the chambers of the filter press, or forced in with the liquid undergoing filtration. The chambers are square, and placed with their diagonals vertically and horizontally. The fixed head of the machine is formed into a reservoir for the turbid liquid and provided with an air-receiving vessel. The moveable head is formed into a receiver for the filtered liquid, and provided with an air vessel similar to the fixed head. There are two conduits at the lower and two at the upper part of the chambers. The liquid introduced through the fixed head enters one of the lower conduits and thence into every alternate chamber, forcing the air from these chambers into one of the upper conduits through a port core and thence into the air vessel on the fixed head, from whence it is allowed to escape. The liquid entering the chamber filters through the filtering walls and media into the remaining alternate chambers, passing therefrom into the other of the lower conduits by a port core and thence to the moveable head, where it is withdrawn; the air from these chambers passes similarly through the other upper conduit and into the air vessel on the moveable head, from whence it is periodically allowed to escape.—C. C. H.

Improvements in Vacuum Evaporating and Distilling Apparatus. H. T. Yaryan, Toledo, Ohio, U.S.A. Eng. Pat. 213, January 5, 1888. 11*d*.

This specification describes improvements upon the multiple effect evaporating apparatus described in Eng. Pat. 14,162, 1886. It consists of a series of tubular evaporators, the first of which is heated by steam and the remainder by the products of evaporation of those earlier in the series. The tubes in each evaporator are arranged horizontally between two tube plates at the ends of a cylindrical heater, and they are connected in such a fashion at each end that liquid entering any two of the tubes returns through other two to the same head at which it entered, and finally by a single tube to the exit end in communication with a receiver, thus traversing the system three times. The concentrated liquid flows off through a receiver, and is drawn by superior vacuum into another evaporator in the series; the vapour from the liquid in each evaporator is used to heat the system of tubes in another of the series. Finally, the fully concentrated liquid is removed from the last evaporator by means of a "tail pump," and the vapour and air pass through a suitable condenser and vacuum pump. Various devices for dealing with different materials are shown. The invention and its various combinations are covered by 16 claims.

—C. C. H.

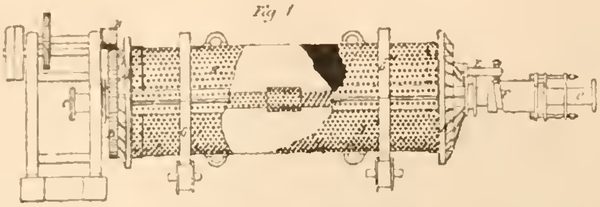
Improvements in Apparatus for Compressing Drugs and other Substances. J. Tinlin, J. J. Piatkowski, S. M. Burroughs, and H. S. Wellcome, London. Eng. Pat. 16,239, November 25, 1887. 8*d*.

The improved apparatus consists of a disc rotated intermittently by suitable mechanism and arrangement of parts; the drugs, &c. are fed into a series of holes, placed concentrically in the disc, from a hopper and automatic filling device; a pair of plungers worked by an eccentric and levers enters one of the holes from above and below when the disc is at rest, and effects the desired compression. The pellets so formed are subsequently disengaged by the action of other small plungers entering the holes at a suitable position and expelling the contents into a receiving hopper. The whole mechanism is operated by a cam, eccentrics, and levers by means of a single shaft.—C. C. H.

Improvements in Filter Presses. J. Brock and T. Minton, Widnes. Eng. Pat. 2127, February 10, 1887. 8*d*.

The object of this invention is to facilitate the lixiviation of the precipitate or residue it is desired to separate from the liquid in which it is suspended. A is a perforated cylinder lined with corrugated gauze covered by a filtering cloth; it is made in halves and jointed axially. A feed pipe C, perforated, passes through the centre of the apparatus through stuffing-boxes F in the covers B; the whole apparatus is mounted on runners and revolves on the steel bands G, by means of the gearing H, D; an end motion is likewise given during rotation by the cam F and arm E.

Fig 1

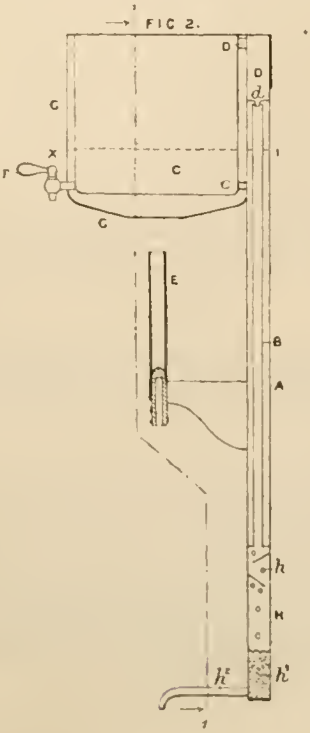


The material is pumped in through C and fills the interior periphery; when a coating of the maximum thickness consistent with rapid filtration has accumulated, wash water is forced through the same pipe and passes evenly through the filtered mud. The patentees state a very rapid lixiviation is the result. The cake or washed mud is discharged by separating the two halves of the cylinder axially.—C. C. H.

Improvements in the Distillation of Water and other Liquids. A. McN. Coyle, E. F. Andrews, and E. C. Davidson, Washington, U.S.A. Eng. Pat. 7896, May 31, 1887. 8*d*.

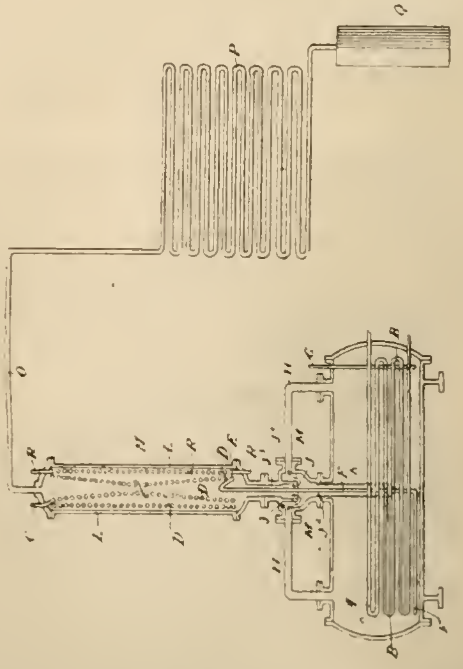
The improved apparatus for the purpose set forth is shown in the annexed drawing. C is a closed vessel covered by a jacket G, and heated by a Bunsen gas burner E. The upper part of C is in communication with a flat tube Liebig condenser B through the opening D^1, and the lower part is in communication with the water jacket A of the condenser through the tube c. When heat is applied the steam formed in C rushing through the orifice *d* into the condenser B causes the vaporisation of the warm water in the upper part of the jacket A, and carries that likewise into the condenser, in which it is condensed, by the cold water entering the lower part of the jacket, along with the steam entering from C at D^1. It is aerated in H by passing through gratings, and also by air entering the small holes *h*. Finally it leaves the condenser through the drip pipe h^2 after passing through the filter h^1. The form of still shown is used in the distillation of water for domestic purposes; a modification suitable for alcoholic distillation is also shown in the specification. The whole invention is covered by 14 claims.—C. C. H.

FIG 2.



Improvements in or relating to Refrigerating Processes and Apparatus therefor. W. P. Thompson, Liverpool. —From J. B. Craft, New York. Eng. Pat. 1419, January 31, 1888. 8*d*.

The improvements described in this specification relate to refrigerating apparatus which operate upon the principle of absorption. The objects are to prevent "priming" or boiling over of the liquid contents of the still, to secure dry gas passing over to the condenser and to so transmit the heat of the gas passing from the still to the strong liquor entering the apparatus without actual contact therewith. A is the still, heated by the steam coil B; the strong liquor enters through the curved and coiled pipe C, passes through the gas receiver J, the rectifying coil D, trap E, and delivery pipe F, to the bottom of still. G is the weak liquor efflux pipe from opposite end of still. H H are the gas outlet pipes opening into J; diaphragm M compels the gas to pass downward before entering J, the water carried over by priming is thrown down and delivered



below liquid in the still by pipe K. The hot dry gas ascends through J and comes in contact with supply coils, giving up its heat to the liquor in the coils, good circulation of gas through the coil of C being secured by means of baffle plate N. P represents the condenser, and Q the liquid gas receiver.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Gas Producer. Zeit. f. ang. Chem. 1888. 168.

This producer is used in the Bangbro Ironworks in Sweden for gasifying charcoal smalls. Its construction is illustrated by drawings of the elevation and plan, and presents no very novel features, except that the hopper has two valves, one above the other, and opening independently, by which the charge can be introduced more conveniently. A spray of water is used in the exit flue for the purpose of freeing the gas from dust.—G. H. B.

On the Decrease of the Illuminating Power of Naphtha-Gas by Admixture of Air, and the Explosibility of such Mixtures. L. Jawein and S. Lamansky. Dingl. Polyt. J. **267**, 416—419.

Naphtha-gas is manufactured in Russia from naphtha and naphtha residues, and is used for illuminating works and public buildings, which have gas-works of their own for this purpose. Owing to the difficulty of obtaining a general average sample of naphtha-gas, the experiments were made on one day, the amount of gas required for the experiments being led into a small gas-holder, which also contained the air for mixing. The mixtures thus obtained were tested as to specific gravity and illuminating power, and gave the following results:—

Gas-Mixture.	Specific Gravity.	Consumption of Gas in Cub. Ft. per Hour.	Illuminating Power in Candle-Units.	Consumption of Gas in Cub. Ft. per Hour and Candle-Unit.
Naphtha-gas …….	0·685	3·3	31	0·107
Naphtha-gas mixed:				
With 5 per cent. air	0·719	3·3	25	0·132
„ 10 „ „	0·732	3·3	21	0·157
„ 20 „ „	0·755	3·4	15	0·226
„ 50 „ „	3·796	3·3	5·5	0·600

In all these experiments the gas was allowed to escape under a pressure of 6 ins., while the temperature of the room was from 19° to 21° C. It will be noticed that an admixture of air increases the specific gravity and considerably diminishes the illuminating effect. For ascertaining the explosibility of mixtures of naphtha-gas and air, different mixtures were submitted in a eudiometer to the action of the electric spark.

Vol. of Gas.	Vol. of Air.	Explosion.
1	4·9—5·2	None.
1	5·6—5·8	Feeble.
1	6·0—6·5	Violent.
1	7·0—9·0	Very violent.
1	10·0—13·0	Violent.
1	14·0—16·6	Feeble.
1	17·0—17·7	Very feeble.
1	18·0—22·0	None.

A mixture of naphtha-gas and air is therefore explosive if gas and air be in the proportion of 1 to 5·6—17·7 by volume, or 1 to 85—91·4 by weight. Of course, these figures are only accurate for the sample of naphtha-gas experimented upon. After all, it is not likely that the figures will vary much with different naphtha-gases, the proportion for marsh-gas being 1 vol. of gas to 6—16 vol. of air.—S. H.

PATENTS.

Separation of Carbonic Oxide from Nitrogen, Carbonic Acid, Hydrogen, and other Gases contained in the Gaseous Mixture resulting from the incomplete Combustion of Coal and of Coke by the use of the Chlorides of Copper and of Iron. H. Gardner, London.—From R. J. Henderson, Oswego, America. Eng. Pat. 6107, April 26, 1887. 6*d*.

The separation depends upon the fact that if the above-mentioned mixture of gases be brought into contact with a solution of cuprous chloride in hydrochloric acid at ordinary atmospheric pressure, and a temperature of 49° C., the carbonic oxide is alone absorbed. By then reducing the pressure over the solution to below 15 or 16 ins., the carbonic oxide is liberated, and the liquid regenerated for further use. The mixture of gases, before reaching the cuprous chloride, is freed from oxygen and moisture by passing first through a refrigerator, then through a solution of ferrous chloride, and finally through a column of coke moistened with sulphuric acid. In order to prevent the oxidation of the ferrous chloride, care is taken to have a certain proportion of hydrogen present in the gaseous mixture, steam being injected into the generator for that purpose.—A. R. D.

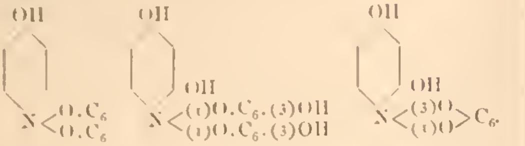
Treatment of Incandescence Bodies formed of Metallic Oxides, for increasing the Luminosity and Resisting Properties thereof, and Apparatus for that purpose. O. Imray, London.—From C. A. von Welsbach, Vienna, Austria. Eng. Pat. 6239, April 28, 1887. 8*d*.

This invention has reference to that system of incandescence burners wherein a mantle or hood composed of a network of the oxides of some of the rare metals is heated to incandescence in a Bunsen flame. It has for its object to regenerate the mantles, so as to restore the brilliancy of the light, which appears to decrease considerably after the hoods have been in use for some time. To this end the mantle is coated anew with a solution of the nitrate of the rare metal, either by dipping, painting, or the application of a spray. After evaporation of the excess of moisture, the burner flame is turned on till the nitrate is decomposed, leaving a film of oxide in its place. If mantles thus impregnated with the nitrate solution are exposed to an atmosphere containing ammonia, oxalic acid, or benzoic acid, there is produced a hard gum-like substance which effectually withstands shocks and vibrations.—A. R. D.

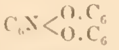
IV.—COLOURING MATTERS AND DYES.

Dichroïnes, Phenoloxychroïne, Thymolchroïne, Thymoquinone. By H. Brunner and D. Chuit. Ber. **21**, 249—255.

It has already been shown that the colouring matters obtained from nitrosophenols (Liebermann) can also be produced by various other reactions, and that Weselsky's diazoresorcinol and diazoresorufin belong to this class of compounds. The constitution of these dyes is shown by the following formula:—

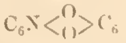


On account of their dichroitic properties those containing the group—



$$C_6N<\begin{matrix}O.C_6\\O.C_6\end{matrix}$$

are termed *a-dichroïnes*, those containing the group—



$$C_6N<\begin{matrix}O\\O\end{matrix}>C_6$$

are named *β-dichroïnes.*

The phenol dye $C_{18}H_{15}NO_3$, the resorcinol dyes $C_{18}H_{15}NO_6$ and $C_{36}H_{26}N_2O_{10}$, and the orcinol dye $C_{21}H_{21}NO_6$ are a-dichroïnes; the orcinol dye $C_{14}H_{11}NO_3$, azoresorcinol, azoresorufin, and azoresorufin ether are β-dichroïnes.

In most of the reactions by which dichroïnes are produced, other dyes are also obtained which are richer in oxygen and do not fluoresce; these are termed *oxychroïnes.*

Only true nitroso-compounds give the dichroïne and oxychroïne reaction, quinone-oximes yield dyes containing the group $(C_6.N)_2:O(C_6)_2$; such dyes are named *chroïnes.*

Acetyl-a-phenoldichroïne, $C_{18}H_{14}(C_2H_3O)NO_3$, is obtained by heating a-phenoldichroïne with three parts acetic anhydride and two parts anhydrous sodium acetate to 140°; it is a brown amorphous substance, which dissolves in ether, alcohol, acetone, and chloroform, forming a brown solution.

Acetyl-a-phenoloxychroïne, $C_{18}H_{14}(C_2H_3O)NO_4$, is prepared in a similar manner from the oxychroïne, which is produced in the preparation of a-phenoldichroïne; it resembles the preceding compound.

Acetyl-a-orcinoldichroïne, $C_{21}H_{17}(C_2H_3O)_4NO_6$, is a brown amorphous mass, soluble in ether, alcohol, chloroform, and acetone.

Thymolchroïne, $C_{40}H_{52}N_2O_5$, was prepared by Liebermann's method, and purified by extracting it with benzene; it forms a dark-violet amorphous mass, and dissolves in alcohol, ether, chloroform, and benzene, with a red colour and slight greenish fluorescence; its alcoholic solution is turned blue by alkalis, the aqueous solution green. When heated to 140° it sublimes, with partial decomposition, forming violet vapours, which condense to a red amorphous mass. The *acetyl* derivative is a brown amorphous mass, soluble in alcohol, ether, and acetone.

In the preparation of thymolchroïne from nitrosothymol thymoquinone is also produced.—F. S. K.

Paranitroso-aniline. By O. Fischer and E. Hepp.

Ber. **21**, 684—687.

The yield of paranitroso-aniline by the method of preparation (this Journal, 1887, 723) is about 50 per cent. The salts of the nitroso-base with mineral acids dissolve readily in water with a yellow colour. The *sodium salt*—

$$C_6H_6N_2O, NaOH, H_2O,$$

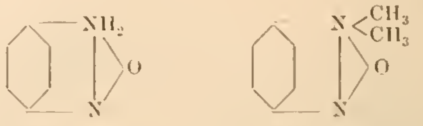
is a yellow crystalline compound. On reduction, nitroso-aniline yields paraphenylenediamine.

When nitroso-aniline is treated with an excess of hydroxylamine hydrochloride, a product is obtained which is identical with quinonedioxime prepared by Nietzki and Kehrmann (Ber. **20**, 612); by this reaction, which appears to be a general one, paranitroso-bases can be converted into quinonedioximes.

Nitroso-aniline and phenylhydrazine hydrochloride yield a yellow crystalline product which is almost insoluble in water and alkalis; this compound seems to be formed by the combination of 1 mol. of nitroso-aniline with 1 mol. of phenylhydrazine, and this reaction also seems to be a general one.

Azophenine is formed in considerable quantities when nitroso-aniline is heated with 1 part of aniline hydrochloride and 5 parts of aniline.

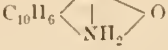
From the above facts it will be seen that the analogy between nitroso-aniline and nitrosodimethylaniline is complete.



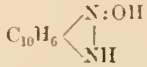
Nitroso-aniline. Nitrosodimethylaniline.

The conversion of nitrosophenol into nitrosoaniline by warming with salts of ammonia, is a reaction common to many other nitrosophenols, for instance nitroso-ortho- and -metacresol, and the nitrosonaphthols.

The product obtained by Illinski (Ber. **17**, 391) from a-nitroso-β-naphthol with ammonia must, for various reasons, be a secondary base; its formula is therefore—



[N:NH$_2$=1:2], and not



[N.OH:NH = 1:2].

—F. S. K.

Dibromnitrosophenol. By O. Fischer and E. Hepp.

Ber. **21**, 674—675.

Diorthobromnitrosophenol is obtained by adding a dilute alcoholic solution of 2·6 parts of bromine to a well-cooled alcoholic solution of one part of nitrosophenol. The product is precipitated by the addition of ice, filtered and recrystallised from dilute alcohol as quickly as possible to avoid decomposition. It is readily soluble in alcohol and ether, less readily in chloroform and glacial acetic acid.

Dibromamidophenol is produced when the preceding compound is reduced in the cold with tin and hydrochloric acid. The tin double salt which is formed is crystallised from hot water, decomposed with sulphuretted hydrogen, and the product precipitated from the filtrate by potassium carbonate; it is then dissolved in dilute potash and reprecipitated by passing carbonic acid through the solution. This compound crystallises in fine needles, which melt at 189°; it is sparingly soluble in ether, but dissolves readily in alcohol. The *acetyl* derivative crystallises from dilute alcohol and melts at 175°.

Contrary to their previous statement (this Journal, 1887, 724), the authors find that when dibromnitrosophenol is heated with aniline and aniline hydrochloride, hydroxyazophenine is obtained, melting at 197°—198°; it dissolves in soda and potash, forming red-brown solutions.—F. S. K.

Azophenine and Quinone-anilides. By O. Fischer and E. Hepp. Ber. **21**, 676—684.

Anilidoethoxybenzoquinone-anil—

$$C_6H_2O(NC_6H_5)(NHC_6H_5)(OC_2H_5),$$

is formed by heating a mixture of one part of azophenine, 100 parts of alcohol, and 50 parts of sulphuric acid (60° Baumé) for one hour at a temperature below 70° (compare this Journal, 1887, 724). Dilute with water, stand for several hours, and filter; ammonia is added to the filtrate, the precipitate dissolved in dilute sulphuric acid, boiled with animal charcoal, and reprecipitated with ammonia. It crystallises from dilute methyl alcohol in red leaves or prismatic crystals, melting at 137°. This compound is identical with that which Zincke and v. Hagen obtained by the action of sulphuric acid and alcohol on dianilidobenzoquinone-anil (Ber. **18**, 788).

Anilidomethoxybenzoquinone-anil—

$$C_6H_2O(NC_6H_5)(NHC_6H_5)(OCH_3),$$

is obtained by heating 2 grms. azophenine, 100 grms. methyl alcohol, and 10 grms. sulphuric acid (60° Baumé) at 75°—80°. This compound melts at 194°, and is identical with anilidomethoxyquinone-anil obtained by Zincke and v. Hagen (loc. cit.).

Reduction of Azophenine.—When a mixture of one part of azophenine, 25 parts of glacial acetic acid, and 25 cc. concentrated stannous chloride solution is boiled for a long time and then water added, a colourless crystalline reduction product is precipitated which is stable in acid solutions, but in presence of ammonia is converted into a red base, which forms blue salts that are readily soluble in water.

Trichlorazophenine is obtained by heating one part of parachloraniline and five parts of parachloraniline hydrochloride to 70°, and then adding one part of nitrosodiphenylamine in small portions. After about an hour's time the mixture is largely diluted with alcohol, allowed to stand, and then filtered; the residue is boiled out with water, dissolved in toluene and ammonia passed into the solution, on filtering into boiling alcohol trichlorazophenine is precipitated in brown-red prisms, which melt at 246°.

Nitrosophenol and Parachloraniline yield a totally different product from the preceding one; it melts at 265°, dissolves only very sparingly in benzene, is insoluble in alcohol, but crystallises from hot xylene in red prisms. This compound is probably tetrachlorazophenine.

When one part of nitrosoorthocresol is added gradually to a mixture of four parts of aniline and two parts of aniline hydrochloride heated at 70°, so that the temperature does not rise above 90°, and the product crystallised from alcoholic benzene, it melts at 172°—173°. This substance is identical in properties with dianilidotoluquinone-anil obtained by Zincke and v. Hagen (Ber. **16**, 1558).

Diparatoluidotoluquinoneparatoluide is prepared in a similar manner to the corresponding aniline derivative from paratoluidine and nitroso-orthocresol.

Naphthoquinone-anilides.— All three known nitrosonapthols yield one and the same *anilidonaphthoquinone-anil.* This compound is also formed from benzenazo α-napthol, aniline, and aniline hydrochloride at 100°; also from benzeneazo-α-naphthylamine, from nitrosophenyl-α-naphthylamine, from benzene-azo-ethyl-and-phenyl-α-naphthylamine. When quinone-anilide is fused with aniline hydrochloride and aniline at 170°, induline is formed. A white crystalline bye-product of unknown constitution is obtained in the above processes, as well as by the action of all nitrosonaphthols on aniline. The anilidonaphthoquinone-anil obtained by any of the above methods was proved to have the constitution assigned to it by Brömme by converting it into hydroxynaphthoquinone.

Dibromanilidonaphthoquinone-anil is obtained by melting α-nitroso-α- or -β-naphthol with a mixture of parabromaniline and parabromaniline hydrochloride. It dissolves sparingly in alcohol, more readily in boiling benzene, from which it crystallises in long red needles, melting at 235°.

Dichloranilidonaphthoquinone-anil is formed by melting parachloraniline with α-nitroso-α- or -β-naphthol. It melts at 217°—218° and resembles the preceding compound in appearance and in its behaviour towards solvents. The same substance is obtained from benzene-azo-α-naphthol and parachloraniline. Parachlorobenzene-azo-α-naphthol and aniline yield anilidonaphthoquinone-anil.

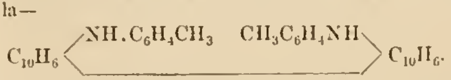
It follows, from the experiments described above, that anilidonaphthoquinone-anil is the azophenine of the naphthalene series.—F. S. K.

Naphthalene Derivatives. By O. Witt. Ber. **21**, 726—728.

Among the large number of experiments which were made in order to test the reaction-proportions between paratolyl-β-naphthylamine and nitrosodimethylaniline were some which gave totally different results from those described in the abstract following this. According to these, only a very small quantity of the nitroso-compound was used up and the formation of the dye was a minimum; in place of the latter, a colourless crystalline compound was obtained in glittering plates.

This phenomenon occurred regularly when acetic acid which had been utilised in previous experiments was used as a diluent instead of the commercial article, and it was found that the cause of the destruction of the dye was an extremely small quantity of zinc chloride which had been carried over in distilling. Further experiments showed that many other metallic salts have a similar action, for instance ferrous and stannous chloride.

When 10 grms. paratolylnaphthylamine are mixed with 4 grms. nitrosodimethylaniline hydrochloride and warmed on the water bath with 10 grms. zinc chloride and 100 cc. glacial acetic acid, a yellow-brown solution is obtained, in which crystals soon make their appearance, until finally the whole solidifies. The product is washed with acetic acid, then with water, and lastly with alcohol; the yield is 80—90 per cent. of the tolylnaphthylamine employed. This compound can be recrystallised from ether, benzene, or xylene, and forms white glittering crystals, which are sparingly soluble in all solvents, with blue fluorescence, and melt at 224°—225°. It is an oxidation product of paratolylnaphthylamine formed under the influence of the nitroso-compound, and its constitution is shown by the formula—



$$C_{10}H_6\langle\overset{NH.C_6H_4CH_3 \quad CH_3C_6H_4NH}{\rule{6cm}{0.4pt}}\rangle C_{10}H_6.$$

The same compound is obtained by the action of ferric chloride on paratolylnaphthylamine in an acetic acid solution, but the yield is barely 4 grms. from 10 grms. of the amine.—F. S. K.

Eurhodines and Safranines. By O. Witt. Ber. **21**, 719—725

Safranines are formed by the action of nitrosodimethylaniline and its homologues on primary amines in which the para-position is occupied, whereas if a secondary amine (in which the para-position is occupied) be employed, a eurhodine base is produced. The genetic relationship between the two classes of compounds is clearly shown by this general reaction which forms the subject of a patent still in force (D.R.P., No. 19,224, February 18th, 1882).

Of the bases in which the para-position is occupied, β-naphthylamine was found most suitable for these experiments; when treated with nitrosodimethylaniline, dimethylnaphthoeurhodine (dimethylamidonaphthophenazine) is formed.

When, however, an equivalent quantity of a corresponding secondary base is employed in the place of the β-naphthylamine, an azonium base or safranine is produced.

Under certain circumstances this latter reaction takes an unexpected course (*see* preceding abstract).

Dimethylnaphtho-eurhodine is obtained by heating an acetic acid solution of nitrosodimethylaniline hydrochloride (20 grms.) and β-naphthylamine (10 grms.). The reaction commences below 100°, and is very energetic, the yield being better the more slowly the reaction takes place. The violet melt is taken up with boiling water acidified with hydrochloric acid, filtered from tar, precipitated while hot with sodium acetate, and the brown-red precipitate dissolved in alcohol acidified with hydrochloric acid: the filtered solution is evaporated to a small volume and fuming hydrochloric acid added, when, after a short time, the whole solidifies to a mass of copper-brown needles; after washing with a little alcoholic hydrochloric acid the hydrochloride of the base is obtained almost pure, and on treatment with ammonia the free base separates in the form of fine, heavy, cinnabar-red crystalline granules. The yield varies from 70—80 per cent. of the theoretical quantity. By crystallising from toluene or xylene the base can be prepared perfectly pure in rhombic, dichroic plates, melting at 205°; it shows all the properties of a true eurhodine; is volatile with slight decomposition and readily sublimes; it dissolves in alcohol, ether, and aromatic hydrocarbons, forming a yellow solution with yellow fluorescence, and is soluble in acetic acid with formation of a red-violet acetate. The concentrated sulphuric acid solution shows the play of colours of the azine bases, though not in a marked manner. The salts of the base all crystallise readily, and are bronze-coloured, they are decomposed by water, in which they dissolve only in presence of an excess of acid. Fuming nitric acid dissolves the base, forming a violet solution, which quickly becomes yellow owing to the separation of a nitro-compound.

By-products of the Eurhodine melt.—The presence of dimethylparaphenylenediamine was proved in the mother liquor from the eurhodine. The eurhodine base is formed at the expense of a part of the nitrosodimethylaniline, which serves as an oxidising agent as is the case in the formation of azophenine.

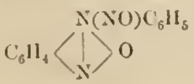
If one mol. of nitrosodimethylaniline and one mol. of β-naphthylamine are employed, part of the latter remains unchanged.

Safranines.—By heating 10·2 grms. nitrosodimethylaniline hydrochloride, 8·8 grms. phenylnaphthylamine, and 50 cc. glacial acetic acid, a deep violet melt is obtained which dissolves completely in water; on adding an excess of hydrochloric acid, and cooling the solution, a dye is obtained in the form of black metallic lustrous needles, which can be purified by repeatedly dissolving in water or alcohol, and reprecipitating with hydrochloric acid. This dye shows all the properties of an amido-derivative of an azonium base, it dissolves readily in water, is not precipitated by a moderate addition of alkali, and forms a sparingly soluble nitrate. The aqueous solution is decolorised by zinc dust, but regains its colour on exposure to the air. The dye dissolves in sulphuric acid with a red-violet colour, which changes to grey and blue-violet on addition of water.

Paratolylnaphthylamine and nitrosodimethylaniline hydrochloride when heated together in the proportion 2 : 3 with acetic acid yield a dye ($C_{25}H_{22}N_3Cl$) which is precipitated from its boiling solution in crystalline needles by the addition of a little hydrochloric acid. This substance is obtained pure by recrystallisation from dilute slightly-acid alcohol, in the form of long, fine, hair-like, violet needles with metallic lustre It is very hygroscopic, dissolves readily in water, with a blue-violet colour, and imparts to fibre fine violet shades. Ammonia has no action on the aqueous solution, but caustic soda, when added in considerable quantities, precipitates the free base in red flocks which are soluble in alcohol, forming a red solution with orange-red fluorescence. Concentrated sulphuric acid dissolves the base, forming a red-violet solution, which, on diluting, passes through dirty-green and pure blue to violet, until finally the *sulphate* is precipitated. The *nitrate* is so insoluble in water that the most dilute solutions are completely precipitated by the addition of one drop of nitric acid. The *platinochloride* is also almost totally insoluble. When the dye is treated with concentrated nitric acid and water added, a red crystalline nitro-compound is precipitated.
—F. S. K.

Para-Nitrosodiphenylamine. M. Ikuta. Annalen **243**, 272—289.

Diphenylamine forms with nitrous acid a nitrosamine, which by the action of an alcoholic solution of HCl is converted into *p*-nitrosodiphenylamine. It forms green tablets with a bluish iridescence, and dissolves in the caustic alkalis, forming salts, which are decomposed by carbonic acid. It likewise yields salts with acids, which on heating are quite as easily split up into their constituents It is especially interesting because by heating with aniline it yields azophenine together with colouring-matters of the induline group. With acetic anhydride it forms a compound of the constitution $C_6H_3.N(C_2H_3O)C_6H_4(NO)$, and by the action of nitrous acid a nitrosamine of the formula—



$$C_6H_4\left\langle \begin{array}{c} N(NO)C_6H_5 \\ | \\ N \end{array} \right\rangle O$$

Nitrosodiphenylamine splits up on heating with caustic soda into nitrosophenol and aniline. With alcoholic potash in sealed tubes at 120°—150° reduction occurs, and *p*-amidodiphenylamine is formed. By the action of nitrous acid upon the latter, diazodiphenylamine is formed. Amidodiphenylamine is suspended in dilute H_2SO_4 and $NaNO_2$ added slowly. On standing, yellow needles of the diazo-compound crystallise out. On exposure to light the crystals decompose. It forms red colouring matter with phenols. When nitrosodiphenylamine is heated with aniline and aniline hydrochloride, azophenine is formed. With bromaniline, tetrabromazophenine is formed. It appears from this and from the composition of the compound formed, that the nitrosodiphenylamine forms a part of the compound, and is not, as Witt affirms, the oxidising agent present. Parachlordiphenylamine is obtained from amidodiphenylamine by converting it into the diazo-compound and substituting the amido group by chlorine according to Sandmeyer's reaction.—J. B. C.

Compounds of Ketones with Dimethyl- and Diethyl-aniline. O. Döbner and G. Petschow. Annalen **242**, 333—348.

By the action of acetone upon dimethylaniline in presence of zinc chloride a compound of the formula—

$$(CH_3)_2C\{C_6H_4N(CH_3)_2\}_2$$

is obtained, which was found to be identical with a by-product obtained by Hofmann and Martius (Ber. **6**, 345) from the manufacture of methylaniline. Diethylaniline and acetone yield a similar product. Ten parts acetone, 50 parts dimethylaniline, and 30 parts of zinc chloride are heated in a closed tube for 12 hours to 170°. The contents are distilled in steam and the residue, which forms a brown oil, solidifies on cooling, and may be recrystallised from alcohol. The composition of this body is $C_{23}H_{34}N_2$. It forms salts with acids. On oxidation it yields a product similar to that obtained by oxidation of the dimethylaniline derivative. The yield is small. By the action of acetophenone on dimethylaniline tetramethyldiamidotriphenylethane—

$$C_6H_5CH_3C\{C_6H_4N(CH_3)_2\}_2,$$

and also smaller quantities of triphenylbenzene $(C_6H_5)_3C_6H_3$ are formed. The latter is a solid crystalline substance boiling above 360° and melting at 170°—171°. The base is homologous with the leuco base of malachite green. When the acetate of the base is warmed with manganese or lead peroxides a permanent blue colouring-matter is obtained.

In addition to this, a small quantity of tetramethyldiamidodiphenylmethane is formed. Benzophenone reacts with dimethylaniline and forms a base dimethylamidotriphenylmethane, but no tetraphenylmethane. Methylhexylketone gives rise to a complex reaction, forming as chief product tetramethyldiamidodiphenylmethane—

$$CH_2\{C_6H_4N(CH_3)_2\}_2,$$

and also a small quantity of an oil having basic properties—probably hexyldimethylaniline. By the mutual action of diethylketone and dimethylaniline tetramethyldiamidodiphenylmethane is also formed, and an oily base.—J. B. C.

Aromatic Nitroso-bases. L. Wacker. Annalen **243**, 290—307.

Propylaniline obtained by acting upon aniline with propyl bromide yields, when subjected to the action of nitrous acid, a nitrosamine derivative. By dissolving one part of the nitroso derivative in two parts of ether, adding four parts of alcohol saturated with HCl, a crystalline substance deposits on standing. This body is the hydrochloride of *p*-nitroso-propylaniline. The nitroso-derivative of this secondary amine is obtained in the usual way by the action of $NaNO_2$. In this manner *p*-nitrosopropylaniline-nitrosamine is prepared. Nitrosopropylaniline hydrochloride may be reduced with a solution of $SnCl_2$, and gives propylphenylenediamine, $NH_2C_6H_4NHC_3H_7$. Heated with caustic soda nitrosopropylaniline behaves like nitrosodimethylaniline, and gives nitrosophenol and propylamine. Paranitrosoisobutylaniline is prepared in the same manner as the propyl compound, and gives a similar series of derivatives, viz., nitrosoisobutylanilinenitrosamine, and isobutylphenylenediamine.

Nitroso-α-dinaphtylamine is prepared from α-dinaphtylamine by a reaction similar to the above, and crystallises from alcohol in red leaflets. It yields on reduction amido-α-dinaphtylamine. The nitro-base splits up on heating either with caustic soda or dilute sulphuric acid into nitrosonaphthol and naphtylamine.—J. B. C.

Aromatic Nitroso-bases. E. Kock. Annalen **243**, 307—313.

The following bases are subjected to similar reactions to the above: ethyl- and methyl-o-toluidine and ethyl-α-naphtylamine.—J. B. C.

On Dichloro-α-naphthoquinone Sulphonic Acid. Ad. Claus and Schoneveld van der Cloet. J. Prakt. Chem. **37**, 181—196.

When naphthol yellow S (the sodium salt of dinitro-α-naphthol sulphonic acid) is treated with excess of HCl and an equal weight of $NaClO_3$, the sodium salt of dichloro-α-naphthoquinone sulphonic acid is obtained on evaporation. The free acid obtained by precipitating the barium salt with the calculated quantity of H_2SO_4 is very soluble in water, and crystallises from aqueous and alcoholic solutions in light yellow leaflets. It is a very strong acid, decomposing both chlorides and nitrates on boiling. Its salts contain no water of crystallisation. They are coloured a dull yellow, and have a tendency to form double salts, which have a more intense colour than the simple salts. On treating with acid reducing agents the yellow solution becomes dark violet, and finally colourless. No doubt the corresponding hydroquinone is here formed. Dichloronaphthoquinone sulphonic acid is readily converted into hydroxychloro-α-naphthoquinone sulphonic acid, which resembles it in most of its properties. It melts with decomposition at 211°. $FeCl_3$ gives a dark red colouration. The mono-basic salts are coloured yellowish-red, the bi-basic ones a dark ruby-red. The di-sodium salt—

$$C_{10}H_3O_2Cl(ONa)(SO_3Na) + 2H_2O$$

is obtained direct from sodium dichloro-α-naphthoquinone sulphonate by mixing with caustic soda. When the boiling aqueous solution of the latter sulphonate is treated with a small quantity of a hot aqueous solution of potassium phenate, dark yellow needles of the phenoxy-derivative separate out. They contain one mol. of phenol.

$$(C_{10}H_3O_2Cl(OC_6H_5)(SO_3Na) + C_6H_5OH).$$

From this the corresponding acid was prepared by means of the barium salt.

When di-sodium dichloronaphthoquinone sulphonate is heated at 100° under pressure with acetyl chloride, sodium acetoxychloronaphthoquinone sulphonate is obtained. Aniline (2 mol.) added slowly to a hot aqueous solution of dichloronaphthoquinone sulphonate (1 mol.) yields anilidochloronaphthoquinone sulphonate—

$$(C_{10}H_3O_2Cl(NHC_6H_5)(SO_3Na)).$$

The free acid prepared from the barium salt crystallises from water in dark red leaflets, soluble in alcohol and melting at 190°. Both the acid and its salts dye wool and silk a fine red, without the use of mordants. The colour withstands acids but not alkalis.—A. R.

A Blue Derivative of Morphine. P. Chastaing and E. Rabillot. Compt. Rend. **105**, 1012.

When oxalic, malonic, and succinic acids act on morphine in presence of sulphuric acid, the compounds $C_{23}H_{34}N_2O_8$, $C_{30}H_{33}N_2O_{10}$, and $C_{32}H_{42}N_2O_{12}$ are formed; other dehydrating agents give similar compounds. When gently oxidised these three bodies give a blue crystalline compound which the authors call *morphine-blue.*

Morphine-blue is obtained by dissolving either of the above-mentioned compounds in caustic potash and passing air through the solution until no more oxygen is absorbed; the liquid is then neutralised with slight excess of hydrochloric acid, whereby a blue flocculent precipitate is formed, which is washed, dried in vacuo, mixed with sand, and extracted with boiling chloroform, the blue colouring matter crystallises from this solvent on evaporation. Formic and other fatty acids are also formed. The substance dried at 120°—125° has the formula $C_{26}H_{22}N_2O_4$; dried at 100° it contains 1 mol. of water. Morphine-blue crystallises in prisms, is red in transmitted, blue in reflected light, and without action on polarised light. The crystals melt at a high temperature to a blue liquid; they are insoluble in water, sparingly soluble in alcohol, very soluble in ether and chloroform; morphine-blue gives blue salts with the alkalis, which are stable in air. The formation of morphine-blue serves as a very delicate test for the presence of small quantities of morphine.—G. H. M.

PATENTS.

Improvements in and relating to the Manufacture of Colouring Matters. Henry Harris Lake, London.—From Wirth & Co., agents for A. Leonhardt & Co., Mühlheim, Germany. Eng. Pat. 4387, March 29, 1886. 6*d.*

This is simply an amended specification granted December 8, 1887, the amendments being that the new sulphonic acid claimed in the former patent is now described as the disulphonic acid of diamidostilbene. It is further claimed in the amended specification that *mixed* tetrazo-colours can be obtained by combining the diazotised diamidodisulphonic acid first with one molecule of an amine, phenol, or sulphonic acid, and then with a second molecule of a dissimilar amine, phenol, or sulphonic acid.—R. M.

Improvements in the Manufacture of Colouring Matters. H. H. Lake, London.—From A. Leonhardt & Co., Mühlheim, Germany. Eng. Pat. 3994, March 16, 1887. 6*d.*

Many of the azo-colours undergo a change of colour when acted upon by soap or weak alkali, owing to the formation of basic salts. Such is the case with the compounds (1) from diazotised diamidostilbenedisulphonic acid and phenol, cresol, or their homologues; (2) from diazotised benzidinedisulphonic acid and phenol, cresol, or their homologues; and (3) with the yellow diamidostilbenedisulphonic acid itself, which, when dyed on to cotton, becomes red under the influence of soap. To obviate this colour change the inventors destroy the power of forming basic salts by chlorinating, brominating, nitrating, or alkylating the colouring matters in question, and thus produce dyes which are faster to soap, &c. The following examples illustrate the principle claimed:—(1.) The secondary azo-colour from tetrazostilbenedisulphonic acid and phenol is benzylated by being heated in alcoholic solution with the necessary quantity of benzyl chloride and soda lye. (2.) The colouring matter from diazotised benzidinedisulphonic acid and phenol is ethylated by being heated with the theoretical quantity of ethyl bromide and soda lye in autoclaves for eight hours at 70°—100° C. (3.) The condensation product obtained by the action of soda lye on paranitrotoluenesulphonic acid is nitrated by the action of hot nitric acid (9 kilos. and 40° B. with 100 litres water). (4.) The same condensation product is brominated by the action of bromine and soda lye.—R. M.

The Manufacture of certain Dye Matters. G. Thomas, Manchester.—From H. Schulz, Berlin, Germany. Eng. Pat. 15,265, November 9, 1887. 6*d.*

The blue colouring matters referred to are produced; (1.) by the condensation of paranitroso-compounds of tertiary monamines with primary monamines and their secondary or tertiary alkyl derivatives in weak acid solution

by zinc chloride in the presence of nascent hydrogen sulphide. The condensation product is afterward oxidised by ferric chloride or chromic acid. (2.) By the condensation of the foregoing paranitroso-compounds with themselves by means of zinc chloride in the presence of nascent hydrogen sulphide and subsequent oxidation as before. The following examples of the the two methods of carrying out the process are given:—(1.) The hydrochloride of nitrosodimethylaniline is prepared in the usual way, and the crystals made into a paste with water and mixed with iron sulphide, zinc chloride, and dimethylaniline. The mixture is heated on a water-bath till it becomes nearly colourless and the sulphuretted hydrogen has disappeared. The solution is filtered and oxidised with ferric chloride, &c., and the colouring matter salted out. (2.) Hydrochloride of nitrosodimethylaniline is treated exactly as in the last example, only the additional dimethylaniline is omitted.
—R. M.

The Manufacture of Yellow Colouring Matters by the reaction of Tetrazodiphenyl or Tetrazoditolyl on Phenol or Orthocresylol. Sylvestre Forel, Mülhausen, Alsace. Eng. Pat. 15,459, November 11, 1887. 6*d.*

The compounds claimed belong to the class of secondary azo-colours capable of dyeing vegetable fibre without the use of a mordant. Their preparation is carried out in the manner usually employed for compounds of this kind, and their nature is sufficiently indicated in the title of the specification.—R. M.

Improvements in and relating to the Manufacture of Colouring Matters. Wilhelm Majert, Berlin. Eng. Pat. 4243, March 21, 1887. 6*d.*

In this specification the author claims the dioxynaphthalene melting at 248°—252° C. prepared by acting upon one molecule of naphthalene with two molecules of chlorosulphonic acid, and then fusing the *αα*-disulphonic acid with an equal weight of potash or soda till hydrogen begins to be evolved. The dioxynaphthalene is then converted into a mono- or disulphonic acid, and the latter combined with diazotised benzidine, tolidine, diamidostilbenedisulphonic acid, &c., to form secondary azo-colours either mixed or homogeneous in the usual way.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Linen from Hop-stalks. Oesterr. landw. Wochenb., 1887, 348.

A useful fabric resembling linen has been manufactured from fibres obtained from hop stalks.—D. A. L.

PATENTS.

Improvements in the Method of, and Composition for Waterproofing Textile Fabrics. G. F. Wilson, London. Eng. Pat. 8167, June 7, 1887. 4*d.*

The articles to be water-proofed are soaked for six hours in an aqueous solution of sugar, soap, extract of soap, soap powder, hydroline, or other similar substance; they are then transferred, wet, to a solution of alum, white, green, or blue copperas, &c.—E. G. C.

An Improvement in Machines for Scutching Flax and other Fibrous Materials. A. M. Clark, London. From A. Casse, Fives-Lille, France. Eng. Pat. 1915, February 7, 1887. 8*d.*

The improved machine consists of two sets of revolving beaters, which are caused to oscillate so as to act more uniformly on the fibre. The inventor claims that by the use of his machine the strength of the fibres is preserved to a greater extent than with machines of the ordinary form.—E. J. B.

Improvements in Treating Rhea Bark, China Grass, or other Material of similar Nature, and in Apparatus applicable therefor. G. I. J. Wells, and S. L. Howard, London. Eng. Pat. 2423, February 16, 1887. 8*d.*

The material to be treated is hung upon rods in a chamber with a roof so arranged that solutions of various kinds can be showered down upon it. The chamber is connected with an apparatus for generating chlorine gas, and one for supplying air for the purpose of drying the fibre after treatment.

The method consists in alternate treatments with cold water, hot water, hot soda lye, hot solution of sodium sulphide, chlorine gas, and hot soap bath.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

On the Precipitation of Manganous Salts with Potassium Chromate, and on the Composition of the Bistre Colours of Balanche and Endler. F. Breinl and J. Klaudy. Mitth. d. Techn. Gewerbemuseums in Wien, 1887, 55.

If a solution of potassium chromate be mixed with one of a manganous salt, a chocolate-coloured precipitate is produced, which, according to *Warrington* and *Reinsch*, corresponds to the formula—$MnCrO_4.MnO.2H_2O$. This precipitate was also made the subject of an analysis by *Fairrie* (*Chem. Pharm. Centralblatt*, 1852, I., 212), by which he was led to adopt the formula—$3Mn_2O_3.3CrO_3.Cr_2O_3 6H_2O$; assuming, therefore, that the precipitate contained manganous oxide as well as chromic oxide. An analysis by Danson is recorded. He arrived at the conclusion that the precipitate consisted of chromic acid and manganous oxide, with an admixture of a certain quantity of chromic oxide. These analysts conclude as to the presence of manganous oxide from the composition of the precipitate, which was produced by dissolving the salt under examination in dilute nitric acid, and precipitating it again by caustic potash, maintaining that the same was an oxide of manganese, containing also chromic oxide. *Endler* produced a brown colour (Bistre) on cotton stuffs, by padding them with a solution of manganese chloride, and after rapidly drying, passing them through a solution of potassium bichromate, neutralised with ammonia.

Based upon the same reaction, *Balanche* prepared a printing colour by mixing the solutions of manganese chloride, potassium bichromate, and acetate of soda, which in the steaming formed a brown-coloured precipitate on the fibre. The formation of the latter was evidently produced in such a manner that during the steaming acetic acid escapes, and monochromate is formed, which in turn acts upon the manganese chloride.

The brown colouring matters, fixed by either of the methods, contain chromium, a circumstance very adverse to a more extensive application of this method of dyeing or printing, especially for discharges, since on the brown ground thus produced only a white which has a slight shade of green from the chromic oxide, can be obtained, and not a pure white.

Concerning the composition of these bistre colours, *Balanche* admits the possibility that his bistre might correspond to the formula given by *Warrington* and *Reinsch*; Endler, on the contrary, believes his analysis indicates the formation of manganese oxide and chromic oxide, according to the formula—

$$6MnO + 2CrO_4H_2 = 3Mn_2O_3 + Cr_2O_3 + 2H_2O.$$

On repeating the analysis by a different method the authors arrive at the following results:—

By the reaction of potassium monochromate on manganous salts, brown precipitates are formed as a rule; these are double compounds of potassium chromate with basic manganese chromate; they have a variable, mostly complicated composition, which essentially depends on the quantitative relation of the two precipitating agents, and on the degree of dilution of the liquids. Under particular circumstances a simple potassium manganese chromate is also obtained, of the formula—

$$K_2CrO_4 . MnCrO_4, H_2O.$$

By washing with water it is decomposed. At a high temperature a basic manganese chromate is produced, under all circumstances, of the composition—$8 MnCrO_4 . 7 MnO, xH_2O$, which also forms the chief constituent of the manganese bistre of *Balanche.*—W. S.

On Turkey-red Oil. R. Benedikt, Mitt. d. Tech. Gewerbemuseums in Wien, 1887, 47. *See* page 328.

Société Industrielle de Mulhouse. Chem. Zeit. **12**, 375.

S. Camille Koechlin, in a paper "On the resistance of resin in bleaching operations, and on the treatment in the acid bath," states that the resin will not dissolve in caustic soda liquors of less than 15 grms. per litre, and is only completely removed by a solution containing 25 grms. per litre. Concerning the new bleaching process of Horace Koechlin (passage through sulphuric acid, open boiling with sodium carbonate and sulphite, chlorinating, and finally passage through sulphuric acid), he states that the passage through sulphuric acid gives the purest white, especially at 80° C., with acid of 0·5—1 grm. per litre; the lime remaining on the cloth is completely removed, and far better than with hydrochloric acid. Even tolerably concentrated sulphuric acid does not attack the fibre, and is far more easily removed by washing than the volatile acids are.—G. H. B.

The Hydrosulphite Indigo Vat. Herzfeld. Chem. Zeit. **12**, 340.

The hydrosulphite vat is not liable to the decomposition met with in the woad vat, neither is there a deposition of such a large quantity of sediment, which renders the woad vat useless at the end of four months. A hydrosulphite vat, will, on the other hand, last for two years, with only a very slight deposition of sediment. It can be left in disuse any length of time, and be very readily brought into condition for use. Whereas the woad vat requires 36 hours' preparation, the more modern method requires only a few hours. The blue does not lose colour by fulling. The hydrosulphite solution is prepared by the reduction of sodium bisulphite with zinc powder. The solution is neutralised with milk of lime or caustic soda, and the precipitate allowed to settle. The solution must be carefully protected from air. The concentrated solution of indigo, reduced with hydrosulphite, is then made and added to the vat, according to the strength required.—J. B. C.

PATENTS.

Manufacture of Bleaching and Disinfecting Liquor. E. Hermite, Dalston, Middlesex. Eng. Pat. 5393, April 13, 1887. 4*d.*

A mixture of from two to three parts of magnesium or calcium chloride, one part of sodium chloride or caustic soda, and 100 parts of water, is electrolysed until it acquires the desired strength.—W. E. K.

Improvements in Dyeing Cotton Yarns and Fabrics. F. A. Gatty, Accrington. Eng. Pat. 6128, April 27, 1887. 6*d.*

For the purpose of fixing oxide of chromium, the yarn or fabric is impregnated with a solution containing per gallon, 1 to 1½ lbs. of bichromate of soda or equivalent of bichromate of potash, together with 4 to 6 oz. of acetate of soda, or an equivalent quantity of carbonate of soda or other alkaline salt, per pound of the bichromate taken. The fabric is next exposed to the action of sulphur dioxide gas until the chromic acid is deoxidised with formation of sulphate of chromium, and the green sesquioxide of chromium is then fixed (either with or without previous drying) by passing through caustic soda at 4° to 6° Tw. and at a temperature of 140° to 160° F. To modify the shade from green to brown, varying quantities of metallic salts, preferably acetate of iron, are added to the bichrome padding liquor. The oxide of chromium or mixed oxides of chromium and iron thus fixed on the fibre may be used as self colours or as mordants for a subsequent dyeing in alizarin or wood colours.—W. E. K.

Improved Colouring Matter for Dyeing, Painting, Staining, or Printing. R. Chadwick and J. W. C. Chadwick, Kidderminster. Eng. Pat. 3280, March 3, 1887. 6*d.*

A mixture suitable for dyeing and staining purposes, and especially applicable for dyeing wool a fast blue or black colour in a single bath is made as follows:—16 lbs. of indigo extract, 1½ lbs. of azo-scarlet, ¼ oz. of atlas violet, ½ oz. of nigrosin and 2 oz. of Irish moss are mixed together, and after an interval of 20 minutes three quarts of cold water are well stirred into the mass, and then one quart of common salt solution of 40° Tw. added. Finally, a further addition of 30 lbs. of indigo extract is made, and after thorough incorporation the mass is filtered, and the pulp remaining on the filter flannel constitutes the desired dyestuff. (*This Journal* 1888, 207.)—W. E. K.

Improvements in Dyeing Vegetable and Animal Textile Materials before Spinning. W. J. S. Grawitz, St. Maur-les-Fossés. Eng. Pat. 13,445, March 4, 1887. 6*d.*

The cotton or wool in the form of fleece or slivers is wound around a skeleton cylinder of metallic lattice work, being retained in position by a second openwork cylinder concentric with and enveloping the first. These cylinders are keyed on to a central shaft mounted on bearings over the dye vat, and by rotating the cage on its horizontal axis the necessary mordanting and dyeing operations are performed without disarranging the fibres, which can be subsequently submitted to the ordinary operations of spinning. By a modification the annular space between the two cylinders is divided into compartments, into which the material is loosely packed.—W. E. K.

Improvements in Apparatus for Dyeing Textile and other Materials. H. H. Lake, London. From U. Weldon, New York. Eng. Pat. 402, January 10, 1888. 8*d.*

This patent, which is an improvement on a U. S. patent granted to A. Moran, describes a special form of dyeing apparatus, for the details of the construction of which the original patent and accompanying drawings must be consulted. It consists essentially of a cylinder or wheel rotating in a semi-circular dye vat, and the wheel itself is made up of partitions having in cross-section approximately the form of a sickle, the handle of which radiates from the hub of the wheel. These partitions serve to carry the goods and give to them a particular motion in their passage through the dye liquor contained in the vat. —W. E. K.

Softening and Purifying Water for Domestic and Trade Purposes. G. E. Davis, Manchester. Eng. Pat. 5655, April 19, 1887. 4*d.*

Crystallised tribasic phosphate of soda is used for the precipitation of the lime and magnesia salts present in the water. The patentee recommends the use of 2·5 grains of the phosphate per gallon of water treated for every degree of permanent hardness, or five grains per gallon for every degree of temporary hardness; such degrees of hardness are understood to be on the "Clark's" scale. —C. C. H.

VII.—ACIDS, ALKALIS, AND SALTS.

A Basic Aluminium Sulphate. C. Bottinger. Annalen **244**, 224—227.

If a clear solution of a mixture of aluminium sulphate and sodium chloride is repeatedly evaporated to dryness at a temperature not exceeding 20°, a white insoluble compound is formed. A better yield is obtained by heating the substances at 130° to 140°. The basic sulphate separates out as a white powder. The new sulphate dried in a desiccator has the composition $Al_2O_3SO_6 + 6\ H_2O$.

—J. B. C.

Revision of certain older Researches on Sulphites. Armin Rohrig. J. Prakt. Chem. **37**, 217—253.

The author gives an extensive account of his investigations concerning the constitution of neutral and acid sulphites as well as pyrosulphites, and corrects several statements made chiefly by Muspratt and Rammelsberg with regard to the water of crystallisation of these salts. He also describes the sulphites of lithium, thallium, and lead which were not hitherto known; furthermore, certain double salts such as potassium - sodium - sulphite and potassium-lithium-sulphite. In conclusion he points out that the great similarity supposed to exist in the constitution of the sulphites and carbonates, to which several authors, notably Muspratt, have drawn attention, applies only in the case of the sulphites and carbonates of the alkalis.—A. R.

Solution of Iron in Caustic Soda. G. Zirnité. Chem. Zeit. **12**, 355.

When a strong current of air is blown into a hot concentrated solution of caustic soda, containing about 34 per cent. NaOH, standing in an iron vessel, or to which finely-divided hydrated ferric oxide has been added, perceptible quantities of iron are dissolved without colouring the liquid. In fact, such a solution will remain clear and colourless for several days at the ordinary temperature; ultimately it becomes turbid, yellow, and finally red, owing to the separation of the hydrated ferric oxide, but this colour disappears again on heating. When the colourless solution is diluted, the oxide is precipitated in about half an hour, but again passes into solution when the liquid is concentrated. Hydrogen sulphide at first produces a deep cherry-red colouration in the colourless liquid, and by its continued action a greenish-black precipitate forms, which settles down, leaving a clear solution, free from iron, but slightly yellow from sodium sulphide. It is suggested that the iron exists in solution as a perferrate, analogous to sodium permanganate, and with the formula $NaFeO_4$ therefore.—D. A. L.

Decomposition of Ammonium Chloride by Phosphoric Acid. K. W. Jurisch. Dingl. Polyt. J. **267**, 424—431.

The author has examined quantitatively O. N. Witt's process (Germ. Pat. 1885, 34,395) for the manufacture of ammonia and hydrochloric acid from ammonium chloride by means of phosphoric acid. By means of this process the distillation of the ammoniacal mother-liquors of the ammonia soda process with lime, is avoided, and the hydrochloric acid is, at the same time, recovered. The separation of the ammonium chloride from the liquors is effected by evaporation to dryness and subsequent sublimation, or by fractional crystallisation. Jurisch finds that phosphoric acid will liberate the whole of the hydrochloric acid from ammonium chloride. The reaction which takes place in the first instance is best expressed by the following equation :—

$$12\,NH_4Cl + 12\,PO_4H_3 = 2\,PO_4H_3 + P_2O_7H_4 +$$
$$4\,[H(NH_4)_2PO_4] + 2\,[H_2(NH_4)_2P_2O_7] + 12\,HCl + 3\,H_2O.$$

At first only hydrochloric acid is driven off, and in order to complete the decomposition at a low temperature, an excess of phosphoric acid should be used. On afterwards raising the mixture of the phosphates formed to a higher temperature, copious streams of ammonia are given off, and, according to circumstances, from 63 to 86 per cent. of the ammonia present is liberated. The residue, which consists chiefly of metaphosphoric acid and some ammonium metaphosphate, is at once ready again to decompose a fresh portion of ammonium chloride. It therefore appears that successive portions of ammonium chloride can be decomposed by the same quantity of phosphoric acid without loss of phosphoric acid. This remarkable process has not yet found an application on the manufacturing scale, owing to the difficulty of procuring a material for lining the furnace or other vessel which can resist the action of fusing phosphoric acid. Messrs. Brunner, Mond, and Co., who undertook to work out this process, state that all metals—even silver and platinum—are so strongly attacked as to put their employment out of the question.—S. H.

Decomposition of Antimonious Sulphide by Boiling with Water. W. Elbers. Chem. Zeit. **12**, 355—356.

When antimonious sulphide is boiled with water it decomposes with the evolution of hydrogen sulphide and the formation of antimonious anhydride.—D. A. L.

Improvements in the Production or Manufacture of Chlorine. A. Brin, London, and L. Q. Brin, Paris. Eng. Pat. 2963, February 25, 1887. 4*d*.

This invention consists in the application of a constant supply of oxygen for the continuous production of chlorine. Manganese oxide or peroxide is treated with hydrochloric acid in a vessel heated externally by steam, while a current of oxygen is passed through the materials. Chlorine is at once generated, and as the oxygen re-oxidises the manganese the evolution of chlorine proceeds continuously, hydrochloric acid being supplied as required. The chlorine is subjected to electric action in an apparatus such as is used in the production of ozone from oxygen.—S. H.

PATENTS.

Improvements in Absorption Towers for the Manufacture of Muriatic or Nitric Acid. H. P. Weidig and R. C. Remmey, Philadelphia, U.S.A. Eng. Pat. 1082, January 24, 1888. 6*d*.

The invention consists in absorption towers composed of a series of cylindrical sections open at the top and closed at the bottom, each section having a vertical channel, extending from the bottom to a short distance from the top, and each section being also provided with a projecting external cup, open at the top and in communication with the bottom part of the section. Fig. 1 is an elevation of one of the towers, and Fig. 2 a cross-sectional view of the other. A are

Fig 1

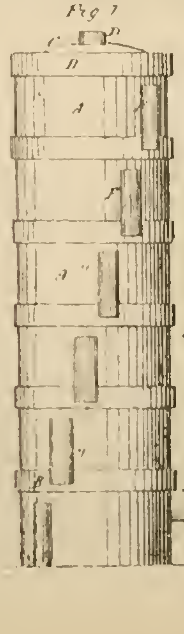
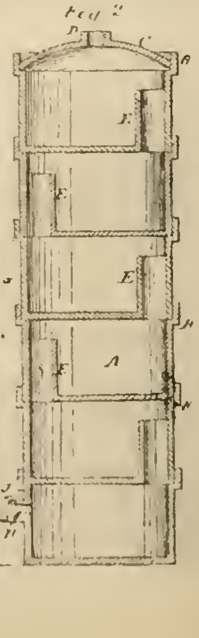
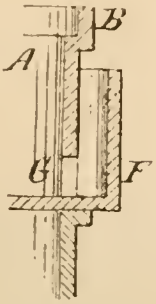


Fig 2



the different sections, made of earthenware, with the annular flanges B at their open ends. Each section contains an upwardly-projecting channel E, formed on the inside. On the top section a cover C is placed, provided with a central neck D for coupling the pipe that leads the gases into the tower. The sections are so placed that the channels E are alternately at opposite sides, so as to lengthen the course of the gas. Each section also contains a cup F (Fig. 3), open at the top, and in communication with the inside by the opening G. The top of the cups F are on the same level with the upper edges of the corresponding channels E. The bottom section has a lateral neck for coupling two towers together. The hot gases from the retorts are conducted into the top of one tower, the gases passing from one section to the other by the channels E, and are for the most part absorbed by coming in contact with a large surface of water. The remaining gases rise upward in the second tower. When the acid thus formed in the first tower almost attains the strength desired, the gases are conducted to the top of the second tower, and passing here downwards, rise again in the first tower. When both towers contain acid of the strength required, the acid is withdrawn by means of siphons placed in the the cups F. The towers are then again charged with water.—S. H.

Fig. 3.

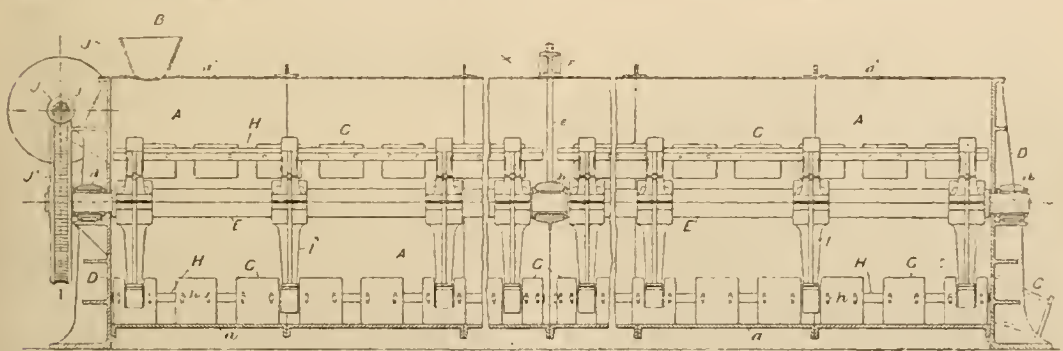


Improvements in the Utilisation of Sulphate of Lime and Sulphate of Baryta in the Manufacture of Alkalis and Sulphuretted Hydrogen. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 5853, April 22, 1887. 6*d.*

Sulphate of lime or baryta is reduced to sulphide, and may be then substituted for Leblanc alkali waste in the first stage of the Parnell and Simpson ammonia-soda process (Eng. Pat. 1885, 381, 1937 and 8140, and 1886, 47).
—S. H.

Improvements in the Manufacture of Caustic Ash. T. T. Mathieson and J. Hawliczek, Liverpool. Eng. Pat. 5757, April 20, 1887. 11*d.*

The invention relates to the manufacture of caustic ash from bicarbonate or carbonate of soda, or a mixture of bicarbonate and carbonate by the addition of a strong sodium hydrate solution. The moist bicarbonate produced by the ammonia-soda process is dried in a horizontal cylinder provided with stirring blades which convey the material from one end of the apparatus to the other, and the sodium hydrate solution is injected in a state of fine division into the cylinder at a point where the bicarbonate has been converted into carbonate. The furnace used is shown in the Figure. A is a horizontal cylinder, made in segments. The lower half a is of cast iron and the upper half a^1 of wrought iron. The lower half is placed above a grate or furnace and heated in any convenient manner. B is the hopper through which the material to be treated is introduced into the cylinder. The ends D, which are made in halves, are provided with bearings d d for supporting the main shaft E. A suspended bearing b is provided midway to support the shaft at that point. G designates the blades and scrapers, which are secured to bars H and are carried by arms I mounted on the shaft E: J and J¹ are worm-wheels and give motion to the main shaft. C is a shoot through which the finished material leaves the apparatus. The cylinder is about 30 feet long; the main shaft makes three or four revolutions per minute, and the blades will propel the material through the apparatus in from 40 minutes to one hour.—S. H.



Process and Apparatus for the Manufacture of Dry Calcium Hydroxide. J. Pfeiffer, Kaiserslautern, Germany. Eng. Pat. 43, January 2, 1888. 6*d.*

The invention relates to the conversion of calcium oxide into calcium hydrate by treating the former with water while enclosed in a heated receptacle. For this purpose semi-cylindrical carriages B (Figs. 1 and 2), charged with broken lime, are introduced into the metallic cylinder A. The latter is provided with a safety-valve, a shut-off valve with discharge pipe, and a pressure gauge. There is also a water-supply pipe E, which branches inside A into two pipes F and G with many small holes, in order to divide the water uniformly over the lime in the carriage B. This carriage serves three purposes: Firstly, it enables the

Fig 1.

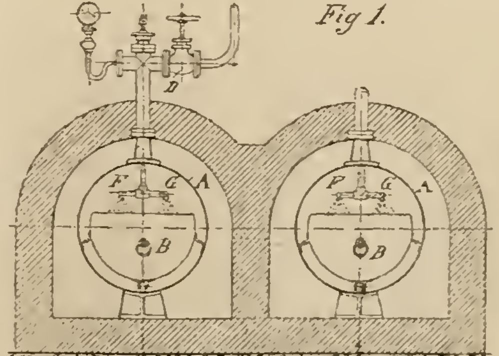
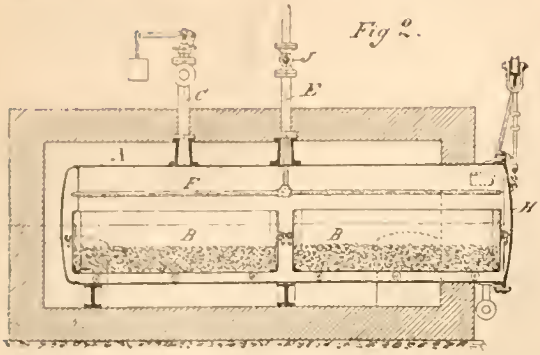


Fig 2.



charge of the cylinder to be easily and rapidly introduced and removed; secondly, the formation of lime dust is prevented; thirdly, it prevents the hydrate of lime from absorbing water of condensation, as the steam formed in consequence of the process of hydration can only condense on the sides of the cylinder A. The water collects at the bottom, and is run off through a tap from time to time. In practice the work is done as follows: After introducing a charge of lime into the cylinder, the cover H is closed tight and a measured quantity of water is run on the lime. Steam is evolved and the pressure in the cylinder will rise to four or five atmospheres. The hydrated lime is allowed to remain under this pressure for about half an hour. In order to prevent the condensation of steam, the cylinder A is slightly heated from outside. After half an hour the steam is allowed to escape and the carriage removed from the cylinder, when its contents will be found pulverised and perfectly dry.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Colouring Porcelain in a High Temperature Furnace. H. Seger. Chem. Zeit. **12**, 282.

In reply to a previous communication on the subject (this Journal, 1888, 210), the author states that the best porcelain hardly ever contains less than 0·5 per cent. of ferrous oxide, mostly 1·0 per cent. and more, and that the more highly coloured Chinese and Japanese porcelains contain as much as 2·5 per cent. The yellow colour of porcelain is due to the presence of this iron in the state of ferric oxide, the green colour to its presence as ferrous oxide, the colour actually produced depending on the nature of the burning. The grey colour due to a mixture of the two oxides seldom occurs, and then only in easily fusible porcelains. The yellow colouration is far more intense than the green; the latter results when a reducing flame is employed, and porcelain coloured pale green thereby becomes yellow by repeated heating in an oxidising flame, the ferrous iron being converted into ferric. The green colour of Indian and of Chinese Celadon porcelain is due to its containing 1·5 to 2·0 per cent. of ferrous oxide. Normal white porcelain, when slowly cooled, assumes a yellow tinge, also due to oxidation, and for this reason it is customary to cool the mass rapidly. The author has never observed any yellow colouration produced by sulphates; in fact, sulphates only occur in very basic and not in the very acid silicates such as porcelain. Also the magnetic oxide of iron is reduced either to ferrous or ferric oxide in presence of silica, and in its absence the metal would result, so that the idea that the whole of the iron is converted, at the high temperature employed in the burning into Fe_3O_4, is out of the question. These remarks regarding the colouring of porcelain also hold good in the case of glass. —C. A. K.

PATENTS.

A New or Improved Method of Treating the Glass Cullet known as "Blacks." J. Northwood, Stafford. Eng. Pat. 16,613, December 17, 1886. 6*d.*

The "blacks" are steeped in hydrochloric acid, until the whole, or nearly the whole, of the attached scale has been dissolved. The partially treated blacks are then immersed in a mixture of one part by volume of the hydrofluoric acid of commerce with about 10 parts by volume of water. By this treatment the last trace of scale is removed, and, after washing with water, the cullet is fit for use in the manufacture of the finest qualities of colourless glass. —E. G. C.

Improvements in Ornamenting Pottery, Tiles, or Glass. H. L. Doulton and W. P. Rix, Lambeth. Eng. Pat. 2305, February 14, 1887. 4*d.*

A soft etching ground is laid in the ordinary way upon a copper plate. A piece of lace, a feather, leaf, or other object, is placed upon the said ground, and a sheet of cardboard is laid above. The whole is laid between the rolls of an ordinary printing press, the lace, &c., being driven through the soft ground, and the copper being exposed in the places where the impression is made. The lace is then removed, and the plate put into the acid bath and bitten to any required depth. The transfer to the pottery is carried out in the ordinary way. The process is slightly modified for tiles and glass.—E. G. C.

An Improved Method of producing Rippled, Chequered, or other Patterns or Designs upon Rolled Plate and Sheet Glass, and Apparatus therefor. A. D. Brogan and A. M. Mallock, Glasgow. Eng. Pat. 5560, April 16, 1887. 8*d.*

The plates of rolled plate or sheet glass are worked up while still sufficiently hot, or if cold they are reheated in a "hot kiln." The semi-plastic plates are passed between one or more pairs of rolls, one roll, or one of each pair has a counterpart of the pattern or design impressed upon it. The plates are then delivered into a lear or annealing kiln. —F. W. T. K.

Improvements in the Method of Preparing Fullers' Earth for use in Manufactures. C. R. Dames, London. Eng. Pat. 603, January 14, 1888. 4*d.*

By this method even those portions of the strata of Fullers' earth which are now commercially valueless can be utilised. The different qualities of Fullers' earth are thoroughly mixed, blended, and amalgamated (the proportions varying according to circumstances) by grinding them, with the addition of water, to a slurry or solution. The slurry is run into reservoirs and allowed to settle. All water rising to the top is removed and the residue is dried. The product is of uniform strength, quality, and colour. —F. W. T. K.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Improvements in Artificial Stone. L. Preussner, Berlin, Germany. Eng. Pat. 4689, March 29, 1887. 4*d.*

Smooth marble or enamel-like objects are produced by mixing burnt magnesia with concentrated muriatic acid in the proportions of 1,500 grms. of the former to 1,000—1,500 grms. or 1,000—1,250 cc. of the latter, and pouring the fluid paste into hard india-rubber moulds, in which it is allowed to harden.—F. W. T. K.

Improvements in the Manufacture or Treatment of Portland and other Hydraulic Cements. W. Scott, J. C. Swan, and H. Smith, Newcastle-upon-Tyne; and W. Whamond and T. Gibb, Jarrow. Eng. Pat. 14,674, November 12, 1886. 4*d.*

Portland or other hydraulic cement is mixed with flints, or flint gravel, or flint sand and slaked lime, and the materials are reduced to a very fine powder, so that 90 per cent. will pass through a sieve of 180 meshes per lineal inch.—E. G. C.

A New or Improved Compound or Cement, and Application of the same in making Asphalte Walks, in Renovating and Repairing old Asphalte Works, in Coating and Protecting Masonry, and for other Analogous Purposes. E. Keirby, Rochdale. Eng. Pat. 10,898, August 9, 1887. 4*d.*

Sand, quicklime, and Portland cement are mixed together in water to the consistency of cream. Copperas dissolved in water is then added, the whole being reduced to the consistency of thick cream. This compound or cement is ready for application to asphalte walks and the like.
—E. G. C.

Improvements in the Manufacture and Burning of Portland Cement. H. Maccvoy, London, H. Holt, London, L. White, London, and W. Wilders, Northfleet. Eng. Pat. 15,012, November 18, 1886. 6*d.*

The inventors grind in with the materials breeze or suitable fuel, in the proportion of about $\frac{1}{2}$ to $\frac{5}{8}$th of the total amount of the fuel required. The slurry thus ground and mixed with breeze is dried on floors or in chambers, and the kilns are loaded with this dried slurry together with hard coke in the ordinary manner. The clinker obtained is afterwards ground, and owing to the porous or honeycomb state in which it is obtained, the cost of grinding is materially reduced.—E. G. C.

The Manufacture of a Cement or Composition for Fastening Wood, Linoleum, Floor Cloth, or other Covering to Iron or Steel Decks, Wood, Flooring, and the like, applicable also for other Purposes. G. F. H Clark and R. J. Clark, London. Eng. Pat. 5152, April 6, 1887. 6*d.*

The ingredients used are fusel oil, 1 gallon, amber or other fossil gum, 6 lbs., shellac, 2 lbs., rubber, $\frac{1}{2}$ lb., and pigments, 2 lbs.; naptha, alcohol, and boiled linseed oil may sometimes be used.—E. G. C.

Improvements in the Manufacture of Artificial Stone. G. G. Girling, Lenham. Eng. Pat. 3568, March 9, 1887. 8*d.*

The inventor manufactures "Petrean Stone," from Portland cement, Kentish rag, and other hard rocks. The conglomerate mass when in a plastic state is filled in moulds and is subjected to the action of a "jumping machine," for the purpose of making it solid, and rendering facing unnecessary. This makes it very durable and proof against frost.—E. G. C.

Improvements in the Manufacture or Preparation of Furnace Slag, and of Cement partly made therefrom. E. Larsen, London. Eng. Pat. 11,303, September 6, 1886. 8*d.*

Furnace slags are disintegrated while still molten, dried, and pulverised. The powder is sifted and mixed with burnt lime, preferably slaked, fallen to a dry powder and well sifted beforehand. The disintegration of the slag is effected by a jet of steam, air, and (in some cases) water combined.
—E. G. C.

Improvements in the Manufacture of Portland Cement, and Apparatus therefor, applicable also for making Bricks, Tiles, and other similar Articles, and for Burning Lime and other Materials. W. Tuffee, Gravesend. Eng. Pat. 2482, February 17, 1887. 8*d.*

This invention relates to the construction and arrangement of an improved mill and kiln for use in the manufacture of Portland cement. The specification is accompanied by drawings illustrating the improved apparatus.—E. G. C.

X.—METALLURGY, MINING, Etc.

A Criticism of Br. Franke's Article "Investigation on Fire-damp." Clemens Winkler. J. Prakt. Chem. **37**, 254—258.

The author criticises several statements made by Br. Franke, which he considers contrary to the experience gained by those who have made a thorough study of the subject in question. Thus Franke says that "Air in which particles of carbon are suspended and mixed with 3—5 per cent. of methane is the chief cause of fire-damp," whereas it is an undoubted fact that carbon dust alone can cause explosions in the entire absence of combustible gases, just as methane will bring about explosions when no coal dust is present.
—A. R.

An Aluminium Bronze. W. Hampe. Chem. Zeit. **24**, 391.

The reduction of alumina by carbon, although very frequently patented, is, on thermo-chemical grounds, impossible; but since aluminium in alloying with copper, especially in the proportion of 9·7 Al with 90·3 Cu (= $AlCu_4$), evolves much heat, it might be possible that the equation—

$$Al_2O_3 + 3\ C + 8\ Cu = 2\ AlCu_4 + 3\ CO$$

should be exothermic. The author has, therefore, mixed alumina with the necessary quantities of lamp-black and copper, and to produce a more intimate mixture has even evaporated together solutions of aluminium and copper nitrates, afterwards igniting them to oxides and adding the needful amount of carbon. These he has heated in draught furnaces in gas carbon crucibles contained within plumbago pots with well luted covers, and in a Deville's blast furnace to a temperature sufficient to frit together the quartz sand with which the space between the two crucibles had been filled; but in no case was there a trace of aluminium reduced, nor did the addition of a flux for the alumina affect the result in any way. It may be assumed that even the somewhat higher temperature of the electric furnace, alone, would be insufficient to accomplish the desired reaction; and hence the effect of the electric arc in the Cowles' process is in the first place electro-thermic in melting the alumina, and then electrolytic in decomposing the fused body.

The following are analyses of Cowles' products:—

—	Aluminium Bronze.	Silicon Bronze.
	Per Cent.	Per Cent.
Copper	90·058	93·35
Aluminium	8·236	..
Silicon	1·596	6·32
Iron	Trace	0·34
Carbon	0·104	..
Magnesium	0·019	..
	100·013	100·01

Again, the electrolysis of aqueous aluminium solutions, although frequently patented, is not to be expected, as the author has previously shown (Chem. Zeit. **11**, 935).

Finally, the author has failed to produce aluminium bronze by treating cryolite with sodium in the presence of copper; 44 grms. of finely divided copper with 15 grms. of sodium in small pieces, and 100 grms. of finely divided cryolite melted rapidly in a carbon crucible, gave no sound such as accompanies other sodium reductions, but emitted much sodium vapour and yielded a copper regulus containing only traces of aluminium. Similarly, the electrolysis of a bath of cryolite with sodium and calcium chlorides, using a layer of melted copper on the bottom of the crucible as cathode, and a carbon rod as anode, gave balls of melted sodium, which floated to the top and burnt, and much free chlorine, at the respective poles, but scarcely a trace of aluminium. Yet here the conditions were most favourable to the production of the required alloy. The battery used consisted of twelve large iron-zinc elements.—W. G. M.

On the Gold and Tellurium Ores of Siebenburg. F. M. Horn. Zeit. f. ang. Chem. 1888, 157—160.

The methods of treatment carried out at the mines are described. The ore from the Allerheiligen mine is pounded roughly and treated in a stamping mill in contact with water, elutriation being then used to effect a partial separation from the dross. The heavier portion containing most of the gold is extracted with mercury by an amalgamation process. The residue is worked up by any method suitable to its composition as determined by analysis, of which the following is an example:—

Lead	19·12
Silver	0·05
Gold	0·062
Tellurium	0·079
Antimony	7·97
Iron	16·94
Alumina	1·27
Zinc	16·90
Lime	1·12
Magnesia	0·45
Sulphur	31·64
Carbonic acid	1·08
Silica	2·99
	99·671

One sample of gold ore from the Allerheiligen mine contained 0·437 per cent. of gold.

Tellurium ore from the Zalathner mine is worked up according to A. Löwe's process. 200 kilos. of rich tellurium ore in grains of 1—1½ mm. are gradually added during two hours with constant stirring to 600 kilos. of sulphuric acid of 66° B. contained and heated in a cast-iron boiler. The boiling is continued for ten hours, until sulphurous acid ceases to be given off. The cooled product is then placed in a leaden vessel and diluted with water to 15°—20° B. The solution is treated with hydrochloric acid to precipitate silver and allowed to stand 48 hours, after which the clear liquid is siphoned off and left in contact with plates of zinc for six days to precipitate the tellurium. The spongy mass is washed with water and then melted. The crude tellurium contained 73·21 per cent. of Te, 12·65 of Cu, and 5·43 of Pb.

200 kilos. of sulphuric acid of 66° B., 8 kilos. of hydrochloric acid, and 30 kilos. of zinc are required for the production of 1 kilo. of tellurium.

To obtain pure tellurium, the crude substance is dissolved in aqua regia and precipitated with sulphurous acid. The finely divided tellurium is well washed, and then fused in a stream of hydrogen.—G. H. B.

Titanium Cyano-nitride. C. Reinhardt. Zeit. f. angew. Chem. 1888, 124—126.

A quantity of this compound was found in some blast furnace slags. It is separated from metallic iron, first, by sieving, and then by treatment with cold hydrochloric acid, which is followed by treatment with warm hydrofluoric acid and sulphuric acid. The carbon is oxidised with chromic acid. After repeating these operations once or twice, and thorough washing with water, the residue is found to be pure titanium cyano nitride. As found in the slag, it consists of copper-red metallic-looking cubes, measuring as much as 0·75 mm. in the side. It is hard and brittle, and retains both its colour and metallic appearance when ground up to a fine powder. Heated in the blowpipe flame until it ceased to gain in weight, the increase was found to be 28·90 and 29·06 per cent. respectively in two portions. During the ignition it becomes light brown. The titanic acid was estimated as follows. Some of the ignited substance was fused with potassium bisulphate for some time, and the flux digested in cold water until solution was effected. A small amount of a white residue remaining was filtered off. The titanic acid was precipitated by means of sodium acetate in acetic acid solution. 65·67 per cent. titanium was found. The analytical data agree with the formula Ti_5CN_4.—J. W. L.

PATENTS.

Improvements in the Method of and Apparatus for Amalgamating and Separating Precious Metals from Powdered Ore or Earth. C. E. Tripler, New York, U.S.A. Eng. Pat. 16,027, November 22, 1887. 8*d.*

A retort set in a suitable furnace is supplied with mercury through an inverted siphon pipe, of which the bottom bend is water-cooled, and the straight or free limb has a glass continuation to indicate the level of the liquid in the retort. The flow of mercury vapour from the retort is directed by means of a three-way cock, either into a condensing tube or into a wide pipe with a perforated hopper top, through which the finely divided ore is continually falling. The vapour condenses on and amalgamates the ore, which now passes into a hopper, and is thence elevated by means of a rotating shaft with curved blades, and delivered by a chute into a tank with perforated bottom. Through these perforations the ore drops upon clean amalgamated plates placed obliquely in a box with sloping bottom, and thence it passes into a second hopper through another elevator and chute, into a second tank with perforated bottom; here (as also in the former tank) it is agitated constantly by a series of swinging bars. Finally it falls upon a series of oblique amalgamated plates placed longitudinally in a sloping box, and is led into a second, and even a third, similar arrangement before passing away. Each of the hoppers and amalgamated collecting boxes is provided with a siphon pipe for the removal of accumulated amalgam.—W. G. M.

Process for providing Metallic Objects with a Coating of Tin. A. E. Barthel and J. C. J. Möller, Hamburg, Germany. Eng. Pat. 17,356, December 17, 1887. 4*d.*

If the objects to be treated are of cast iron they are first coated with pure iron by electrolytic means, then painted over with a solution of zinc chloride, alone or with ammonia, and dipped into a bath of melted tin, the excess of which may be removed by brushing. If they are too large to be thus treated, or are of lead or other fusible metal, they are, after coating with the pure iron, covered with tin electrolytically instead of by fusion: the coated iron (but not the lead) is then heated to the melting point of the tin. Wrought iron does not require the preliminary film of pure iron.
—W. G. M.

Improvements in the Treatment of Auriferous Minerals. J. Weirich, Bèziers, France. Eng. Pat. 7657, May 26, 1887. 8*d.*

A rectangular furnace chamber is divided longitudinally into two superposed sections by a couple of iron trays placed one above the other, with a few inches distance between them, the lower one being supported by transverse iron bars. The space between the two trays is filled with melted lead, and that beneath them is provided with a grate and flue for heating the bath. The pyritous ore is spread upon the upper tray, and becomes heated to 350°—400° C. in a current of air, which enters through a suitable door at one end of the chamber, and passes out laden with sulphur and other volatilisable bodies into flues at the other end.

The ore is maintained at this temperature (or at any other that may be required) until further action has ceased, when it is withdrawn, and may be treated as described in Eng. Pat. 12,909 of 1885. (This Journal, 1886, 494.) The object of the lead bath is simply to maintain an uniform temperature; other metals or alloys might therefore be substituted for it. The auriferous pyrites is partially decomposed, a portion of the sulphur which attacks the mercury during amalgamation being removed. The higher temperatures are required in dealing with arsenical or antimonious ores. In no case must the temperature suffice for the ignition of the pyrites.—W. G. M.

An Improved Method for Treating and Separating Refuse Metals. J. E. T. Woods, London. Eng. Pat. 4434, March 24, 1887. 6*d.*

This process is intended chiefly for the recovery of tin from the tinned iron cans which have been used for preserving provisions. The scrap is packed in iron wire cages and boiled in caustic soda or potash solution ($\frac{1}{2}$ to 1 lb. per gallon) until paint, grease, and other impurities are removed; it is then transferred to a bath of fused caustic alkali containing about 10 per cent. of sodium nitrate and 1 per cent. of manganese dioxide, where it remains at a temperature of 500° F. until the tin has dissolved into the liquid as alkaline stannite and stannate, and the solder has melted off and collected at the bottom. The solder may be used again; the tin compound is treated in the usual way, the residual alkali being again serviceable; the stripped iron may be re-heated and hammered into bar; and the rough soap which floats on the surface of the first bath is available for use as soap or for the manufacture of railway grease. The vessels containing the treating liquids are both of iron.—W. G. M.

Improvements in Apparatus for the Amalgamation of Gold. A. Woodhouse, London. Eng. Pat. 5627, April 18, 1887. 8*d.*

After leaving the stamps, the ore passes through a perforated distributor, over amalgamating inclines and "ripples," and thence into an amalgamated or silvered copper amalgamating box, with transverse divisions provided with orifices and side projecting faces or wings, so arranged as to flank each other in the successive check gates.—W. G. M.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Electro-plating with Nickel. Electrician 20, 202.

The following solution is used by several firms in Hainault:—500 grms. of nickel sulphate, 365 grms. of neutral ammonium tartrate, 2·5 grms. of tannin dissolved in ether and 10 litres of water. $1\frac{1}{2}$ litres of water are first added, and the mixture boiled for 15 minutes; the remainder of the water is then added, and the whole filtered. The solution yields an even white deposit, which is not brittle, and the cost of which is hardly more than that of electroplating with copper.—C. A. K.

Electrolysis of Calcium Chloride (Solution). By K. W. Jurisch. Chem. Ind. 1888. No. 5.

The purpose of this investigation was to determine the cost of production of bleaching powder from the chlorine evolved in the electrolysis of calcium chloride, under the condition necessarily of the interposition of a porous diaphragm between the anode and cathode and the consequent prevention of secondary combination of the ions.

The electrolytic cell was of glass, the anode a carbon plate, the cathode a sheet of platinum foil. In the first instance the author surrounded the cathode with a strong solution of sugar. A preliminary experiment showed that the Cl liberated was almost entirely evolved as gas; the deposit on the cathode was a mixture of tri-and mono-calcium saccharate in the proportion 2:1.

The following results are given, the current measurements being taken with a tangent galvanometer and water voltameter in circuit:—

$CaCl_2$ solution, sp. gr. 1·33 containing 270 grms. Cl per litre. Volume in cell 1175 cc. Duration of electrolysis 19·5 hours, mean current 2 ampères.

	grms.
Cl. in original solution	189
Cl. remaining................	160
Evolved during electrolysis	29 or 1·487 per hour.

In the following experiments no sugar was added in the cathode cell. The current was supplied by a battery of 10 Bunsen cells, of internal resistance 0·15 ohm. The resistance of the voltameter was 0·77 ohm. The Cl gas evolved was absorbed by a mixture of slaked and quick lime, and the available Cl determined in the resulting bleaching powder.

(*a.*) The yield of Cl was 5·4 grms. per hour, or 0·771 grms. per ampère hour, *i.e.*, 58·8 per cent. of the theoretical.

(*b.*) The yield of Cl was 0·875 Cl (equivalent to 2·5 grms. bleaching powder of 35 per cent. Cl) per ampère hour, or 66·6 per cent. of the theoretical. The author remarks that in this experiment the carbon anode was powerfully attacked.

The mean current in this experiment (*b*) being 7 ampères with a difference of potential at the terminals of 8·4 volts., the results are calculated into equivalents of mechanical energy as follows:—

$$\frac{7 \times 8{\cdot}4}{736} = 0{\cdot}08 \text{ E. H. P.}$$

This the author doubles for the steam power expended. Hence 0·16 H. P. gives 33·6 grms. chlorine (as bleaching powder) in $5\frac{1}{2}$ hours. Taking 2 kilos. coal burnt per H. P. per hour, he arrives at the conclusion that the preparation of 1 kilo. bleaching powder by means of electrolytic Cl takes place at the expense of 18 kilos. coal burnt to supply the power. This he contrasts in conclusion with the 0·5 kilo. coal required per 1·0 kilo. bleaching powder prepared by the Hurter-Deacon process.—C. F. C.

PATENTS.

Improvements in the Manufacture of Chlorates of the Alkalis or Alkaline Earths. H. Gall and A. de Montlaur, Paris. Eng. Pat. 4686, March 29, 1887. 6*d.*

The process consists in subjecting the solution of the respective chlorides to the action of a current of electricity in a trough divided into two compartments by a porous partition. The liquid is caused to circulate from the negative to the positive compartment, so that the base set free in the negative compartment may combine with the chloric acid in the positive compartment as it is formed. The solution is kept at a temperature of 50° C. during the process.—S. H.

Improvements in Galvanic Batteries. H. Liepmann, London. Eng. Pat. 5583, April 16, 1887. 8*d.*

This patent is an extension of the author's specification No. 4832 of 1887. It relates to the construction of carbon electrodes made of rods or plates of carbon, in one or more rows, united mechanically and electrically by a lead head cast round the tops, the whole having a circular, triangular, square, polygonal, or horse-shoe form, to meet requirements. Where a corrugated porous pot is used the carbons may be made to follow the undulations, the object in all cases being to obtain the greatest possible surface in the smallest space. The cast tops may be stiffened by pieces of brass cast in, and the bottoms of the carbons held in place in the same way as the tops, or by lead-wire asbestos, &c., or by a paraffined wood frame. Ordinary electric-light carbons may be used.
—E. T.

Improvements in Secondary Batteries. W. Kingsland, London. Eng. Pat. 5867, April 22, 1887. 8*d.*

To make electrical contact with plates composed wholly of active material, a strip or plate of platinum is clamped between two of the active plates—which thus expose only one surface each—or between each such plate and a small strip or washer of active material, one or more bolts and nuts of ebonite or some such material being employed for this purpose. The object is to have active material on both sides of the platinum. These strips or washers may be made thick enough to act as separators between two adjacent anodes, the intervening cathode being made in two parts or cut away to avoid contact with them, or the bolt or bolts may pass through both anodes and cathodes, a perferably elastic insulating material, as india-rubber, being inserted between the strip or washer of active material and the *cathode.*—E. T.

Improvements in the Electrolytic Treatment of Zinc and its Ores. A. Watt, London. Eng. Pat. 6294, April 29, 1887. 6*d.*

This invention consists in the use as electrolyte of a dilute vegetable acid, preferably commercial acetic acid, or of a solution of zinc or its ores in such a liquid. The anodes may be masses of impure zinc, or, in the extraction of zinc from its ores, may be of carbon or other insoluble material. The cathodes may be of carbon, greased or dirty metal, or thin sheets of good zinc. The solution should not be allowed to become too acid, and, in the extraction of zinc from its ores, constant circulation must be produced, and the acid formed in the bath allowed to take up more ore, though the solution is preferably kept diluted with water to a density of 1·15 or 1·16. Calamine may be crushed, sifted, and treated directly, but Blende must be first roasted. An excess of metallic impurities in the solution may be precipitated by sulphuretted hydrogen. The advantages claimed are better and more regular deposits and the production of very little gas.—E. T.

A Process for the Extraction of Aluminium from its Fluorides by Electrolysis. E. de Pass, London.—From M. and E. Bernard, Paris, France. Eng. Pat. 10,057, July 18, 1887. 8*d.*

The inventors electrolyse a mixture of chloride of sodium with fluoride of aluminium, or with the separate or double fluorides of aluminium and sodium, melted in a non-metallic crucible, or in a metal one enclosed in a thin brick covering to avoid filtration. Metal crucibles are, however, liable to dissolve, and therefore, when an alloy is required, the aluminium is deposited on them as cathodes and allowed to run down and out by a taphole at the bottom of the crucible; or, when pure aluminium is required, carbon cathodes are employed, resting in small supplementary crucibles, a small part of the current being, however, allowed to pass to the large metal crucible, as the deposit thereby produced protects it from solution. The anodes may be always of carbon, or in some cases of red copper.
—E. T.

Improvements in the Means of and Apparatus for the Coating of Pieces of Metal, applicable also for Cleaning Articles of Metal. F. (F. E.) Elmore, London. Eng. Pat. 4054, March 17, 1887. 8*d.*

The articles are first placed in a revolving cylinder or rumble with caustic potash and oxide of iron, or some such material, to remove dirt, &c. Any oxide may then be removed by sulphuric or hydrochloric acids, if of iron, or by potassium cyanide, if of copper, &c. They are then placed in a cylinder provided at each extremity with inwardly projecting flanges, such as to leave a central hole at each end. This is mounted on wheels or rollers which impart to it a rotary motion. Bars of copper run longitudinally inside the cylinder at equal distances, one end of each being turned towards the axis and out at one of the central openings at the end, then being connected to blocks or pieces which form a commutator. A brush pressing against the latter makes contact with whatever bar happens to be at the bottom. The anodes are suspended from a rod passing through the central openings. The current passes from these through the electrolyte to the bar in contact with the brush, and to those of the objects in metallic contact with it. The continual movement of the articles during deposition against each other and against rounded pieces of glass or such material, thrown in for the purpose, causes them to become bright and burnished, and at the same time dissipates any gas formed. For the latter purpose also jets of strong electrolyte are thrown into the liquid. By passing the current in the reverse direction and in a suitable solution, the objects may be scaled and cleared of other impurities.
—E. T.

Improvements in Electro-deposition of Cobalt. S. P. Thompson, London. Eng. Pat. 4472, March 25, 1887. 6*d.*

To deposit films of cobalt of greater tenacity, density, and brilliancy of tint, the inventor employs, with a solution of sulphate or chloride of cobalt, or with the double sulphate or chloride of this metal and ammonium, sulphate or chloride of magnesium, or some other suitable salt of this metal, such as the citrate. The current density should be between one and four ampères per square foot, and the solution gives the best results when warm.—E. T.

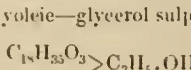
New and Improved Methods of Charging and Recharging, Cleansing, Changing, and Varying the Chemicals and Liquids used in Secondary Batteries (or Accumulators). J. T. Armstrong, London. Eng. Pat. 5009, April 4, 1887. 6*d.*

To enable the liquids to be removed or changed at will, the battery is connected to cisterns that are raised or lowered, and are usually balanced in an analogous way to the methods described for primary batteries in the inventor's specifications, Nos. 6878 of 1885, and 398, 8573, and 10,824 of 1886. One cistern is connected so as to receive the liquid of one or more cells, while the other is ready to charge them when required. Acid contained in bottles is allowed to trickle into one or both of the cisterns and mix with clean water. By these means, and with the help of a cleansing tank, it is claimed that sulphate may be prevented from forming thickly, and from accumulating so as to short circuit the plates; and that the density of the liquid is completely under control.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

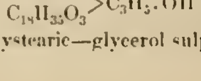
On Turkey-red Oil. R. Benedikt. Mitth. d. Tech. Gewerbemuseums in Wien, 1887, 47.

Liechti and Suida have drawn the conclusion that that part of Turkey-red oil which is soluble in water consists of glycerol sulphates, one of which is derived from the hydroxystearic acid $C_{18}H_{36}O_3$, the other from an hydroxyoleic acid



$$\begin{array}{l} C_{18}H_{33}O_3 > C_3H_5OH \\ \quad\;\; SO_4 \\ C_{18}H_{33}O_3 > C_3H_5OH \end{array}$$

Hydroxyoleic—glycerol sulphate; and



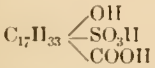
$$\begin{array}{l} C_{18}H_{35}O_3 > C_3H_5.OH \\ \quad\;\; SO_4 \\ C_{18}H_{35}O_3 > C_3H_5.OH \end{array}$$

Hydroxystearic—glycerol sulphate.

The circumstances that oleic acid gives the same product as triolein (Müller-Jacobs), that from Turkey-red oil only very small quantities of glycerol can be obtained, and that bodies of the above constitution would have to be neutral and not strongly acid, are opposed to this view.

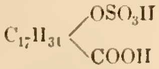
These formulæ having to be excluded, there remain only two possible views of the constitution of the compounds in question. They may either be true sulphonic acids—a view advocated by Scabanjew and Müller-Jacobs—or they are compounds analogous to "sulphuric esters."

For the product arising from oleic acid, the difference of constitution is made apparent by the following formulæ:



$C_{17}H_{33}\begin{cases}OH\\SO_3H\\COOH\end{cases}$

Hydroxystearin sulphonic acid.



$C_{17}H_{31}\begin{cases}OSO_3H\\COOH\end{cases}$

Hydroxystearin sulphate.

The author has now shown, together with F. Ulzer, that the soluble part of a Turkey-red oil produced from olive oil consists principally of hydroxystearin sulphate, while a Turkey-red oil from castor oil contains ricinoleïn sulphate.

To show this the sulphonic acid of a higher fatty acid was first obtained by a totally different method, in order to ascertain whether the compounds belonging to this group of bodies behaved similarly to the Turkey-red oil acids soluble in water.

The compound obtained, which it was impossible to prepare in a pure state, is, by its origin, undoubtedly a true sulphonic acid. In many respects it is very similar to the acid of Turkey-red oil, representing a more or less yellow oil, which can be mixed with water in any proportion. From the aqueous, strongly emulsive, bitter solutions it can be salted out, and its behaviour towards a concentrated solution of caustic soda or potash at boiling heat is the same.

For the purpose of comparison, the fatty acid prepared according to the directions of L. Liechti and Suida was employed, after being cleared as completely as possible from oleic acid and hydroxy-fatty acids by repeated solution in water, extracting the fatty acids insoluble in water with ether, and salting out.

Of each of the two acids under comparison, 5 cc. were boiled with 100 cc. of caustic potash of 20 per cent. for seven hours in a flask provided with a reflux condenser, and after cooling the liquid was acidified with equal quantities of dilute hydrochloric acid; from both acids drops of oil were separated which settled at the bottom.

On extracting with ether, the latter takes up an oil soluble in water.

Neither of the two fatty acids is therefore attacked by boiling solutions of alkali.

The statements of Liechti and Suida that by boiling alkalis the Turkey-red oil was decomposed, can be referred to the circumstance that by an addition of hydrochloric acid in a large quantity after the boiling a partial decomposition takes place.

The two acids are, however, essentially different from each other in this respect: The fatty-sulphonic acid is not decomposed by concentrated hydrochloric acid, even at a high temperature; while the acid from Turkey-red oil is easily decomposed even by dilute hydrochloric acid into sulphuric acid and hydroxystearic acid.

Turkey-red oil is, therefore, no true sulphonic acid; it belongs, according to its whole behaviour, to the class of sulphuric "esters." This view is supported by the circumstance that dilute solutions of the sulphuric esters undergo a decomposition in the same manner when merely left standing in the cold, and still more easily when heated or acted upon by dilute acids; while, on the other hand, hot concentrated alkaline solutions remain without influence.

L. Liechti and Suida have considered the soluble acid arising from oleic acid to be an acid sulphate of hydroxystearic acid, and have explained the decomposition of the acid thus:—

$$C_{18}H_{34}O_2 + H_2SO_4 + C_{18}H_{35}(OSO_3H)O_2 =$$

Oleic acid. Hydroxystearic hydrogen sulphate.

$$2\ C_{18}H_{35}(OSO_3H)O_2 + H_2O = C_{18}H_{35}(OH)O_2 + SO_4H_2.$$

If the soluble part of Turkey-red oil (from olive oil and from oleic acid) be considered as hydroxystearic sulphate, its composition will explain the different behaviour of the red oil produced from castor oil compared with that of the products obtained from other oils.

If from olive oil, cotton-seed oil, and castor oil, the corresponding Turkey-red oils are prepared, and if the "collective fatty acids" are separated by first saponifying that part of the triglycerides which has escaped the reaction, and then by decomposing the fatty sulphonic acids into hydroxy-fatty acids and sulphuric acid, the preparations thus made may be compared very conveniently. The method applied in the separation of the hydroxy-fatty acids is briefly as follows:—

To 1,000 grms. of each of the original oils, 400 grms. of concentrated sulphuric acid were carefully added drop by drop during continual stirring, for the purpose of transforming them into the corresponding Turkey-red oils. The products were washed first with cold water, then with solution of common salt.

The purified product was boiled with twice its volume of alcohol (50 per cent.) and 500 grms. of caustic potash.

If, after this, the mass was poured into much water, the mixture acidulated with sulphuric acid, and if each of the solutions obtained from the different oils is boiled for several hours, the corresponding fatty acids separate on the liquid. The decomposition of the fatty sulphates from castor oil takes place most readily.

The fatty acids separated from the aqueous solution were then filtered at 50° C. and left to cool. The fatty acid from cotton seed oil becomes solid, that from olive oil nearly so, but the fatty acid from castor oil remains liquid, and only after lying at rest for some time a crystalline separation is obtained.

Of the fatty acids thus obtained, the acetyl numbers were determined in the usual manner (*see* Benedikt and C. Ulzer: *Monatsh. für Chem.* **8**, 41), and brought into comparison with those numbers resulting from an equal testing of various commercial Turkey-red oils.

The acetyl numbers show that, while with castor oil the numbers remained nearly the same, those of the acids from olive oil and cotton oil became considerably greater by the transformation into oxy-fatty acids.

From an examination of the constitution of olive oil and of castor oil, it is obvious that the latter as an hydroxy-acid can combine with sulphuric acid with elimination of water, to form a sulphate, which in the decomposition regenerates ricinoleic acid and sulphuric acid. The process resembles the generation of sulphuric esters from alcohol.

The annexed table (*see page* 330) shows the result of the researches.

Oleic acid behaves quite differently; by sulphuric acid it is transformed into hydroxystearin sulphate, and this explains that the Turkey-red oil from castor oil contains the acid sulphate of a non-saturated acid, and that the Turkey-red oil from olive oil contains a derivative of a saturated acid.

A further reason for this assertion is to be found in the fact that the acid from olive Turkey-red oil does not absorb any iodine, while the analysis made by the author and F. Ulzer furnished for the acids from castor Turkey-red oil the iodine number 77·3, and for the castor oil acid 85·2 per cent. of iodine.

The Turkey-red oil from castor oil has therefore a far greater capability of oxidation than the olive Turkey-red oil, and is consequently a better mordant than the latter, a circumstance which, in the art of dyeing, especially in Turkey-red dyeing, is of leading importance.

(*See also this Journal*, 1887, 543 ; 1885, 115 ; 1884, 412 ; 1883, 537.)

Turkey-red Oils.	Fatty Acids from Turkey-red Oils.			From the Original Oils.
	Acid Equivalent.	Saponif. Equivalent. Number.	Acetyl-Number.	Acetyl-Number.
Olive Turkey-red oil	151·6	255·6	104·0	4·7
Cotton Turkey-red oil...	178·7	231·4	52·7	16·6
Castor Turkey-red oil ...	140·0	283·4	143·1	142·7
Castor Turkey-red oil, soluble part	139·2	286·4	147·2	..
Castor Turkey-red oil, insoluble part	153·5	278·5	125·0	..
Castor Turkey-red oil of Javal	152·0	301·0	149·0	..
Castor Turkey-red oil, Apollo Candle Works, in Vienna	141·1	291·3	150·2	..
Calculated for hydroxystearic acid	164·0	328·0	164·0	..
Calculated for ricinoleic acid	165·0	330·0	165·0	..
Calculated for dihydroxystearic acid	140·25	420·75	280·5	..

—W. S.

Linseed Oil. F. Moerk. Amer. Pharm. J. 59, 601.

The experiments were made with pure linseed oil extracted from linseed by means of petroleum spirit or carbon bisulphide. The pure oil was found to dissolve completely in a small amount of carbon bisulphide and in 5 parts of absolute alcohol. The author questions the assertion that solvents of different boiling points influence the solubility of the oil, his experiments showing no divergence among the various extracts. The solubility in alcohol is decreased by the purification of the oil with sulphuric acid. The saponification equivalent of linoleic acid was found to be 264·7, which confirms Allen's number. Norton and Richardson have recently shown that when linoleic acid is dried at 100° in a current of hydrogen, a constant loss in weight occurs. The author, therefore, subjected the acid to distillation and obtained 75 per cent. of a volatile colourless liquid of the composition $C_{20}H_{36}O_2$, having a sp. gr. of 0·9108. The saponification equivalent of its glyceride was equal to 320·7, which is higher than that of linseed oil (287—300 according to Allen), so that the saponification equivalent of the 25 per cent. of non-volatile acid should not be more than 240, which corresponds to an acid of the composition $C_{14}H_{24}O_2$. The author is pursuing this investigation.—D. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

PATENTS.

Improvements in the Manufacture of Distemper Colours. J. Nipper, Axbridge. Eng. Pat. 678, January 16, 1888. 4*d*.

To a mixture of whiting, linseed oil, glucose, salt, saccharine matter, and water, the inventor adds fine flour, fresh eggs, condensed milk, lime, and whiting in certain proportions; aniline or other suitable colours are added to give the required tint, and water is added to any desired consistency.—E. G. C.

Improvements in the Manufacture and Treatment of Lead Pigments and Compounds, and in Apparatus therefor. J. B. Hannay, Dumbarton. Eng. Pat. 13,416, October 21, 1886. 6*d*.

This inventor claims an improved combination of processes for the manufacture of lead sulphate, to be used as a white pigment, or for making other lead compounds or pigments; and an improved furnace, for the above purposes, comprising a lower vertical part in which the materials are first heated, and an upper lateral reverberatory chamber in which the oxidation is further effected.—E. G. C.

An Improved Compound or Varnish for the Coating of Metal, Wood, and other Materials. F. Crane, New Jersey, U.S.A. Eng. Pat. 5791, April 20, 1887. (From J. Hale, New Jersey, U.S.A.) 6*d*.

The principal base of the varnish is pyroxyline; and gums, oils, pigments, aniline dyes, or the like, may be added. The solvents may be ethyl ether, acetone, wood spirit, benzene, amyl alcohol, &c., according to circumstances.—E. G. C.

A Substitute for Printers' Varnish for Fastening and Glazing Printing Inks, especially for Posters, Show Cards, and General Use in Printing. H. Cunliffe and M. Condon, Barrow-in-Furness. Eng. Pat. 15,685, December 1, 1886. 6*d*.

The inventors use a "painters' terebene" composed of linseed oil, turpentine, and acetate of lead, to which is added boiled linseed oil and a varnish or glazing agent, consisting of pale hard copal, boiled linseed oil, and spirit of turpentine. —E. G. C.

New or Improved Rubber Compositions. A. M. Wood, Westminster. Eng. Pat. 967, January 21, 1888. 4*d*.

Various mixtures of Para-rubber with whalebone, asbestos, sulphur, alum, camphor, borax, tungstate of soda, &c. for the packing of glands and other purposes, are described. —E. G. C.

Improvements in the Method of Manufacturing Non-blooming Vulcanised Soft Rubber. F. Wilhöft, New York, U.S.A. Eng. Pat. 394, January 10, 1888. 4*d*.

The sulphur is rendered amorphous either by subjecting the sulphurous rubber mass to a heat above 330° Fahr. in vulcanising, or preferably by using a sulphur preparation or sulphur compound in which the sulphur is already in a lastingly amorphous condition. The sulphur may be rendered lastingly amorphous by fusing it, under certain conditions, with any fatty, greasy, resinous, or turpentine-like body.—E. G. C.

Improvements in the Vulcanisation of Waterproofed Fabrics and other India-rubber Goods in continuous Lengths, and in Apparatus employed therefor. H. H. Waddington, Manchester. Eng. Pat. 15,680, November 16, 1887. 8*d*.

A vulcanising chamber is employed fitted with a series of rollers, and having an inlet and outlet opening so that the goods can be continually passing through.—E. G. C.

Process for Treating Vegetable Milky Juices, and extracting therefrom India-rubber, Gutta-percha, Mangabeira, and such like. E. J. P. Robet, Nantes, France. Eng. Pat. 9751, July 12, 1887. 4*d*.

The milky juices from which the india-rubber and other products are extracted are first mixed with a small quantity of ammonia, to prevent fermentation or alteration, and sulphuric acid is added afterwards, with agitation of the mixture. The india-rubber, gutta-percha, &c., are by these means coagulated at the bottom of the vessel, and the acid can be drawn off and treated so as to be employed for another operation.—E. G. C.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Compounds of Soluble Albumen with Tannic Acid. C. Böttinger. Annalen **244**, 227–232.

The compound obtained by combining solutions of tannin and glue, forms a thick white granular precipitate. The dry compound is brittle, and contains from 10·73 to 11·08 per cent. N. The glue obtained from leather contains 16·5 per cent. N. The tannin present in the compound amounts, therefore, to about 34 per cent. Heated in a sealed tube with water to 130° it decomposes and melts. On heating for several hours at 150° a homogeneous dark-coloured solution is obtained, and on cooling a semi-fluid substance separates. Tannin from oak bark yields a compound containing 9·4 per cent. N., corresponding to 42·7 per cent. tannin. Heated to 150° in sealed tubes, it splits up into three compounds. One is a brown powder, insoluble in water, alcohol, and ether; the second dissolves in hot water; and the third in cold water and in aqueous alcohol. They all contain tannin. Compounds of glue with tannin have to a certain extent the character of salts. Their action is similar to the addition compounds of phenylhydrazine.—J. B. C.

PATENTS.

An Improved Method or Means of Preserving and Preventing the Putrefaction of Animal and Vegetable Substances. C. Collin and L. Benoist, Paris. Eng. Pat. 16,935, December 8, 1887. 6*d.*

The patentees find that a solution of mercuric iodide possesses powerful antiseptic properties; it destroys germs of putrefactive fermentation and is not precipitated by acids or alkalis. Iodide of mercury is dissolved with an equal weight of potassic iodide, and used as follows:—To such vegetable or animal substances as are liquid or rendered so by heat, from 0·5 grains to 15·5 grains of mercuric iodide per litre of material are added. Solid or porous substances, *e.g.*, hides, bones, horns, &c. are treated by immersion from 12 to 24 hours in water containing about 15·5 grains of mercuric iodide per litre. Leather or dry hides are brushed with a solution containing 31 grains per litre. The quantity of the iodide of course varies with the nature of the body treated, but in all cases the germs of putrefaction or fermentation are destroyed.—C. C. H.

Improvements in the Manufacture of Artificial Leather from Leather Waste and Scraps, and in the Utilisation of the same, and in Machinery employed therefor. H. House, Ripon. Eng. Pat. 5741, April 20, 1887. 6*d.*

Screened leather wastes and scraps are passed through a disintegrating machine of a special character, and then mixed with a naphtha solution of rubber. Glycerin is added and the whole kneaded up, without pounding. The dough is put into moulds, rammed, partially dried, rolled, and again partially dried and rolled, this process being repeated every two or three hours for several days. When of the requisite thickness the cakes are dried and stored.

For the manufacture of leather cloth no glycerin is used. Seven claims are made.—B.

An Improved Method for Treating Hides and Skins for Leather. J. S. Hooper, London.—From J. W. Darrow, Vanersberg, Kentucky, U.S.A. Eng. Pat. 6914, May 11, 1887. 4*d.*

A process for purifying or preserving hides and skins from taint, and for neutralising lime or the effects of lime or deleterious matter remaining in hides and skins after treatment for taking off the flesh or hair. Charcoal and sulphur are burnt for about 12 hours in a room where the hides and skins are hung, whereby these are softened and whitened ready for tanning, improving the texture of the leather.—B.

XV.—AGRICULTURE, MANURES, Etc.

Potato Cultivation. Heine, O. Cimbal, and others. Bied. Centr. **17**, 48—56.

A large number of different varieties of potatoes have been submitted to experimental cultivation.

Heine tried 130 sorts on alluvial land with light surface, but heavy subsoil, and manured with farmyard manure, Chili saltpetre, and double superphosphate, and found the following varieties the best:—Gelbe Rose, Richter's Imperator, Magnum Bonum, Euphyllos, Eos, Frühe Nassengrunder, Richter's Schneerose, and also has a good opinion of Rosalie and Amaranth, whereas Hermann, with high percentage of starch, has the drawback of ripening very late. Many new sorts which at first had shown up well, in subsequent seasons had degenerated, showing the importance of not judging of the growing capabilities of a potato from the yield of one season's growth alone. Of 40 new sorts examined for the first time, only one, Deutscher Reichskanzler, promised well, although such familiar varieties as the Beauty of Kent, White Elephant, Telephone, Late Beauty of Hebron, &c. were included in the trials. O. Cimbal has cultivated 110 different sorts of potatoes, including many new varieties, on a mild loamy soil manured with farmyard manure. He finds that Charlotte, Hermann, Juno, Odin, Aurelie, Kornblume, Richter's Imperator, figure amongst the twelve best, whilst Deutscher Reichskanzler stands 14th on his list (compare this Vol., p. 221).

Richter's Imperator, Magnum Bonum, Richter's Schneerose, Frühe Nassengrunder, and Gelbe Rose are good for dietetic as well as technical purposes.—D. A. L.

Experiments on Drainage Water. Berthelot. Compt. rend. 1887, 640—646.

These experiments were instituted to compare the nitrogen supplied to the soil in rain and from the air with that washed out by drainage.

Weighed quantities of soil were exposed in pots perforated below, the surface was measured and records were kept of the quantity and composition (as regards nitrogen) of the rain, drainage, and soil during the period of exposure. In five experiments, two with simple air-dried soil (one with and one without vegetation), and three with soil from which the nitrates had been washed out (one without and two with vegetation). The quantity of drainage was always much less than the quantity of rain, but the total nitrogen removed by drainage in all cases far exceeded the total nitrogen supplied by rain, although the excess was much diminished where the previous washing of the soil had been resorted to, and to a less extent by the presence of vegetation (*amaranthus plants*). The amount of nitrogen retained by the soil varied considerably in each experiment. The nitrogen of the drainage waters was almost exclusively as nitrate; this agrees with observations by previous investigators. In one experiment 55 kilos. of earth, containing 45 kilos. of dry matter, was placed in a glazed porcelain pot, exposing a surface of 1,550 square centimetres, and the gain and loss of nitrogen were estimated after each fall of rain, with the results tabulated below; the figures being calculated to one square metre. The analyses were made within 48 hours of the falling of the rain :—

Date.	Rain.			Drainage.	
	Quantity.	Nitrogen (grams).		Quantity.	Nitrogen (grams).
	Litres.	As Ammonia.	As Nitric Acid.	Litres.	As Nitric Acid.
June 3rd………	31·87	0·0340	0·0070	9·36	0·229
„ 26th………	21·96	0·0050	0·0076	3·61	0·303
July 22nd …….	49·58	0·0298	0·0098	12·91	0·840
„ 31st………	33·29	0·0133	0·0089	12·91	0·970
August 19th …..	47·96	0·0326	0·0070	26·77	2·018
September 15th ..	27·48	0·0098	0·0063	6·45	0·418
October 7th ……	20·54	0·0186	0·0088	11·10	0·462
Totals …….	232·68	0·1431	0·0554	83·11	5·240

Allowing that the quantity of organic nitrogen in the rain is the same as the nitric nitrogen, one litre of rain would contain 0·0011 grm. total nitrogen, whilst the drainage water contained 0·063 grm. nitrogen according to the above experiment, and 0·058 grm. in a duplicate. The ratio of ammoniacal to nitric nitrogen in rain is about 3:1, although it varies to some extent when individual rainfalls are taken into consideration.—D. A. L.

Experiments with Farmyard Manure, &c. E. Heiden. Bied. Centr. 17, 154—165.

The author's experiments show that by strewing the stalls in which cattle are kept three times a day with superphosphate of lime, using 2 lbs. for every 1,000 lbs. live weight in feeding, a very great economy is effected in the manure, since it is not only obtained in larger quantities, but is also superior in quality, and when stored suffers less loss of both dry matter and nitrogen than untreated dung and litter. This result is true if the stalls are cleaned out every two or three days, or if the dung and litter are left under the cattle for six weeks. When liquid manure is acidified with sulphuric acid containing phosphoric acid, the usual loss of nitrogen is greatly diminished, and experiments indicate that at a cost of 4*s.*, 24*s.* worth of nitrogen may be saved in the year by such treatment. Some plots of heavy land had been used for experiments with special manures, and had become unequally impoverished, but by a dressing of farmyard manure one year and ammonia salts and superphosphate the next season, the land was brought to a uniformly fertile condition. Experiments with oats receiving phosphoric acid as superphosphate, or as Thomas-slag, or as precipitated phosphate, but otherwise treated in a similar manner, appear to show that the slag occupies an intermediate position; the results, however, are not regular.
—D. A. L.

Comparative Manurial Value of Nitrogen in form of Ammonia Salts and Chili Saltpetre. G. Klein. Bied. Centr. 17, 166—168.

Experiments were made in four localities. In three of them the soil was limy and rich in humus, whilst the fourth was rich in lime and poor in humus. These were all dressed with phosphoric acid and kainite, and plots were arranged without nitrogenous manure and with nitrate or ammonia, or both. With the first three soils the action of the manures was about the same, but with the fourth soil the nitrate was much more effective than the ammonia salts; this failure of the ammonium salts is chiefly owing to the lime in the soil, late sowing, and unfavourable weather.
—D. A. L.

Manurial Value of the Free Lime in Basic Slag. E. Jensch. Bied. Centr. 17, 12—16.

Experiments were made with oats on a sandy loam, all conditions favourable to vegetation being alike throughout, except that in some cases the plants received neither phosphoric acid nor lime, whilst in other cases lime alone, or basic slag, or basic slag from which the lime had been removed by means of sugar solutions, were applied. The author concludes from the results that the manurial value of the slag depends on the phosphoric acid, and not at all on the lime.—D. A. L.

Absorption of Atmospheric Nitrogen by Vegetable Soil in the presence of Vegetation. Berthelot. Compt. rend. 1887, 625—630.

These are parallel experiments with those on the same subject, but with soils in absence of vegetation (Berthelot, this Journal, 1887, 552). The plant employed in the present instance was amaranthus pyramidalis, and these were plucked and analysed from time to time throughout the experiments; and various other data were carefully noted. The results, both with the ordinary soil and with soil washed free from nitrates, are summarised in the following table; the figures are grams.

At Commencement of Experiments.	Ordinary Soil.	Washed Soil.
Nitrogen in the 50 grams of soil……….	54·090	54·600
„ supplied in rain…………….	0·053	0·051
„ „ as ammonia from air ..	0·048	0·048
„ „ in the plants……….	0·350	0·349
Totals…………………………….	54·541	55·048
Differences………………………….	− 4·637	− 7·582

At Close of Experiments.	Ordinary Soil.	Washed Soil.
Nitrogen in the soil…………………..	56·540	60·53
„ removed in the drainage water .	0·403	0·23
„ „ by the plants………	2·235	1·87
Totals……………………………..	59·178	62·63
Differences…………………………	+ 4·637	+ 7·58

The author regards it as quite conclusive that soil does absorb considerable quantities of nitrogen from the atmosphere; and it matters not whether the soil is sandy or clayey or vegetable, or if it bears vegetation or does not; it is true that the amount of nitrogen retained by the soil is less when plants are growing on it than when there are no plants, the numbers being 4·64 and 7·58 against 12·7 and 23·15. This the author attributes to the plant having utilised, and probably dissipated, some of the nitrogen.
—D. A. L.

The Action of Artificial Manures on White Mustard (Sinapis alba). P. Pudrin and Strecker. Jour. f. Landw. 35, 249.

The experiments were carried out in zinc vessels, which were filled to an equal extent with earth, partly with and partly without manures. As manures, calcium phosphate, sodium nitrate, potassium nitrate, ammonium sulphate, and kainite were employed; each manure was first tried by itself, and afterwards a mixture of the nitrogenous manures with calcium phosphate. The results showed a larger production with than without manure. The nitrogenous substances increased the yield 40—50 per cent., and the yield was still further increased by the joint use of nitrogenous manures and calcium phosphate. Ammonium sulphate gave a greater produce than sodium nitrate, the efficacy of which was, however, increased by the addition of calcium phosphate. The latter employed alone did not give such good results, especially when the mustard was sown in late summer. Kainite did not give favourable results as a manure.—G. H. M.

Ammonium Phosphate as a Manure for Beet. D. landw. Presse **15**, 45.

In an experiment on the relative values of ammonium phosphate and of ammonium superphosphate as manures for beet, it was found that the former yielded 15½ cwt. of beet less, but 0·4 cwt. of sugar more, per acre, than the latter.—C. A. K.

Farmyard Manure and Calcium Sulphite. E. Jensch. Chem. Zeit. **12**, 354—355.

The author points out that the usual mode of storing farmyard manure is liable to very great and serious losses of nitrogen. These losses can be reduced by scattering in the manure gypsum, superphosphate of lime and kainite; but inasmuch as such additions are, from a manurial point of view, superfluous in many districts, the suggestion has not met with extensive application. Calcium sulphite is now suggested to retain the nitrogen, and it has the additional advantage of acting at the same time as a disinfectant. It is produced as a waste product from the gases evolved in roasting zinc blende; it is hence very cheap, and can be prepared with an ammonia-absorbing efficiency of 85 per cent., as compared with 68 per cent. in the best commercial gypsum. Its action on vegetation has not as yet been studied.—D. A. L.

Decomposing Bone Earth with Sulphuric Acid. F. Stolba. Chemické Listy. **12**, 150.

By the ordinary method for obtaining phosphoric acid or phosphates, incinerated bones are treated with dilute sulphuric acid in such a way that a heating for 12 hours or more is required. A quicker decomposition is accomplished by the following method. One part of the finely powdered bone earth is mixed with one part of water, and then gradually with one part of concentrated sulphuric acid, by which the mass becomes very hot. After about 20 minutes, five parts water are added, and the whole is brought to boiling in about 40 minutes. The bone earth is completely decomposed. Five parts cold water are then added to the hot liquid, which is then filtered, preferably with pressure: the water used to wash the residue can be employed in the first part of the process in a subsequent charge. The solution of impure phosphoric acid and monocalcium phosphate is then worked up in the ordinary way.
—G. H. B.

PATENTS.

A New or Improved Material to be used as a Disinfectant, Manure, Preservative against Decay, and for other Purposes, such as Litter for Stables and Farmyards, Packing for Fragile Objects, and as a Filtering and Decolorising Material. E. Edwards, London.—From J. Jeger, Varsovie, Poland. Eng. Pat. 5532, April 15, 1887. 6*d.*

The new material is a vegetable powder prepared from mosses belonging to the family of Bryineæ, and especially the species Hypnum and Bryina. These mosses occur in some localities in layers on the banks of rivers from 13 to 20 feet thick; the layers are removed, dried by exposure to the air, and reduced to a fine powder by suitable appliances. Used for the purposes set forth in the title, the powder is highly efficacious.—C. C. H.

Process and Apparatus for the Separation and Disinfection of Fæcal and other Matters. G. Gehring, Landshut, Bavaria. Eng. Pat. 3352, March 4, 1887. 8*d.*

This specification describes a form of closet resembling the well known "Moule's earth closet." Beneath the pan of the closet is placed a receiver for the solid and liquid fæcal matter: the latter percolates through a filtering bed of peat resting on a perforated plate, and the former is retained on the bed of peat. A device is provided so that each time excreta is admitted into the receiver a small quantity of dried peat is let down so that it covers and deodorises the excreta. The base of the receiver is removeable, and the contents, forming a "compost," can be readily removed.—C. C. H.

XVI.—SUGAR, STARCH, GUM, Etc.

The Formation of Orthosulphamine Carboxylic Acids. By C. Fahlberg and R. List. Ber. **21**, 242—248.

The nature of the product obtained by oxidising an aromatic sulphonic-amide depends more on the character of the oxidising agent than on the relative position of the side chains.

When *orthotoluenesulphonic-amide* is oxidised at 100° with excess of an *alkaline* solution of potassium manganate, oxidation is complete in a few hours, and an almost theoretical yield of *orthosulphaminebenzoic acid* is obtained. Strongly alkaline potassium permanganate gives a similar result.

In a *neutral* solution potassium permanganate first oxidises orthotoluenesulphonic-amide to the *sulphonic-imide*, which is gradually converted into *orthosulphaminebenzoic acid* as the solution becomes alkaline, owing to the decomposition of the permanganate. If, however, the solution be kept neutral, the formation of orthosulphaminebenzoic acid can be considerably checked.

In an acid solution of potassium permanganate, orthotoluenesulphonic-amide is converted into *orthosulphobenzoic* acid, and the whole of the nitrogen is oxidised to nitric acid.

It seemed probable that the first product in all three cases is *benzoylsulphonic-imide*; and it was found that when this compound is treated with hydrochloric acid it is converted into orthosulphobenzoic acid, and when boiled for five hours with a 3 per cent. solution of potash, it is completely transformed into orthosulphaminebenzoic acid. Ammonia, carbonates of the alkalis, and oxides of the alkaline earths do not convert the sulphonic-imide into sulphaminebenzoic acid, but on melting it with potash, sulphobenzoic acid is formed.

O-p-disulphaminebenzoic acid—

$$C_6H_4COOH(SO_2NH_2)_2\ [COOH : SO_2NH_2 : SO_2NH_2 = 1 : 2 : 4]$$

was prepared, (1), by oxidising o-p-toluenesulphonic-amide with an alkaline solution of a manganate; (2), by evaporating the sulphonic-imide of sulphaminebenzoic acid with potash. It is extremely soluble in water and in alcohol, crystallising from the former in microscopic needles. It dissolves sparingly in ether, and has a sourish taste. When heated it melts at 182°—183°, solidifies again, and turns brown when the heating is continued, until at 250°—260° it is completely decomposed. The salts all crystallise very readily. Those of the alkalis and alkaline earths are soluble, those of the heavy metals insoluble.

The most simple general method for the preparation of an orthosulphamine carboxylic acid is to evaporate a sulphonic-imide with caustic potash, dissolve the residue in water, and acidify with a mineral acid. (This Journal, 1887, 587, 808, 560.)—F. S. K.

Extraction of Sugar from Sorghum. Bied. Centr. **17**, 68.

Kohlrauser reports favourably on this subject, but Wiley states that no satisfactory results have been obtained at Fort Scott, Kansas, with crystalline sugar; the failure being attributed to want of machinery, to the setting in of frost, and to leaving the cut sorghum too long before diffusing. (This Journal, 1888, 222.)—D. A. L.

Preparation of Raffinose. Burkhard. Neue Ztschr. Zuckerind. **20**, 16.

In treating pure bye-products from the desaccharification of molasses with methyl alcohol, and evaporating the extract, syrups are obtained which dissolve in ethyl alcohol of 80 per cent., and refuse to crystallise, or crystallise with difficulty. They are purified by diluting with water and evaporating to expel the alcohol, and then treating with strontium hydroxide. The raffinose is thus separated as insoluble saccharate, which is collected, washed with a hot saturated solution of strontium hydroxide, and decomposed with carbonic anhydride. The filtrate is evaporated to a thick syrup, dissolved in alcohol of 80 per cent., and allowed to crystallise. Raffinose thus obtained is a perfectly white substance. To isolate pure raffinose from syrups extracted from the bye-products of the desaccharification of molasses, it is proposed to saturate the solution with monostrontium saccharate, absorb the precipitate in sawdust previously exhausted with alcohol, dry the mixture in vacuo, and extract it with methyl alcohol. The extract is then purified with strontium hydroxide, as described in the above.

—D. B.

A Substitute for Gum Arabic. Trojanowsky. Pharm. Ztschr. Russia **27**, 33.

Linseed is the substitute recommended. The seeds are first boiled with water for an hour, the resulting thick mass filtered and then treated with twice its volume of 90 per cent. spirits of wine. A flocculent white precipitate separates, from which the dilute spirit can be readily decanted. A yield of 10 per cent. of dried "Gummi Lini" on the weight of seeds taken is obtained. The gum forms a clear, grey-brown fragile mass, which dissolves in water without taste or smell, similarly to gum arabic. 2 grms. are sufficient to form an emulsion with 30 grms. of oil, which resembles the emulsion formed with gum arabic both in taste and in appearance.—C. A. K.

Investigations on the Development of Beet. Briem. Ztschr. f. Zuckerind. **38**, 35.

A series of observations on the development of the beet, and on the origin and accumulation of the sugar, are given. It is stated that during the months July to October the moisture in the beet decreases in quantity whilst the dry substance increases, and that during the same period the quantity of sugar increases steadily with the weight of the root, especially in August, but also to a considerable extent in October, although this is contrary to the general belief.

—C. A. K.

Importance of a Definite Quantity of Alkali or Lime in Raw Sugar. Strohmer. Bied. Centr. **17**, 68.

It is well known that in the absence of alkalis or lime, or in acid solutions, raw sugar undergoes gradual inversion. Moreover, in the presence of a very small quantity of alkali, inversion proceeds slowly until all alkalinity is neutralised, after which the inversion continues at an increased rate. With sufficient alkali or lime (and the author considers alkalinity equal to 0·03 per cent. of lime sufficient) no inversion of the sugar takes place, and raw sugar can be kept without fear of such change for months.—D. A. L.

Removal of Sugar from Molasses by Means of Lime. Lefranc. Chem. Centr. 1887, 420—421.

The molasses is diluted to a strength of 5—10 per cent. of sugar, mixed with milk of lime and lime powder, then filtered and the clear solution heated. The gelatinous saccharate which separates is mixed with more lime filtered off and treated in the usual manner, whilst the 3 per cent. of sugar remaining in the filtrate is also extracted as calcium saccharate by a complicated process. The filtration before heating is an important factor in the operation, as otherwise the excess of lime acts destructively on the sugar (compare this Journal 1887, 668).—D. A. L.

The Formation of Levulinic Acid. C. Wehmer and B. Tollens. Annalen **273**, 314—337.

The following carbohydrates yield levulinic acid when heated with dilute mineral acids: cane-sugar, dextrose, levulose, inulin, starch, gum-arabic, filter paper, tan bark, carragheen moss, levulin, milk sugar, galactose, raffinose, and irisine. On the other hand, substances resembling carbohydrates, such as saccharin and inosite, do not give levulinic acid. This has led to the supposition that the formation of levulinic acid is a characteristic property of carbohydrates. To substantiate this view the authors have investigated the action of dilute HCl upon a large variety of substances of similar nature or occurrence to the carbohydrates. The substance is heated for 20 hours on the water bath with dilute HCl of sp. gr. 1·10. The product is filtered and the filtrate extracted with ether. The residue left after distilling off the ether is digested with ZnO and the zinc salt obtained. As it is an easy matter to overlook small quantities of levulinic acid when present, the authors are only able to state their results within certain limits.

In addition to the substances mentioned above, the following have been found to yield levulinic acid, viz.: all carbohydrates, and the glucosides, salicin, amygdalin; but inosit, isosaccharin, phloroglucinol, santonin, tannin, elastin, casein, fibrin, blood urine, piperinic acid, &c. give no such acid.—J. B. C.

Amount of Salts in Molasses. Leplay. Bull. Ass. Chim. **6**, 405.

By recent experiments with numerous beet- and cane-sugar molasses, the former were found to contain 12—18 per cent., the latter 2—4 per cent. of organic acids combined with potassium, and 8—9 per cent. and 0·5—1 per cent. respectively of organic acids combined with calcium. The sugar-cane only contains 18 parts of organic acids against 100 parts in the beet, therefore the amount of salts in the colonial molasses must be much smaller than in the beet-molasses, and if this does not agree with the calcium salts, which are first formed during manufacture, it therefore follows that the latter is still very defective and in need of improvement.—G. H. M.

PATENTS.

An Improved Manufacture of a Non-Fermentable Cementitious Body, Soluble in Water, from Starch. A. Schumann. Düttlenheim, Strasburg, Germany. Eng. Pat. 5459, April 14, 1887. 6*d.*

Starch is stirred up with water to a milk of thick consistency, one per cent. of fixed acid is added, and the whole allowed to stand 24 hours. The precipitated starch after being washed free from acid is heated with fresh water in a digester or otherwise to 160° to 170° C., until all the starch is converted and gives no further reaction with iodine. The soluble product thus obtained is then added to a solution of albumen of from 20° to 25° Baumé, and is raised to boiling point, filtered and refined by means of animal charcoal or other reagents. The resulting body is then evaporated to any desired consistency, or to dryness, first adding with advantage some vegetable mucilage.

The commercial product thus obtained produces a clear solution with hot or cold water, is devoid of taste or smell, and is similar in appearance and action to gum arabic.

—A. J. K.

An Improved Method of Enriching Seed Plants with Alimentary Substances. F. Knauer, Groebers, Germany. Eng. Pat. 6843, May 10, 1887. *4d.*

The enriching of beet-root or other plants can, it is claimed by this method, be effected quickly and mechanically by enriching the seed plant with sugar or such other alimentary substance as it is desired to produce. A hollow is made in the root of the beet, and sugar is introduced either mixed with 50 per cent. of sand, or in a state of solution. In either case the hollow is closed with clay, and the sugar is gradually absorbed by the root. It is claimed that roots grown from the seed of such a plant are of a higher class as regards per-centage of sugar, and that it makes no difference whether the sugar contained in the seed plant was grown there or introduced artificially.—A. J. K.

Process and Apparatus for Acid Saccharification of Starchy Materials. V. C. A. M. Bondonneau, Paris, and A. J. M. G. Foret, Chalon-sur-Saône, France. Eng. Pat. 986, January 21, 1887. *8d.*

In the saccharification of starchy matter by acids, there is produced a large quantity of broken up membranous substances which after filtration are useless as food for cattle, and can only be used for manure. The present invention consists of a process and apparatus for converting all the starchy ingredients, and at the same time producing a pulp equal to that which is obtained by the malt process.

The grain is subjected to the action of an acid at a temperature of from 95°—100° C., and the process is so arranged that the conversion is effected without injuring the structure of the enclosing membranes of the vegetable cells. As soon as the conversion is completed the saccharine matter is extracted from the mass by a process of diffusion. Special apparatus for effecting this diffusion with the least possible injury to the grain is described in the specification. It is claimed that by this process the residue obtained is suitable for food for cattle, and that a syrup is obtained containing the whole of the products of saccharification, which can be used in distilleries and for the manufacture of glucose.—A. J. K.

Improvements in the Treatment of Saccharine and Sacchariferous Matters for the purpose of Decolouring, Purifying, or Refining them. A. Brin, London, and L. Q. Brin, Paris, France. Eng. Pat. 2298, February 14, 1887. *4d.*

The saccharine or other matter to be treated is introduced into an air-tight agitator. It is there treated in the form of a solution with chloride of lime and alumina, or some compound thereof, at a temperature of about 60° C. A little carbonate of soda is also introduced to prevent injury from the tendency to acidity. When the reaction is complete the liquor is filtered through carbonate of lime.
—A. J. K.

Improvements in the Treatment of Saccharine and Sacchariferous Matters for the purpose of Decolouring, Purifying, or Refining them. A. Brin, London, and L. Q. Brin, Paris, France. Eng. Pat. 2297, February 14, 1887. *6d.*

Same as the above, but instead of chloride of lime a mixture of chlorine and oxygen gases is introduced into the agitator, or the gases may be first subjected to the action of an electric current. By this means the oxygen is reduced in volume, and is known as ozone, the chlorine also undergoes a reduction in volume, and is called "chlore naissant," and the mixture of the two the authors designate "autochlorozone.—A. J. K.

An Improved Process of producing Refined Sugar from Raw Sugar. N. Tscherikowski, Smiela, Russia. Eng. Pat. 12,834, September 21, 1887. *6d.*

To produce refined sugar direct from well-cleaned raw white sugar, the raw sugar is converted as quickly as possible into a hot liquid mass or pulp by means of steam. It is then caused to run into moulds where it is rapidly cooled and the sugar crystallises out, the syrup is then removed from the crystals by centrifugal machines or by suction, and the refined sugar is then dried.

To produce refined sugar from ordinary yellow raw sugar, the raw sugar as before is quickly reduced to a pulp by means of steam in an agitator, and then run into moulds and crystallised. The yellow syrup in this case is removed from the crystals by means of "cleare," and then the refining process finished off as in the case of the raw white sugar.—A. J. K.

Improvements in the Purification of Extracts or Juices from Fruits, Roots, Malt, and other Vegetable Matters, and of Juices from Maltose. W. P. Thompson, London. —From F. Kleemann, Schoeningen, Germany. Eng. Pat. 13,196, September 29, 1887. *4d.*

For the purification of above substances a soft porous coal of the Tertiary formation, known as brown coal or lignite, is used, either in the form of a layer of greater or less thickness, through which the syrup is filtered, or it may be mixed with the syrup as a powder and the whole filtered through a filter press. In either case the purity of the syrup is much increased, so that bone-black may be either dispensed with altogether or it will last for a much longer period without requiring to be revivified. The lignite may be washed and dried and used a second or third time, or it may be used as fuel. It possesses the property of removing from the syrups just those ingredients which are most injurious to bone-black or animal charcoal.—A. J. K.

An Improved Manufacture of Dextrin or Soluble Starch free from Smell and Taste. A. Schumann, Düttlenheim, near Strasburg, Germany. Eng. Pat. 5460, April 14, 1887. *6d.*

Ordinary dextrin of commerce has an unpleasant penetrating taste and smell. It is prepared in the dry way by sprinkling starch flour with acid, mixing thoroughly, drying and roasting with continuous stirring at a temperature of from 100° to 150° Centigrade. A bad smelling dextrin is thus obtained which cannot be freed from acid and cellulose, and which is therefore a very imperfect product.

By the improved process of this specification one per cent. of fixed acid is agitated and allowed to stand for 24 hours with cold starch milk, the water is then separated from the precipitated starch, and the latter washed with fresh water until free from acid. The washed starch, once more reduced by water to a milk of 15° Baumé, is then boiled under pressure of three to four atmospheres with one half per cent. of saturated sulphurous acid solution until the first trace of glucose can be detected in the product. The reaction is then stopped, the slight trace of sulphuric acid formed is fixed, and the syrup is filtered through animal charcoal and evaporated. The dry mass obtained is of a brilliant white colour, and has all the properties of commercial dextrin, except the objectionable smell and taste. It is also free from acid and from cellulose. The process is not more expensive than the one already in use.—A. J. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

Denaturation of Alcohol. Chem. Zeit. **12**, 173.

The denaturation of alcohol by means of tar oils and magenta is said to give rise to continual complaints on the part of the manufacturer, who requires a pure spirit, and the consumer who employs the alcohol for burning, owing to the very unpleasant odour which this addition imparts to the alcohol.—D. B.

Probable Occurrence of Vanillin and Eugenol in Alcohol. E. Bauer. Chem. Zeit. 12, 151.

The author has extracted vanillin and eugenol from a strongly-coloured spirit made from molasses rich in alcohol. On evaporating one litre of the spirit (slightly acidified with sulphuric acid) on a water bath, an oily green mass is obtained, from which ether extracts microscopic needles of coniferylic alcohol and a considerable quantity of a substance which was found to be eugenol. The author is of opinion that although this substance may exist in alcohol in conjunction with vanillin, it is more probably a reduction product of coniferylic alcohol (the product of the decomposition of vanillin). The occurrence of vanillin in alcohol is, however, most probably due to the grain, and is not attributable to direct addition, as asserted by Salzer. —D. B.

Munich and Berlin White Beer. E. Wein. Allgem. Brauer und Hopfenz. 28, 2.

Munich white beer is brewed mainly from wheat malt, barley malt being added at times, whilst Berlin white beer is prepared almost exclusively from barley malt. The following table exhibits the results of the chemical examination of both kinds of beer:—

Name of the Beer.	Sp. Gr. of the Decarbonated Beer.	Alcohol.	Extract.	Concentration of Original Wort.	Fermenting Temperature.	Grms. of Lactic Acid in 100 cc. of Beer.	Sugar.	Dextrose.	Ash.	Albuminous Matter.
Munich white beer........	1·0154	3·68	5·51	12·59	56·3	0·159	1·64	2·33	0·121	0·345
Munich Bock beer	1·0243	4·15	7·96	16·04	50·5	0·182	2·94	3·23	0·171	0·525
Berlin white beer	1·0118	2·82	4·21	9·65	56·3	0·234	0·92	2·10	0·124	0·320

—D. B.

Improvements in Beer-brewing. Dingl. Polyt. J. 267, 410—416.

C. Lintner (Zeits. f. d. ges. Brauwesen 10, 489), asserts that for browning malt a certain quantity of moisture is necessary, and describes a process for carrying out the operation. Kiln-dried malt is heaped up and watered several times, then spread out and frequently turned during six to eight hours. The whole is then roasted in a cylinder heated from below, care being taken that the malt is sufficiently hot, when emptied out, to bring about a darkening on exposure.

G. E. Holm (Zeits. f. d. ges. Brauwesen 10, 449), describes an apparatus for preventing the introduction of germs to cooling wort by access of air.

P. Linder describes experiments (Wochenschr. f. Brauerei 4, 753), which support Hansen's assumption as to the similarity of different cultivations of yeast. The same author gives also (*l.c.* 953) observations on the formation of yeast spores.

The work of K. Amthor (Zeits. f. d. ges. Brauwesen 10 534), supports the observation of Borgmann, that in beers prepared from pure yeast cultivations there is less glycerol than in those made in the ordinary way. He also declares that during fermentation dextroses are converted into sugar, and (contrary to the statements of Brown and Morris) the pure yeasts hydrolyse more dextrose and ferment more sugar.

Lindner describes the preparation of coloured yeast preparations ("Wochenschr. f. Brauerie" 4, 773 and 878), his apparatus for detecting the presence of micro-organisms in breweries, and thus adding to safety in working.—B.

Presence of a Glycol in the Products of the Alcoholic Fermentation of Sugar. Henniger and Sanson, Compt. Rend. 106, 208.

Isobutylene glycol $C_4H_{10}O_2$, obtained by Névolé by the action of potassium carbonate on isobutylene bromide, is formed in the fermentation of sugar by yeast, 100 kg. of sugar yielding 308 grms. of the glycol.—C. A. K.

Alcoholic Fermentation of Galactose. E. Bourquelot, Compt. Rend. 106, 283.

The author finds that galactose does not ferment with yeast, his results agreeing with those obtained by Kiliani and F. Koch; Pasteur, von Lippmann, and Tollens, on the other hand, regard galactose as fermentable. In presence of glucose, levulose or maltose, fermentation takes place. —C A. K.

Bases extracted from Solutions which have undergone Alcoholic Fermentation. E. C. Moren. Compt. Rend. 106, 360.

In order to isolate the bases contained in the higher alcohols, the residue from the distillation of crude, unwashed fusel oil, boiling above 130·5°, was repeatedly washed with dilute hydrochloric acid, the last traces of the alcohols removed by distillation, and then the bases distilled over with steam after treating the solution with an excess of alkali. After drying the distillate, three bases were isolated by fractional distillation boiling at 155°–160°, 171°–172°, and 185°–190° respectively. Of these, the middle and largest fraction was specially examined. This base is readily soluble in water, alcohol, and ether, and forms a colourless, very mobile, and strongly refractive liquid, having a sp. gr. of 0·9826 at 12°. Its formula is $C_7H_{10}N_2$; it possesses a very unpleasant smell, slightly resembling that of the pyridine bases, and forms a crystalline platinum double salt. The base is not precipitated by a solution of iodide of mercury in potassium iodide until a drop of hydrochloric acid is added, when a flocculent precipitate forms which redissolves at once. This reaction is not given by the pyridine or by the quinoline bases, and serves to detect 0·1 per cent. of the base in question. The same quantity of the base may be detected by a solution of mercuric chloride when a white flocculent precipitate also forms. Phospho-tungstic acid gives a white precipitate, and phospho-molybdic acid a yellow precipitate with the base, and 1 part in 10,000 parts of solution may be detected by either of these reactions, which, therefore, serve for the detection of the bases in alcohols.—C. A. K.

The Pneumatical System of Malting (J. Saladin's). Saare, Wochenschr. f. Brauerei 5, 17.

By this system it is possible to maintain constant conditions of temperature and moisture of the germinating barley at all seasons, to keep them independent of external changes of weather, to prevent contact with adverse influences (mould, &c.), to effect economy in malting room and labour, and to minimise loss arising from injury to the grain. The soaked barley is shovelled into a germinating box, in which it remains to the conclusion of the germination. The box is fitted with a perforated bottom, by which moist air at a regulated temperature can pass through the malt. Air is driven by a fan through the alternator (changeur), an apparatus consisting of several perforated drums which revolve slowly, whilst being partly immersed in water maintained at a suitable temperature. The air, brought to a given temperature and saturated with moisture, now streams through the heap of malt, which is thus kept at 13–14° R., and supplied with pure fresh air, without losing any considerable amount of moisture. The ventilation must be kept constant day and night. Every 12-20 hours the heap is loosened by a "stirrer." This consists of an iron traveller running on rails over the germinating box, and carries a stirrer working corkscrew fashion, which operates on the malt by separating the grains which may have begun to stick together. The malt can be finally desiccated in the same box. Saare's comparative trials of the pneumatic method and the malting on floors show that:—by the first the oscillations of temperature were smaller than by the latter; the quantity of carbonic acid in the air of the germinating box was smaller than in the air of the malting floor, and was, in fact, frequently absent altogether (according to Schütt, carbonic acid is injurious to the progress of malting); the box malt remained free from mould, and showed only a few fully budded grains, whilst the malting on a floor gave rise to a pronounced formation of mould and much sprouting. The proportion of moisture in the malt was subject to variation in both cases; still, in spite of several sprinklings of the heap on the floor, the loss of moisture was only 1 per cent. less than by the pneumatic method.

The weight of a given measure of malt was somewhat greater, and the yield of malt was also throughout somewhat more favourable by the pneumatic method.—G. H. B.

The Bitter, Unpleasant, After-taste of Beer. C. Grönlund, Ztschr. f. d. gesammt. Brauwesen **10**, 469.

Brewers' yeast is, according to Hansen, often contaminated with wild-yeast of the Genus Saccharomyces which, under certain conditions of cultivation, forms ascospores in a shorter time than the former.

Of the wild forms which have been at present examined Sacch. Pastorianus II. exercises no injurious influence on beer. Sacch. ellipsoideus I. has not yet been examined in this respect. Two varieties, Sacch. Pastorianus III. and Sacch. ellipsoideus II. cause yeast-turbidity, and one, Sacch. Pastorianus I., gives an extremely unpleasant bitter taste to beer without causing turbidity.

The author had occasion to examine a beer, which was quite sound and bright, but which possessed a very bitter and unpleasant sharp taste. The sediment consisted of Sacch. cerevisiæ and a wild form which the author conclusively proved to be identical with Hansen's Sacch. Pastorianus I., mentioned above, and the cause of the bitter taste, since when cultivated in a state of purity and used for the fermentation of fresh wort, it produced exactly the same taste as the original beer.—G. H. M.

Analysis of Lichtenhainer Beer. J. Herz. Rep. Analyt. Chem. 1886, 301.

Analysis of this beer gave the following results: Sp. gr. 1·0071; alcohol (weight per cent.) 3·02, extract 3·22, original extract 9·16, fermentation degree 64·85, ash 0·121, acid (as lactic acid) 0·2376, acetic acid 0·0101, sugar (maltose) 0·66, dextrin 1·42. A deposit of calcium oxalate was observed; also oxalic acid in solution. Yeast and fungi were also detected.—D. A. L.

Detection of Micro-organisms in Water for Brewing purposes. E. C. Hansen. Bied. Centr. **17**, 203—205.

Koch's method is a hygienic one, and determines merely the micro-organisms existing in the water, but cannot give any idea as to whether these exercise an injurious effect on beer. Hansen conducted a series of preliminary experiments in which he showed that a certain water contained (analysed by Koch's method) a large number of organisms. The same water examined by what he terms the zymotechnical method gave an exceedingly small number. By this method 5 cc. water with respectively 5 cc. beer or 5 cc. wort were sterilised. To 15 flasks containing beer and 15 containing wort a drop (0·01 cc.) of these solutions was added. All the appliances used were sterilised. Drops of the above mixtures were placed also on gelatine plates, kept moist and at a temperature of 24°—25° C. The hygienic method always gave too high a result, and the wort and gelatine is likewise not good. Guided by the results of these experiments Hansen proposes as a better method to add a drop (0·04 cc.) of the water to beer and to wort, and also $\frac{1}{4}$ cc. to other samples of beer and wort. These all remain at a temperature of 24°—25° C. for a fortnight, and are then examined.—B.

PATENT.

An Improvement in the preparation of Gelatinised Grain. James Death and A. S. Tomkins, London. Eng. Pat. 12,188, September 8, 1887. 4*d*.

In preparing gelatinised grain for the use of brewers, distillers, or vinegar makers, it has been the usual custom to pass steam into cold moist grain, but in this case owing to the condensation of the steam a porridge or agglutination is often formed, so that the grain after being more or less gelatinised is difficult to dry, and portions of it are lost. By the improved method the moistened grain is heated by hot air or other means before the steam is introduced.

—A. J. K.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

Value of sour Beet-leaves. H. Braune. Deutsch. landw. Presse **14**, 556.

The author has examined the feeding value of sour beet-leaves. The experiments were made on sheep, and were compared with similar experiments made with some beet-slices. The results for sheep were not favourable, but the author recommends the use of sour beet-leaves as fodder for working-oxen in winter, and as a substitute for scanty pasturage.—G. H. M.

The Preparation of Peptone by Chemical Reactions. A. Clermont. Compt. Rend. **105**, 1022.

It is known that traces of peptone result from the action of acidified water at 100° on chopped meat. The author, however, was able to bring about the complete conversion of meat into peptone by heating a mixture of 20 grams of chopped fillet, 30 grams of water, and 0·5 gram of pure sulphuric acid in sealed tubes for six hours at 180°. The filtered products of the action evolved ammonia on evaporation to dryness on a water-bath. When the evolution ceased, the dry mass was dissolved in water and filtered. The solution thus obtained is not precipitated by acids; when it is diluted with four times its volume of 90 per cent. alcohol it gives a copious precipitate; tannin, mercury chloride, and platinum chloride also give precipitates. The author obtained four grams of peptone from 20 grams of fresh meat.

When this experiment was repeated with the sulphuric acid omitted, a slightly turbid liquid, difficult to filter, resulted, which gave a copious precipitate with nitric acid. In this case only syntonin was formed and no peptone. The syntonin was quickly converted into peptone when digested in slightly acidified water with pepsine at 35°.

The author considers that these facts have a practical importance, and that syntonin will serve as a valuable foodstuff in the numerous cases where the digestive functions are impaired.—G. H. M.

PATENTS.

Improvements relating to the Manufacture of Margarine, Oleomargarine, and similar Substances. H. N. Hillman, and G. B. Kleinpass, London. Eng. Pat. 3592, March 9, 1887. 6*d.*

This invention relates to the manufacture of a cheap and good substitute for butter from the marrow and other fatty or oleaginous matters contained in the bones of oxen and other animals. Only fresh bones are used. The marrow is forced out of the "pipe bones," heated to from 105° to 115° Fahr., strained through muslin into a settling pan and refined or clarified. The bones themselves are crushed and heated with water to 150° Fahr. so that the fat rises to the surface; it is then strained and refined.—E. G. C.

A New and Improved Method for the Preservation of Fresh Fruit for Storing or Transport, and the Process of Preparing Packing Material for such Purpose. J. Storer, London. Eng. Pat. 214, January 5, 1888. 4*d.*

Sawdust, chaff, grain husks, shavings, &c., are saturated with a solution of boracic acid, an alkaline borate, or a bi-borate in water. If the former be used, one pound of acid to the gallon of water is found to work well, and one gallon of such solution may be added to 112 pounds of sawdust, &c. The mixture is heated to 212° F. in a closed vessel, and afterwards dried. The product is used in which to pack the fresh fruit in closed cases, and operates effectually as a preservative.—C. C. H.

An Improved Method of Preserving Animal and Vegetable Substances for the Food of Man. R. Jones, Berkeley. Eng. Pat. 6003, April 25, 1887. 6*d.*

The substance is first cooked, either by boiling or baking, &c.; it is afterwards placed in suitable vessels and submitted in a chamber to a temperature of about 212° F. for from 10 to 20 minutes. The chamber may be heated either by a stove or a hot-water arrangement, and the outlets of the vessels are provided with a plug of cotton-wool, so that after sterilisation fresh air admitted cannot carry with it any *new* germs. The vessels may be subsequently sealed, or this may be done in the heating chamber. The temperature of the preliminary cooking depends upon the nature of the substance.—C. C. H.

(*B*)—SANITARY CHEMISTRY.

Bacteriopurpurin and its Physiological Significance. Th. W. Engelmann. Arch. f. Physiol. **42**, 183.

The author finds in sea- and fresh-water, numerous red, living schizomycetes, which belong to the sulphur bacteria. They are all coloured by a red substance diffused through the protoplasm, and act towards light like the photometric bacteria. The influence of light on these forms is very different. The purple bacteria gives off oxygen in the light. They grow and increase only in presence of light. The bacteriopurpurin is, according to the author's view, a true chromophyll, which only differs from other chromophylls by the absence of the green constituent.—J. B. C.

Geochemical Studies. J. Stoklasa. Chem. Zeit. **12**, 339—340.

The following waters have been analysed with the object of finding the effects on the composition of the water of the character of the rock through which it flows. The spring water of Littlebach flows through coarse sandstone, consisting of rough quartz grains, cemented with carbonate and silicate of lime, and silicate of alumina. 26·5 per cent. of the rock is soluble in HCl, and 69 per cent. is quartz and silicate of iron and alumina. 100 grm. of the powdered sandstone was left in contact with 1,000 cc. distilled water, saturated with CO_2 for 50 days. The water was then analysed with the following results:—The hardness agreed with the analysis of the sandstone. The difference between potash and soda was inconsiderable, although the sandstone contained more soda. More chlorine was found than sulphuric acid, although the difference in quantity in the sandstone was small. This can be explained by supposing that in presence of carbonic acid, chiefly insoluble sulphates are formed. Spring water flowing through the sandstone was analysed each month with the result that an interesting agreement between the chlorine, nitric acid, and hardness, on the one hand, and ammonia and organic compounds on the other, was noticeable. The solid residue increases in the summer months. In the summer months the nitric acid increases in amount, whereas ammonia diminishes proportionately. This is probably due to the action of the sun's rays in producing more energetic oxidation.—J. B. C.

PATENT.

Treating or Purifying Sewage, Waste Liquors from Manufactories, and other Foul Liquids, and Producing Valuable Substances therefrom. G. E. Davis, Manchester, and J. B. Aitken, Widnes. Eng. Pat. 5661, April 19, 1887. 6*d.*

A solution of tribasic phosphate of soda is added to the sewage, and if insufficient lime salts are present to combine with the phosphoric acid, a further equivalent of lime is added also. The quantity of the phosphate requisite to effect purification may vary between 10 and 100 lbs. per million gallons of sewage treated. The resulting sludge may, after drying, or partially so, by any known method, be converted into a high class manure by the addition of sulphuric acid, and previous to this, if thought requisite, the whole or a portion of the carbonate of lime may be removed by the addition of HCl.—C. C. H.

(*C*)—DISINFECTANTS, &c.

Lime as a Disinfectant. Liborius. Centr. f. d. medizin. Wissenschaften, **51**, 968.

Lime water containing 0·0074 per cent. of lime is sufficient to kill the typhus bacillus completely, whilst a strength of 0·0246 per cent. of lime destroys the cholera bacillus within a few hours. The author recommends powdered lime or strong milk of lime for purposes of disinfection.—D. A. L.

XIX.—PAPER, PASTEBOARD, Etc.

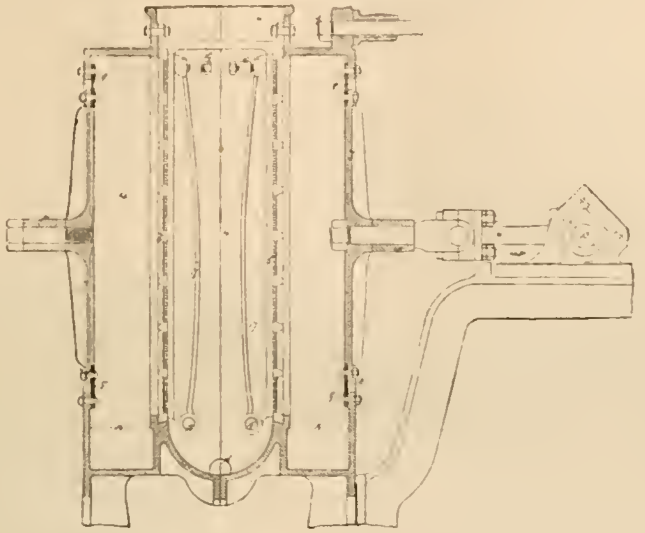
Paper Testing. C. Wurster. Papier Zeitung, **13**, 411.

It has often been stated that the cause of paper becoming brittle or tender is to be found in the presence of alum or sulphate of alumina in the paper. The author's observations, extending over 10 years, tend to the conclusion that neutral or basic sulphate of alumina exercises no decomposing influence at ordinary temperatures on paper, whether size be present or not, but that sulphate of alumina has a strongly caustic action if chlorides, such as those of sodium and calcium, be present, especially at higher temperatures. In this case an injurious action on the paper arises from the formation of aluminium chloride or free hydrochloric acid, which act by abstracting hydrogen, or the elements of water, from the cellular substance. The manufacturer should therefore endeavour to remove, as far as possible, by washing from the fabric any sodium or calcium chloride resulting from the bleaching powder. It is accordingly not advisable to kill the bleach by antichlor without subsequent washing. From these considerations, the testing of paper should include a qualitative or quantitative examination of the chlorides present, which have hitherto been regarded as quite harmless.—G. H. B.

Improved means for Straining Pulp. T. Goodall and T. Webster, Sunderland. Eng. Pat. 5528, April 15, 1887. 11*d.*

The apparatus is shown in section in Figure. The strainer plates 5 are hinged at 18, and are kept in position by the bolts 19. They form two sides of a vat, into which the pulp to be strained is conducted.

The discs 7 are connected with the outer sides of the vat by means of the india-rubber diaphragms 8. These discs are furnished with rods 10, which by means of a connecting rod 14 and crank 13 are made to vibrate rapidly. This rapid motion assists the passage of the pulp through the slits of the strainer plates 5. The strained pulp is discharged by suitable openings at 15, while the knots and impurities retained by the plates are removed by an opening at 16.—E. J. B.



The Treatment of Fibres for Pulp and the Manufacture of Paper therefrom. A. Wilkinson, Chiswick. Eng. Pat. 3937, March 15, 1887. 6*d.*

The inventor takes any suitable vegetable fibre and treats it in a tank with a hot solution made by adding to 250 gallons of water, 5 lbs. of chloride of lime and 3 lbs. sulphuric acid. After this treatment the fibre is boiled with caustic soda under pressure.

Fibres may be bleached in a bath prepared as follows :—

Seven pounds of sulphite or "sulphate of barium" are dissolved in seven pounds of either sulphuric or hydrochloric acid. To this is added four pounds of bisulphide of lime or magnesia, together with one pound of sodium hypochlorite and 500 gallons of water.

For loading the pulp the inventor uses a mixture of rice starch, animal size, china clay, and pyrites.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Erythrophleine Hydrochloride. E. Merck. Chem. Zeit. **12**, 173.

Erythrophleine is the alkaloid obtained from the bark of *Erythrophleum guinense.* The tree belongs to the family of Leguminosæ-cæsalpinieæ, and is found on the West Coast of Africa. The alkaloid was brought into commerce as soluble hydrochloride by the author, in 1881. Lewin has recently found that it possesses local anaesthetic properties resembling cocaïne; its activity does not, however, take place immediately as in the case of cocaïne, but requires an interval of 15—20 minutes. It is, on the other hand, retained for a longer period (as long as two days).—D. B.

Removing the Bitterness of Cascara sagrada. F. Grazer, Pharm. Rundsch. **6**, 9.

Cascara sagrada, the bark of *Rhamnus purshiana,* is employed as a laxative; its use in medicine is, however, limited, owing to its bitter taste. An extract of this bark has been introduced into commerce from which the bitterness has been removed by the following treatment :—500 grams of bark are intimately mixed with 30 grams of calcined magnesia and 300 grams of water. After digesting the mixture for 12 hours 300 cc. of alcohol are added, the maceration being continued for a further period of 24 hours.—D. B.

Lucuma. T. Peckolt. Pharm. Rundsch. **6**, 5.

Lucuma, a genus of the family of *Sapotaceæ,* is found within the tropics and is capable of many applications. The following species are described :—

Lucuma litoralis, a small tree with alternate leaves and small yellowish-green flowers. The fruit has a yellowish-red colour, a sweet but unpleasant taste, and is taken as a remedy for chronic diarrhœa.

Lucuma mammosa, a native of the West Indies, is cultivated in Brazil. It forms a large tree bearing fruits resembling a large apple, which have a sweet aromatic taste, and contain black seeds similar to bitter almonds in taste. They are used in medicine for kidney disease. The seeds contain about 25 per cent. of a fatty oil. The bark is used as a remedy for intermittent fever.

Lucuma obovata yields a large fruit resembling a pear, which is sweet and used for food. The seeds are employed as emulsion for inflammation of the bladder.

Lucuma procera is a large tree bearing an egg-shaped fruit of the size of a plum, which is sweet and pleasant to the taste. The tree yields about 3 kilos. of a milky juice containing about 18 per cent. of a gutta-percha-like substance and 8 per cent. of *massarandubin* (a crystalline resin). The author is of opinion that the gutta percha obtained from the juice by evaporation should prove a saleable article, providing its recovery is effected in a judicious manner.—D. B.

Two new Alkaloids from the Bark of Xanthoxylon senegalense. Giacosa and Monari. Gazz. Chim. **17**, 362.

The powdered bark of *Xanthoxylon senegalense* when extracted with petroleum ether, yields a heavy fatty oil possessing an acid reaction and a burning taste resembling that of the bark itself. Tabular prismatic crystals separate after a time, which when pure, are quite white; they are free from nitrogen, melt at 120 to 125°, and appear to be a pseudo-cholesterin. After exhausting with petroleum ether an alcoholic extraction is dark wine-red coloured and of bitter taste and acid reaction. This latter contains two very similar alkaloids distinguished by the author as A and B, which may be separated by means of boiling water in which B dissolves, forming a blood-red solution from which red needles and tables crystallise on cooling; A is amorphous. The salts of both are yellow, crystalline, and have a bitter taste. A produces muscular contraction and slows the action of the heart; it occurs to the extent of 0·1 per cent. in the bark, B of 0·03 per cent.—C. A. K.

Ophioxylin. W. Bettink. Nieuw. Tijdsch. Pharm. Nederland. 1888, 1.

Ophioxylin is the name given by the author to a crystalline substance which occurs together with a volatile pungent oil and a tannin matter in the root of *Ophioxylon serpentinium*, one of the Indian *Apocyneæ*. It forms orange-yellow tetragonal crystals, which have a sharp burning taste, and which are difficultly soluble in water, more easily in alcohol, and very readily soluble in chloroform, benzene, and carbon bisulphide. The empirical formula is $C_{16}H_{13}O_6$; in its properties and reactions ophioxylin resembles juglone, but differs from the latter in its melting point, 71°·8, juglone melting at 151°—154°.—C. A. K.

Schinus molle. H. Helbing. Pharm. Ztg. **32**, 721.

The fruit of *Schinus molle* is a stone-fruit, covered with a thin straw-like brittle layer of a beautiful rose colour, in which the brown seed lies. The fruit is rich in resinous bodies, which are in combination with ethereal oils, has a strong flavour of pepper and fennel, and resembles the latter in smell. Distillation produced 3·35 per cent. of a colourless ethereal oil of odour and taste like fennel; it is soluble in alcohol and ether, and has a specific gravity of 0·830 at 10°. Extraction of the fruit with ether gives a residue of 14·62 per cent. of resin. The resin has a transparent light-brown colour, recalling Venice turpentine in consistence and properties, it is soluble in ether and alcohol, and possesses a harsh and penetrating taste, and a refreshing smell resembling juniper.—G. H. B.

New Drugs. Chem. Zeit. **12**, 250.

Jurumbeba (*conclusion*, this Journal, 1888, 229). The piece of the root here described is 2 c.m. thick, greenish brown on the outside, and somewhat wrinkled. The section of the wood shows fine radial markings of brown colour. The rind (Fig. 1) of the root consists of a thin layer of cork consisting of rather large cells, which covers a layer of large cells arranged tangentially, in which a few cells are of horny appearance. The bast (Fig. 2) as well as the rind of the stalk are much firmer; the pith consists of 1—2 rows of cells arranged somewhat radially; the bast fibres, which consist of larger groups, are porous and thickened to a narrow bore; sandy crystals of calcium oxalate occur in individual cells in the pith as well as in the rind of the root. The wood (Fig. 3) of the root and stalk consists of somewhat condensed wood-cells and very wide cavities formed of 1—2 rows of radial cells, with the walls somewhat condensed and pitted. There occurs here also, but only in the wood of the root, a few wood and pith cells filled with sandy crystals. The root, of which there was only a small specimen, is tough, knotty, and much branched.

Fig. 1.

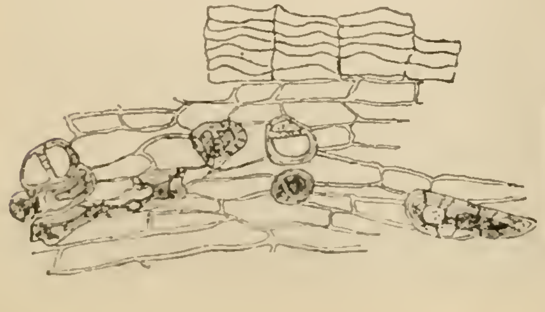


Fig. 2.

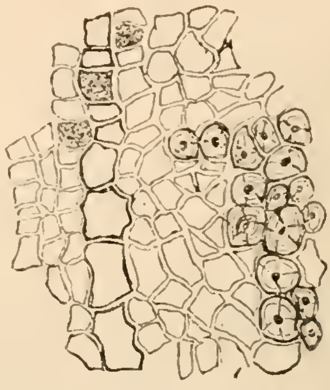
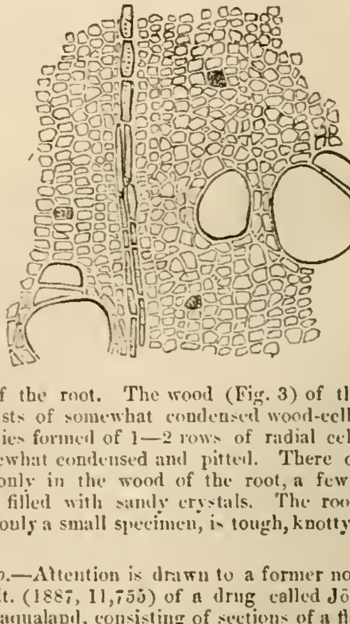


Fig. 3.



Okahero.—Attention is drawn to a former notice in the Chem. Zeit. (1887, 11,755) of a drug called Jōā, obtained from Namaqualand, consisting of sections of a fleshy plant-stalk, and also of another drug called Okahero, obtained from the Kalahari desert in South Africa; they prove to be identical.—G. H. B.

Lanolin. Chem. Zeit. Rep. **12**, 31.

As the result of numerous observations this substance provides an excellent remedy for cuts and burns. In the case of cuts especially, after a careful anointing with lanolin, scab is never formed, the substance acting, according to Bernh. Fränkel, as a preventive. It is noticeable that cuts when protected by an application of lanolin can be cooled in a rapid stream of water, without danger of removing the lanolin. Bleeding is arrested almost instantaneously.

Lanolin attracts considerable notice in agricultural circles on account of its property of preserving the elasticity of the hoof and the suppleness of leather. Lanolin owes its great superiority in this respect over other fatty substances to its great capacity for uniting with water, in consequence of which it penetrates better than other fats into moist leather and into the deeper layers of the skin and of the hoof.—G. H. B.

Coca Bases. O. Hesse. Pharm. Zeit. **32**, 668.

In a former paper (this Journal, 1887, 675) the author describes a base prepared from coca leaves. He has now purified it and given it the name *Cocaïdine*, $C_{17}H_{21}NO_4$. It forms colourless brittle plates, melting at 51°; is isomeric with cocaïne and cocamine, and when boiled with alcoholic barium hydrate solution yields, among other products of decomposition, benzoic acid.

Since cocaïne, cocamine, and cocaïdine are not volatilised by boiling with water, the author adopted this method for the preparation of hygrine, the properties of which were described in the former paper. Hygrine has the formula $C_{12}H_{13}N$, and appears to be a homologue of quinoline, C_9H_7N. It gives crystallisable salts with hydrochloric and oxalic acids.—G. H. M.

Fatty Oil of Millet and its Crystalline Constituent. G. Kassner. Archiv. d. Pharm. **14**, 395—402.

The author has found in two experiments 18·64 and 18·8 per cent. of oil in the refuse known as "Poliermehl," produced in dressing millet, whilst the "Staubkammermehl" yielded 25 per cent. of oil. The oil extracted by ether is pale yellow with a faint pleasant odour, and is at first mild to the palate but after a few minutes causes violent irritation in the throat. It dissolves in all proportions in 96 per cent. alcohol, and on the addition of water the solution separates into two layers; the upper one is strongly acid whilst the lower stratum is not so strongly acid and has not an intolerable taste. The acid oil is a drying oil, and consists of an acid resembling linoleic acid and a white substance with a low melting point. The original oil from the ethereal extract deposits white crystals, which are easily purified by washing with ether. They have the composition represented by the formula $C_{13}H_{20}O$, melt at 285°, can be sublimed, are insoluble in water and alcohol, but dissolve readily in chloroform, carbon bisulphide, and benzene. This substance is called "panicol"; it is not an alcohol, and is to be further investigated.—D. A. L.

The Action of Sulphur on the Salts of Aromatic Hydroxy compounds. By M. Lange. Ber. **21**, 260—264.

Thio-substitution products of aromatic hydroxy compounds can be prepared by warming an aqueous solution of the sodium salt with sulphur. Most of these compounds are completely insoluble in water and tolerably indifferent substances; they can therefore be introduced into an animal organism in large quantities without having any primary toxicological action. As, however, under the influence of many chemical agents, they are readily re-converted into the phenol, it seems probable that by their gradual decomposition in the organism such compounds would prove very effective in causing the death of pathological germs without giving rise to any secondary poisonous action.

Dihydroxydinaphthyldisulphide, $(C_{10}H_6OH)_2S_2$, is formed by boiling two molecules of β-naphthol, dissolved in an aqueous solution of 3—4 molecules of caustic soda, with an excess of sulphur. On concentrating the solution the compound is obtained as a white crystalline substance, which is purified by washing with water. It is readily soluble in glacial acetic acid, benzene, and amyl alcohol, and crystallises in white opaque needles, which melt at 210°; it is insoluble in water, dissolves only sparingly in alcohol, but readily in alkalis and alkaline sulphides.

A yellow crystalline compound, melting at 168°—170°, is also obtained in the preparation of dihydroxydinaphthyldisulphide by the above method. This substance is much more soluble in all solvents, and remains in the mother liquor, from which it can be precipitated with hydrochloric acid and purified by recrystallising from alcohol. It is probably either an isomer or a reduction product of the preceding compound. Both substances yield β-naphthol on distillation or when heated with alkalis; with acids sulphurous acid is evolved.

Thioresorcinol, $C_6H_4O_2S_2$, is produced when two molecules of resorcinol and six molecules of caustic soda are dissolved in water and heated with six molecules of sulphur. The solution is acidified with hydrochloric acid, and the yellowish, flocculent precipitate purified by re-dissolving in dilute soda and precipitating with acid, the operation being repeated several times. It is a yellow powder, which dissolves readily in alkalis, alkaline carbonates, and sulphides, but very sparingly in all other ordinary solvents; on heating it chars before melting.—F. S. K.

PATENT.

A Process and Apparatus for the production of Hydrogen Gas by a Dry Method, chiefly for Military Purposes. W. Majert and G. Richter, Grünau, Prussia. Eng. Pat. 4881, April 1, 1887. 8*d*.

The inventors mix zinc dust with various hydrated substances, such as calcium hydrate, magnesium hydrate, doubly-hydrated calcium chloride, &c., &c. Care is taken to expel all mechanically held moisture before adding the zinc dust, and the mixture is packed in tightly soldered sheet-iron cases. When hydrogen is required these cases or cartridges are heated in a retort, and, the solder melting, the liberated gas goes forward to be suitably dealt with. A portable retort and heating arrangement is illustrated in the drawings accompanying the specification.—A. R. D.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Prevention of the Formation of Bubbles when using Hydroxylamine Hydrochloride as a Developer. B. Krüger. Phot. Corresp. **28**, 40.

To prevent the formation of bubbles when using the hydroxylamine developer (0·3 grms. hydroxylamine hydrochloride, 0·4 grms. caustic soda, and 60 grms. water) the plates are prepared with hard gelatine which has been treated with chrome alum, and sodium sulphate is added to the developer. A gelatine film thus prepared sticks fast to bromide paper, and if the hydroxylamine developer be used the picture comes out sharp and of a good colour and is free from bubbles and spots. The same developer can be used two or three times successively, and the unused solution keeps any length of time.—C. A. K.

Stable Form of Developer. Photo. Rundschau **2**, 364.

Dissolve 25 grms. of potassium carbonate, 25 grms. of sodium carbonate, and 160 grms. of sodium sulphite in 400 cc. of distilled water, and then add 18 grms. of pyrogallol. The solution requires filtering; it turns slightly brown, but if placed in well stoppered bottles in a dark cool place it keeps well. For use 40 cc. of water are added to 70 cc. of the solution.—C. A. K.

The Vergara Film. Phot. Mittheil **24**, 282.

This consists of a thin gelatin film, the object of which is to obviate the difficulties met with in the use of bromide paper for negatives. Pure gelatin is soaked in a solution of potassium bichromate, then poured on to glass plates and dried in the daylight; the film is thus rendered insoluble. It is washed with acidified water in order to remove the excess of bichromate, again dried and then treated with the gelatin emulsion. After the whole has become hard and dry it may be detached from the glass plate and is ready for use.—C. A. K.

Preparation of Lantern Transparencies. Laterna Magica. **10**, 16.

The collodion process is recommended. The glass plate is first covered with a thin layer of albumen (solution used contains one part of albumen to 150 parts of distilled water), the film allowed to dry, treated with an old solution of collodion which has turned red from separation of iodine, and then silvered as usual. The developer employed contains 20 grms. of ferrous ammonium sulphate in 400 cc. of water, together with 150 cc. of alcohol, and 150 cc. of a solution of gelatin in glacial acetic acid.—C. A. K.

Chloride of Iron in Oxalate Developer. Photogr. Archiv. **28**, 358.

A better developer is obtained, if, instead of ferrous sulphate, ferrous chloride be used, which is produced by dissolving iron filings in hydrochloric acid; an excess of acid must be avoided. The potassium ferrous oxalate thus produced is a more powerful developer than the ordinary one.—G. H. B.

Hydroquinone Developer. Phot. Archiv. **28**, 321.

Whilst hydroxylamine is an unsatisfactory developer on account of a tendency to form blisters in the gelatine film, hydroquinone (as a substitute for pyrogallol) is recommended especially for dia positives and negatives after retouching, on account of the fine velvety black colour of the precipitate and the clearness of the negative shadow. The prescription is: (1) sodium bicarbonate, 5 grms.; water, 40 cc. (2) hydroquinone, 1 grm.; sodium sulphite, 5 grms.; water, 40 cc. For use, 40 cc. of (1) are added to 80 cc. of (2), together with 40 cc. of water. The latter is made warm in winter and cooled with ice in summer. Addition of alum and other restraining substances (bromides) is not required.—G. H. B.

New Hydroquinone Developer. Phot. Archiv. **28**, 366.

The best prescription is said to be the following: 3 grms. potassium chloride, 45 grms. potassium sulphite (neutral), 6 grms. potassium bitartrate, 140 grms. potassium carbonate are dissolved in 480 cc. distilled water, and 12 grms. hydroquinone are added to the filtered solution. For use, 1 part of this solution is diluted with 16 parts distilled water; for dia-positives only 8 parts of water are added.—G. H. B.

Hydroxylamine Hydrochloride Developer. Deutsche Phot. Ztg. **11**, 334.

As a result of trials by practised photographers, the prescribed addition of sodium hydrate as well as carbonate is abandoned, as the former gives rise to much "pitting," which spoils the whole picture or loosens the film from the glass, and with the carbonate no picture at all is developed. A means of obtaining the necessary alkalinity without incurring the above defects still, therefore, remains to be desired.—G. H. B.

Chrome Alum Bath with Citric Acid. Phot. Rundschau **1**, 239.

This has been of great service on journeys for bringing home the negative unfixed. The following is the prescription: 16 grms. chrome alum and 4 grms. citric acid are dissolved in 1 litre of water, and in this bath is placed the developed and lightly-rinsed plate, by which further development is at once arrested. After two minutes the plate is washed, finally with a little sugar water, then dried and packed. On arriving home the plates must be well washed before fixing, otherwise the citric acid will decompose the sodium hyposulphite. This chrome alum bath is also an excellent means of clearing such plates as have become yellow during development with alkaline pyrogallol solution.—G. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

Improvements in the Manufacture of Explosives. Dingl. Polyt. J. **267**, 419—428.

P. Hess, Vienna, has invented a fulminating-mercury fuse, which must sooner or later replace the electric fuse. If the fulminating-mercury fuse be lighted, it burns quietly away, but if it be detonated by a percussion-cap it explodes violently. Cold and moisture have no influence on the fuse; a fuse kept under water for 120 hours is unaltered, and detonates readily. If a fuse without a percussion-cap be introduced into a dynamite cartridge, the latter can be made to explode without diminution of explosive power. Since fulminating-mercury does not fire an atmosphere containing 10 per cent. of fire-damp, the pretty general application of the fuse in coal mines may be predicted. Pietrowicz and Siegert have taken out a patent for a new explosive, which they name "*silesite*." It consists of 60 parts of chlorate of potash, 10 parts of antimony pentasulphide, and 30 parts of sugar. The two latter ingredients are first mixed in a mortar and the chlorate of potash is gradually added along with three parts of water. The mass is spread on a board and there mixed with a wooden spatula. D. Johnson advocates the manufacture of gunpowder from nitro-cellulose. For the preparation of sporting powder, 68 parts of dinitro-cellulose, 25 parts of barium nitrate, 6 parts of potassium nitrate, and 1 part of ultramarine are intimately mixed with the addition of some water. The mass is grained in a drum and dried. 100 parts are then moistened with a solution of 10 parts of camphor in 50 parts of benzene and allowed to stand for 15 minutes. The benzene and camphor are then driven off by careful heating. For the manufacture of gunpowder for military purposes 35 parts of dinitrocellulose, 60 parts of barium nitrate, and 5 parts of charcoal or soot are mixed and treated in the same manner with a camphor solution. The latter is known to harden nitrocellulose. Berthelot has found that picric acid explodes even in small quantities, if surrounded by a highly heated atmosphere. It is well known, that many explosives possess this property, and from this point of view picric acid must be regarded as an explosive. H. von Vessel examined the percussive power of two brands of dynamite, occurring in commerce, viz., gelatin-dynamite No. 1 and rhexite No. 1, and found that they show nearly the same effect as the kieselguhr-dynamite adopted by the Austrian army for military purposes. Experiments with a new explosive, named *Tsilotwor*, recently undertaken in Russia, have turned out a failure. It is thought that the explosive is nothing more than trinitrocellulose.—S. H.

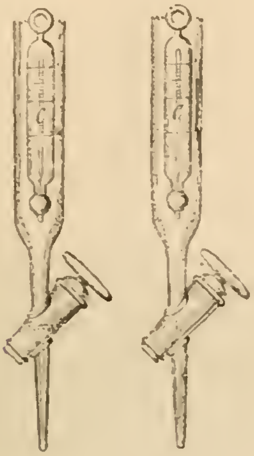
Recent Experiments with Explosives for Blasting.
(Glückauf, 1887, No. 93.)

Experiments at Neunkirchen showed that *roburite*, when exploded in confined spaces, gives no flame. In presence of 10 per cent. of fire-damp and of coal dust no explosion was caused, and the results were generally satisfactory. In other districts, however, the use of roburite is not considered satisfactory, and its hygroscopic properties are said to detract from its value. *Carbonite* is not so dangerous as roburite; the latter cannot, however, come into general use until its cost is considerably reduced.—B.

XXIII.—ANALYTICAL CHEMISTRY.

New Stop-cock for Burettes. C. Meissner. Chem. Rep. 12, 65.

The arrangement of this new kind of stop-cock is shown in the annexed figure, and needs no description. The object attained is a perfectly secure tap.—J. B. C.



New Method of Estimating Soluble Phosphoric Acid in Superphosphate. A. Emmerling. Landw. Versuchsstat., 1886, 428—439.

The superphosphate solution is mixed with excess of calcium chloride and titrated by running in caustic soda. This operation must not be reversed, since by running the superphosphate solution into the soda mixed di- and tricalcium phosphates are produced, with consequent incorrect results. When phenolphthalein is used as an indicator, both the monocalcium phosphate and free acid are estimated, but with methyl-orange only the latter is indicated; the colour changes are not always very distinct in these titrations. The results agree fairly well with those obtained by the uranium method.—D. A. L.

A New Method for the Quantitative Estimation of Thallium. G. Neumann. Ber. 21, 356—359.

The following method will probably be found applicable in other analyses besides that of thallium. Thallium, it is well known, can be precipitated, by electrolysis, from a solution containing ammonium oxalate. The metal thus precipitated cannot, however, be weighed directly, on account of its great tendency to combine with the oxygen of the air. The author places the solution of the thallium salt in a flask capable of holding about 100 cc., and having two platinum electrodes fused into it. After about 5 grs. of ammonium oxalate have been added to the solution, the whole is gently warmed, and a current of 0·1 volt passed through 0·6—0·8 grs. of thallium (adhering firmly to the cathode) separate out in seven hours. To wash the flask and the thallium without allowing the latter to come in contact with air, the arrangement shown in Fig. 2 is resorted to, by which means water is run in at the top of the flask as quickly as the contents of the latter are syphoned out at the bottom. One advantage of this arrangement is that the current can be kept going during the washing process. One litre of water is sufficient for washing purposes. The water is then boiled for a short time to drive out gases adhering to the electrodes, and the flask is then connected with a "hydrometer," Fig. 1 (*see also* Zeit. f. Anal. Chem., 1887, 531), acid is run in and the hydrogen evolved, on the thallium dissolving it is collected in the "hydrometer" and read off and calculated as thallium. With care, accurate results (within 0·2 per cent.) are obtained.—F. W. T. K.

Fig. 1.

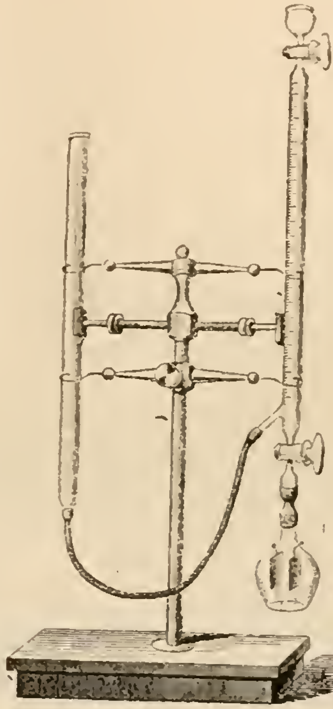
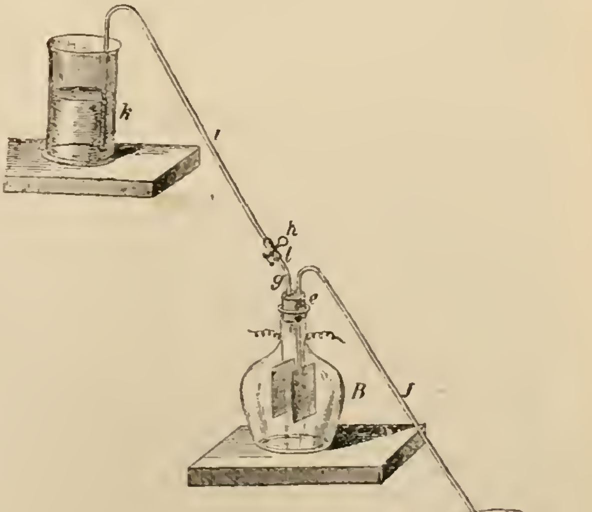


Fig. 2.



Separation of Tin Oxide from Tungsten Trioxide. E. Donath and T. Müller. Mon. f. Chem. **8**, 647–649.

The tin and tungsten alloy is treated with nitric acid, and the mixture of stannic oxide and tungsten trioxide is ignited and weighed, and then rubbed up in an agate mortar with double its volume of zinc dust, zinc powder, or zinc filings. The mixture is transferred to a small covered porcelain crucible, and the whole is then heated to bright redness for a quarter of an hour. This treatment reduces the tin oxide to a spongy mass of tin, but the tungsten trioxide is only reduced to a lower oxide. When cool, treat with dilute hydrochloric acid, and boil till all the tin is dissolved. The liquid is allowed to cool a little. Potassium chlorate is then added till all the blue oxide of tungsten has been converted into yellow tungsten trioxide and the liquid does not show the slightest blue tint. Water is now added, and the volume of the liquid increased by 1½ vols. The mixture is then allowed to stand 24 hours (better still, two days, so as to ensure complete precipitation of tungsten trioxide), filtered, and the tungsten trioxide washed, first with water acidified with nitric acid, and then with a hot dilute solution of ammonium nitrate. With water alone the filtrate is turbid. The tungsten trioxide is ignited and weighed. The tin can be determined by difference, or it can be precipitated as sulphide, oxidised, and weighed as oxide.—F. W. T. K.

On Iodometry. J. Klaudi. Listy Chem. **12**, 91.

In determining sulphurous acid in many refuse waters, Raymann found that the iodine volumetric method gave considerably higher results than the estimation by weight, and he attributed the discrepancy to the action of organic substances present. The author has investigated this matter by operating on sulphurous acid solutions containing known substances. He finds that fatty acids and sugar exercise no influence on the iodometric estimations, but benzoic and salicylic aldehydes, phenol, pyrocatechin, hydroquinone, resorcine, gallic acid, and tannin use up a large quantity of iodine solution. The reaction involved is certainly one of oxidation, giving rise in some cases to colour changes. As many refuse waters, *e.g.*, from cellulose factories, are likely to contain various phenols and aromatic hydroxy acids and aldehydes, the estimation of sulphurous acid by iodometry cannot be relied on, and the estimation by weight (oxidation with bromine and precipitation as barium sulphate) should be adopted.—G. H. B.

On the Volumetric Determination of Antimonic Acid. G. v. Knorre. Zeit. f. ang. Chem. 1888. 155—157.

The author has tried the methods hitherto proposed, and gives the results of his experience. Weil's process of titration with stannous chloride, with cupric chloride as indicator, is quick and serviceable if only approximate results are required. Herroun's method of treatment of the acid solution with excess of potassium iodide and titration of the liberated iodine with hyposulphite could not be made to give constant results. Weller's method of distillation with potassium iodide founded on Bunsen's process for chlorine estimation yields accurate results. The author also proposes a modification of Fleischer's process as follows:—The solution of antimonic acid is strongly acidified with hydrochloric acid in an Erlenmeyer flask and treated with successive small portions of strong sodium sulphite solution, and well boiled. After boiling off the sulphurous acid the solution is cooled, excess of sodium bicarbonate added, and the whole titrated with iodine solution. The author describes the last two methods as being equally satisfactory.—G. H. B.

New Method for the Volumetric Determination of Antimonious and Arsenious Acids. A. Jolles. Zeit. f. ang. Chem. 1888. 160.

The solution to be tested is placed in a burette and run into a solution of potassium manganate until the green colour disappears. The manganate solution should be freshly prepared, and its strength determined by titration with a standard solution of tartar emetic. The liquid must contain an excess of alkali at the conclusion. It remains clear with a yellowish-brown colour, due to a soluble but unstable compound of the alkali with manganic oxide, which latter separates as a precipitate only after some time. The end of the reaction is sharply defined, and the results obtained are accurate. The reactions involved are quantitatively expressed by

$$Sb_2O_3 + 2\,K_2MnO_4 = Sb_2O_5 + 2\,K_2MnO_3.$$

$$As_2O_3 + 2\,K_2MnO_4 + 2\,KHO = 2\,K_3AsO_4 + 2MnO_2 + H_2O.$$

—G. H. B.

Quantitative Analysis by Electrolysis. By A. Classen. Ber. **21**, 359.

The paper contains an account of further experiments on electrolytic methods of analysis.

A rheostat is described consisting of horizontal bands of nickel gauze, and provided with a series of binding screws by means of which a number of determinations can be made simultaneously. Experiments are quoted in which determinations of nickel and copper are made simultaneously. The intensity of the current is best measured by means of a voltameter, a particular form of which is described, consisting of two vertical graduated tubes, the lower ends being combined together by caoutchouc tubing so as to form a U.

By its means the level in both tubes can be adjusted, and then the volume of the gas is more readily determined. For supporting the vessel in which the electrolysis is conducted, a glass stand is preferable to the ordinary retort stands, which are readily attacked by laboratory fumes. The stand is provided with a glass ring and an arm, by means of which connections pass to positive and negative poles respectively.

The electrolytic determination of copper is less exact in presence of arsenic; the latter is best removed by evaporation with bromine, when it is volatilised as the tri-bromide. Lead and copper can be determined in the same solution, if the current is of such an intensity as to yield 3 cc. of electrolytic gas per minute; the former metal separates as the peroxide at the positive pole and the latter at the negative pole. Experiments are quoted to show the accuracy of this process.—V. H. V.

Quantitative Separation of Titanium from Iron. By A. Classen. Ber. **21**, 370.

Schönn observed that titanic acid, both in the solid form and in solution, is coloured red by hydrogen peroxide, a reaction which, as Richards found, can conversely be applied for the detection of hydrogen peroxide. In presence of an alkali a reddish-yellow precipitate is formed, which consists of a higher oxide of titanium, though the analyses, hitherto made, have been far more concordant. It is here shown that this substance consists of titanium trioxide TiO_3, associated with variable qualities of water, one sample of which, however, possessed approximately the composition $Ti(OH)_6$.

This reaction can be used not only for the qualitative detection, but also for the quantitative estimation of titanium in presence of iron. Thus for the former a solution of hydrogen peroxide and an excess of potash is added to a solution of a ferric salt containing titanium dioxide; the liquid is allowed to stand. The clear supernatant liquid is syphoned off, acidified with hydrochloric acid, evaporated, and the residue taken up, with hydrochloric acid and hydrogen peroxide added, which produced the characteristic yellow coloration.

For the quantitative determination the process is conducted in a similar manner. The iron is weighed as ferric oxide and the titanium as the dioxide. Test experiments are adduced to show that this method is applicable in the case of a mixture containing as little as one per cent. of titanium. When aluminium is present a part passes into the alkaline filtrate; the separation of titanium and aluminium is best effected by the method of Gooch.—V. H. V.

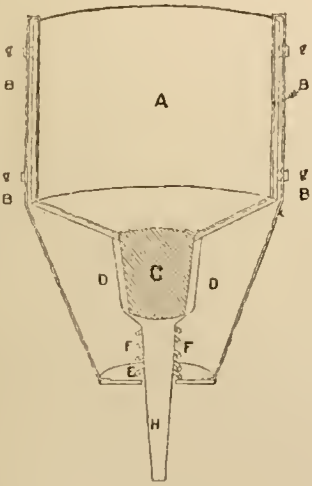
Estimation of Retrograde Phosphoric Acid. V. Dirks and F. Werens. Kiold. Landw. Veruchsst. **34**, 425.

The authors assert that it is not possible to effect a rigid separation of di- or tri-calcium phosphate in calcium phosphates by any of the methods hitherto proposed. The best results are obtained with Petermann's process, which consists in the use of a neutral solution of ammonium citrate sp. gr. 1·09 treated with 50 cc. of ammonia sp. gr. 0·91. This reagent dissolves the dicalcium phosphate and the precipitated iron and aluminium phosphate, *i.e.*, all reverted phosphoric acid. The authors have examined the different methods of estimating the phosphoric acid contained in the "citrate" solution, and found that the precipitation may be effected with molybdic solution without the previous removal of the citric acid. Direct precipitation with magnesia mixture gives unsatisfactory results.—D. B.

PATENT.

An Improved Measuring Funnel. H. O. Dahmo, Sydney, New South Wales. Eng. Pat. 6014, April 29, 1887. 8*d*.

A is the body of the funnel, with neck H enlarged at D to form a seat for the stopper C, which is rigidly connected with the plate E by means of the arms B B passing through guides *g g*. The spring F resting on plate E forces the plug C on its seat, and thus enables any quantity of liquid to be measured in A. When it is desired to empty the funnel it is only necessary to rest the plate E on the neck of the bottle or vessel and depress the body of the funnel; plug C is thus held off its seat, and the liquid in A escapes.—C. C. H.



Examination of Pyridine Bases. Weppen and Lüders. Chem. Zeit. **12**, 151.

One of the tests in the official examination of the pyridine bases employed by the German Government for the denaturation of alcohol, consists in treating an aqueous solution of the bases (1 in 250 of water) with a 5 per cent. solution of cadmium chloride, when a distinct turbidity should appear in a few moments. The authors had occasion to examine pyridine bases by this test and failed to obtain the reaction, whilst the manufacturer asserted that in his trials he invariably observed the turbidity. It was found by experiment that although pure cadmium chloride was employed by both operators, the authors' preparation contained less cadmium than the salt used by the maker, the difference in the percentage though small being sufficient to account for the non-appearance of the turbidity. In order to ensure success in every case the authors recommend the use of a more concentrated solution of the bases.
—D. B.

Detection of Adulterations in Orchil and Cudbear. F. Breinl. Mitth. d. Techn. Gewerbemuseums in Wien, 1887, 37.

Although certain artificial colouring matters produce even faster colours than preparations from orchil, the latter are still frequently used in wool dyeing for the production of brown and other dark colours, as well as for saddening red or green shades, chiefly, perhaps, because they dye wool evenly, not only in an acid, but also in a neutral bath. The price of such preparations being, however, relatively higher than that of most of the coal-tar colours of similar shades, they are often adulterated not only with coal tar colours, but also with extracts of logwood, redwoods, &c. Several methods for the detection of such adulteration have, at various times, been proposed. But, as most of them lead to inaccurate, or at least doubtful, results, and since of the adulterations with coal tar colours only the derivatives of rosaniline have been taken into consideration, it became desirable to enlarge the sparse literature on the subject with a description of new researches, especially because, within the last ten years, there has been discovered a whole series of azo dyes, from crimson to claret red, some of them furnishing shades so similar to that of orceïn that they are brought into the trade at once under the names of orchil-extract, orchil-red, orsellin, &c. These colouring matters being, besides, very much cheaper than magenta, cerise, &c., an adulteration of orchil preparations with them is not excluded.

The following table shows the results of new researches, made with all those coal-tar colours available which produce dyes similar to those of orchil; also the reactions leading to their detection and distinction from each other, and the method followed in producing the reactions.

The colouring matters mentioned in the table can obviously not be considered as exhausting the whole series of coal-tar colours which produce similar shades to orchil. It is, besides, very probable that, under the names mentioned above, different colour works produce different dyestuffs, while the same products are brought into commerce under different names. Thus, the table shows a difference in the products denoted as orselline; and an "amaranth" is produced by several colour works from the residue of magenta; it belongs, therefore, to Group II., and is not the "amaranth" mentioned in Group III.

The reactions described were produced with the aqueous solutions of the colouring matters, with the exception of that with acetate of lead, which, with respect to its application for the examination of orchil and cudbear, was produced in alcoholic solution of the colouring matters, containing 25 vol. per cent. of absolute alcohol.

The solution of *stannous chloride* was prepared by dissolving 10 grms. of tin crystals ($SnCl_2 + 2\ H_2O$) in a mixture of 25 cc. of concentrated hydrochloric acid, and 50 cc. of water; the reactions with it were made at boiling heat. All the other reactions took place in the cold.

Common salt, in a solid form, was added to saturation. The concentrated *sulphuric acid* ought to be added to the solution of the colouring matters, with the precaution that it may collect in a greater quantity at the bottom of the test tube. The colour reactions at the separating level of the two liquids will then appear very distinctly, and with some of the colouring matters various transitional colours will, moreover, be preserved in the higher layers, which are very characteristic, for instance, in the case of safranines.

The reaction with nitric acid is effected by mixing the solution of the colouring matter as rapidly as possible with an equal volume of concentrated nitric acid, and observing immediately. This is necessary, because the colourings which appear at the beginning are in most cases not of long duration, the liquids soon assuming a brown, and at last a yellow colour.

Group.	Name of Colouring Matter.	Stannous Chloride Solution.	Basic Lead Acetate. 52° Tw.	Common Salt.	Caustic Soda.	Concentrated Sulphuric Acid.	Concentrated Nitric Acid.	Concentrated Hydrochloric Acid.
—	Orchil (filtered solution).	Decolourised, or coloured light brown.	Completely precipitated.	Little precipitation, which, on washing with solution of common salt, is dissolved.	Blue-violet.	Reddish brown.	Orange-red.	Crimson-red.
I.	Acid magenta.	Darker and more bluish colouration.	Partially precipitated.	Not salted out.	Completely decolourised.	Brown without fluorescence.	Little alteration.	More bluish colouration.
	Acid colouring matters obtained from magenta residues; cerise S., grenadino S., Nacarat S., Marron S., &c.	Ditto.	Ditto.	Ditto.	Brown colouration, when hot almost completely discoloured.	Brown with slightly green *fluorescence.*	Darker and more bluish colouration.	Ditto.
	Red violet, IV. R. S., Bad. Anil. and S. F.	Ditto.	Ditto.	Ditto.	Ditto.	Brown without fluorescence.	Darker and more yellowish.	Unchanged.
	Orselline R. and Orselline B., Hochst Colour Works.	Intense bluish-violet colouration.	Ditto.	Ditto.	Ditto.	Ditto.	More bluish colouration.	More bluish colouration.
II.	Safranine.	Violet, later decolourised.	Not precipitated.	Almost completely salted out.	More yellowish colouration, no precipitate.	*Green, blue,* and *violet* successively.	*Blue.*	*Violet* to *blue.*
	Magenta (diamond).	Yellowish brown, after cooling lighter.	Ditto.	Ditto.	Reddish-violet precipitate.	Yellowish brown *without* fluorescence.	Yellowish brown *without* fluorescence.	Yellow.
	Basic colouring matters obtained from magenta residues; cerise, grenadine, nacarat, magenta, &c.	Ditto.	Ditto.	Ditto.	Brown precipitate.	Yellowish brown with slightly *green fluorescence.*	Yellowish brown with strong *green fluorescence.*	Reddish to yellowish brown, in great excess yellow.
III.	Orchil Red G. Actien Ges. f. An. Fab.	Completely dissolved.	Completely dissolved.	Almost completely salted out.	Unchanged.	*Violet.*	*Crimson-red.*	Scarcely changed.
	Amaranth. L. Casella & Co.	Ditto.	Ditto.	Partially salted out.	Darker and more yellowish colouration.	Ditto.	Scarcely changed.	Ditto.
	Carmoisin B. F. Bayer & Co.	Ditto.	Ditto.	Almost completely salted out.	Ditto.	Ditto.	Ditto.	*Red* precipitate.
	Azorubin S. Actien Ges. f. An. Fab.	Ditto.	Ditto.	Ditto.	More yellowish colouration.	Ditto.	Ditto.	*Orange* colouration.
	Fast Red A. Bad. An. & S. F.	Ditto.	Ditto.	Completely salted out.	Yellowish-brown colouration conc. solution gelat.	Ditto.	Ditto.	*Yellowish-brown* precipitate.
	Fast Red B. Bad. An. & S. F.	Ditto.	Ditto.	Ditto.	Darker and more yellowish colouration.	*Blue.*	Ditto.	Scarcely changed.
	Bordeaux B. Actien Ges. f. An. Fab.	Ditto.	Ditto.	Ditto.	Ditto.	Ditto.	Ditto.	Ditto.
	Bordeaux G. F. Bayer & Co.	Ditto.	Ditto.	Ditto.	Darker and more crimson colouration.	Ditto.	*Dark blue violet.*	Dark yellowish-brown colouration.
	Bordeaux B. X. and Bordeaux extra. F. Bayer & Co.	Ditto.	Ditto.	Ditto.	Darker and moro yellowish colouration.	*Bluish-green.*	*Dirty brown.*	Reddish-brown precipitate.
	Cloth Red G. Oehler.	Ditto.	Ditto.	Ditto.	Yellowish-brown precipitate.	*Blue.*	*Blue,* rapidly changing to dirty violet.	Nearly unchanged.
	Cloth Red B. Oehler.	Ditto.	Ditto.	Ditto.	*Claret-red* precipitate.	Ditto.	*Blue,* slowly changing to violet.	Ditto.
	Orchil Red A. Bad. An. & S. F.	Ditto.	Ditto.	Ditto.	Yellowish-brown colouration.	Ditto.	Dirty violet.	*Claret-red* precipitate.
	Orchil Red B. F. Bayer & Co.	Ditto.	Ditto.	Ditto.	More yellowish colouration and partially precipitated.	Ditto.	*Orange-red.*	*Violet* precipitate.
	Orselline B. B. F. Bayer & Co.	Ditto.	Ditto.	Ditto.	Darker and *more bluish* colouration.	Ditto.	*Blue,* rapidly changing to violet.	Dark red colouration and precipitate.

The table now shows that the colouring matters of the Groups II. and III. only can actually be isolated from orchil, the former by precipitating the natural colouring matters from their alcoholic solution by means of acetate of lead, the latter by salting out with common salt. Such an isolation of the colouring matters of Group I. is not possible; nevertheless, they may be distinctly detected, even if present in very small quantities, by their unaltered stability when boiled with a solution of stannous chloride, and by this they may also be distinguished from the colouring matters of the remaining groups.

The most suitable method of proceeding in examining orchil preparations is to test them in succession with respect to the single groups. It is, in most cases, sufficient to take 1—2 grms. of substance for each of these testings.

In the first place, such a quantity is boiled with about 100 cc. of water for every gramme of substance, filtered, and the filtrate, after addition of 15—20 cc. of hydrochloride of tin, again heated to boiling. If, after some minutes of continuous boiling, the liquid appears only yellow or yellowish-brown, no colouring matter of Group I. is present; but if the liquid retains a bluish-violet colour, orselline R or B is present. If the liquid retains a red or reddish-violet colour, acid magenta, red-violet, or an acid colouring matter obtained from magenta residues, is present, which it will be scarcely possible to determine. If the result of testing for colouring matters of Group I. is negative, the testing is resumed with respect to those of Group II. The orchil is either dissolved in absolute alcohol (about 20 cc. for 1 grm. of extract), treated with acetate of lead, and a sufficient quantity of water is then added till the liquid contains about 25 vol. per cent. of alcohol; or a hot solution in alcohol of 25 vol. per cent. is made, and after filtering, if necessary, acetate of lead, at 30° Bé., is added to the solution (10 cc. of acetate of lead for every gramme of liquid extract are quite sufficient). By this the natural colouring matters are completely precipitated, while the colouring matters of Group II. remain in the alcoholic solution, which is then filtered. If the latter is quite or nearly colourless, not any of these coal-tar colouring matters is present; but if it has a distinct crimson colour and a yellow fluorescence, the sample contains *safranine*, the presence of which is confirmed best by the sulphuric acid reaction. If, however, the alcoholic filtrate is coloured magenta-red, without fluorescence, it is tested, after removal of the alcohol, with nitric acid. If by this it assumes only a yellowish-brown colour, without fluorescence, pure *magenta* is present; but if, at the same time, a yellowish-green fluorescence is perceived, the latter proves the presence of a basic colouring matter (*cerise*, *grenadin*, &c.) prepared from magenta residues. The aceton reaction may also be advantageously employed for the detection of rosaniline derivates.

The above reactions are done in alcoholic solution, partly on account of the difficult solubility already mentioned of the compounds of orceïn with colour bases in water, partly because the aqueous solutions of the basic colouring matters obtained from magenta residues are partially precipitated by acetate of lead. It is, however, not advisable to employ the alcohol in a more concentrated state than indicated, because otherwise some orceïn remains dissolved in it.

In order to establish the presence or absence of the colouring matters of Group III., a new portion of the sample is boiled with water (about 100 cc. for 1 grm. of substance), left to cool, filtered, and the filtrate saturated with common salt. By this all the colouring matters of Group III. are precipitated, most of them completely. In most cases, however, part of the orceïn is at the same time precipitated, probably as an alkali compound. The residue on the filter is therefore washed with a saturated solution of common salt (to which, for the purpose of a more rapid removal of the precipitated orceïn, a few drops of dilute caustic soda may be added), and the washing is continued until the liquid runs off quite or nearly colourless. If there is still a residue, it is dissolved in hot water, and the solution treated, after cooling, with concentrated sulphuric acid. If by this a distinct, even though not very intensely coloured, violet or blue zone is obtained, the presence of a colouring matter of Group III. may be stated with certainty; the further reactions, as well as dyeing experiments on wool or silk, will furnish further information as to its nature. If, on the contrary, sulphuric acid produces a red or brown zone, this originates from orceïn only which was precipitated by common salt and not completely washed out.

Nearly all the colouring matters mentioned in the table may, by the method described, be distinctly detected, even if they occur in a quantity of not more than one-tenth per cent. of the orchil. Even of amaranth (L. C. & Co.), which of all the colouring matters of Group III., is salted out by common salt in the least complete manner, as little as one-half per cent. may be distinctly detected.

Although there may be several colouring matters, besides those mentioned in the table, which produce shades similar to those of orchil preparations, yet it scarcely admits of any doubt that it will be possible to bring them under one or the other of the three groups. Again, the possibility is not excluded that two coal-tar colouring matters, which belong to different groups, might be found in the same sample of orchil or cudbear, since various products brought into the trade as orchil substitute, orchil-red, &c., are a mixture of several colouring matters. Thus, it was found that such an "orchil extract" in the form of a very uniform orange-red powder, was a mixture of acid magenta with orange II.

Although it may not be possible for the analyst, in all cases, to establish the species of coal-tar colour employed in the adulteration, he will now at least be able to state whether such a substance is present or not.

An adulteration of orchil colouring matters with logwood or Brazil-wood may be shown very easily by a dye trial on mordanted cotton. Cotton yarn or cloth mordanted with iron or alumina salts answers the purpose best. The cotton stuff is dyed for half an hour in the hot solution of the suspected sample, which before has been boiled and suitably diluted; it is then washed in a warm solution of soap. Pure orchil or cudbear produces scarcely any colour on mordanted cotton (an extremely faint pink only), while a sample containing an extract of logwood or redwood dyes the cotton readily, extract of logwood dyeing cotton mordanted with iron salts, bluish-grey or black; if mordanted with alumina salts, bluish-violet. By the redwood, cotton mordanted with iron salts is dyed a blackish-brown; if mordanted with alumina salts, red.

By dyeing experiments of this kind it is possible to detect one-tenth per cent., and even less, of the mentioned extracts of colouring matter in orchil or cudbear, and even their quantity may, by comparative trials, be approximately determined.—W. S.

Methylene Blue as a Test for Glucose, Invert-sugar, Dextrose, and other Non-saccharin Organic Substances in Beet-sugar.

A. Ihl. Deutsche Zucker Ind. 1888, 8.

Pure beet-sugar solution mixed with sodium carbonate and boiled with methylene blue does not decolorise the latter, but in the presence of any of the above substances, even in the smallest quantities, the blue is reduced and the colour discharged.—D. A. L.

Detection of Cane Sugar in Vegetable Substances.

E. Schulze. Landw. Versuchsst. 34, 408.

The author has isolated crystals of cane sugar from etiolated potato sprouts, the seed of the flowers of *Pinus sylvestris*, the roots of carrots, and leaves of *Vitis vinifera* by digesting the substance with alcohol of 90 per cent., treating the extract with strontium hydroxide and decomposing the precipitate with carbonic anhydride. Although maltose is also precipitated by strontium hydroxide, it is readily distinguished from cane sugar crystallographically as well as by the formation of mucic acid on oxidation with nitric acid.—D. B.

Guarana.

A. Kremel. Pharm. Post. 21, 101.

The author recommends the following method for the determination of the caffeïne in Guarana:—Dissolve 10 grms. of Guarana powder in 100 grms. of 25 per cent.

alcohol in a small flask and weigh the whole. Digest the mixture on the water bath for one to two hours, make up the loss in weight by 25 per cent. alcohol, and filter off 50 cc. of the solution into a porcelain dish. To this an excess of calcium hydrate is added, the mixture evaporated to dryness, and the residue, after being powdered, extracted with chloroform in an extraction apparatus. The residue from the chloroform extract is dried at 100° and weighed. Commercial Guarana contains 3·12 to 3·80 per cent. of caffeïne.—C. A. K.

Determination of Nicotine in Tobacco extract. J. Biel. Pharm. Ztschr. Russil, **27**, 3.

Kissling's method is recommended, in which the extract is distilled by steam after treatment with caustic potash; but instead of extracting the concentrated distillate in a Soxhlet apparatus with ether, the author finds that six shakings with ether, using 20 cc. at a time, is equally efficient —C. A. K.

The Determination of Starch in Vegetable Substances. Goldmann. Süddeutsche Apoth. Zeit. 1887, **27**, 230.

Zipperer (Chem. Zeit. Rep. **11**, 11) reccommends $3\frac{1}{2}$ hours' heating under a pressure of four atmospheres in a Soxhlet's steam apparatus, in order to convert the starch contained in vegetable substances into soluble starch. According to the author, cellulose and allied substances also go into solution when heated under this pressure, whence too high results are obtained; $2\frac{1}{2}$ hours heating under a pressure of $2\frac{1}{2}$ atmos. is sufficient in the case of pepper, and with cinnamon 1 hour at 2 atmos. is enough. Results are given supporting these statements.—C. A. K.

The Determination of the Bases in Commercial Alcohol. L. Lindet. Compt. Rend. **106**, 280.

The nitrogen of the bases is converted into ammonia by Kjeldahl's method, and the latter determined by standard acid. 0·5 to 1 litre of the alcohol are diluted to 50° (Gay Lussac) shaken with 20 grms. of sulphuric acid, and then the alcohol and water completely distilled off. The sulphuric acid first carbonises the residue, sulphur dioxide is evolved, and the whole forms a clear solution to which 0·5 grm. of mercury are added, and the mixture heated nearly to boiling for 1—2 hours. The solution is then transferred to a Schloesing's apparatus, and the nitrogen contained in the bases determined as ammonia by treatment with potassium sulphide and caustic potash. The method is accurate and very delicate. The amount of ammonia obtained per litre of alcohol varied in the case of 10 kinds of brandy tested from 0·40 to 1·40 m. grms., in one instance reaching 2·86 m. grms.; rum from molasses reaches 2·54 to 5·30 m. grms., and spirit from beet-root molasses 16·23 to 23·05 m. grms. of ammonia per litre alcohol.—C. A. K.

Copper in Plum Jam. E. Reichardt. Arch. Pharm. **26**, 80.

In four samples of plum jam 0·0015 to 0·003 per cent. of copper was found by the author, who states that he has detected copper in every case which he has tried. The preserve is prepared in copper vessels.—C. A. K.

Tea Testing. A. Bukowski and M. Aleksandrow. Chem. Zeit. Rep. **12**, 55.

The tea is first dried at 100°—110° and then the amount of extract, of theïn, and of total and soluble ash determined in the dried sample. Of 40 samples examined, one-half were found to be adulterated. The percentage of extract varied from 23·3 to 40·08 per cent., and was somewhat less in the adulterated samples than in the others, but it varies too much with the different kinds of tea to be of value in determining the quality. The percentage of theïn was 0·05 to 2·80; the adulterated samples always contained less than 1 per cent., mostly from 0·4 to 0·5 per cent. The ash varied from 5·6 to 40 per cent.; the pure samples did not contain above 10 per cent. of ash; a considerable amount of brass filings were found in one of the adulterated samples. Amongst the colouring matters employed, caramel, logwood extract, Prussian blue, and indigo were detected. The authors also examined the samples under the microscope, and they lay great stress upon the value of such an examination.—C. A. K.

The Reichert-Meissl Method for Testing Butter, and Wollny's Modification of the same. F. Goldmann. Chem. Zeit. **12**, 283—284 and 317—319.

(Continued from p. 238 of this Journal, 1888.)

The apparatus in which the distillation by steam is effected is described in detail. The flask containing the melted fat has a long neck, and is connected by tubes passing through a rubber stopper, with the steam generator on the one side, with the condenser on the other, and also with a pipette for introducing the sulphuric acid. The melted butter fat is first placed in the flask, the alcohol and caustic alkali added, and the whole heated for 20 minutes, the flask being attached to an upright condenser. After this, the condenser is reversed, and 6 cc. of liquid distilled off, when a 50 cc. flask is placed as the receiver, and the distillation continued until 50 cc. have passed over. The last traces of alcohol are removed by means of steam, the steam delivery tube being allowed to play just on the surface of the liquid. The alcohol is thus completely removed, and the soap is treated with 5 cc. of dilute sulphuric acid (1:4) which is run in by means of the above-mentioned pipette, so that the stopper of the flask need not be taken out. The fatty acids separate, and the volatile acids are removed by steam. There is no fear of sulphuric acid passing over if the heating is carefully conducted. To guard against any of the liquid passing over owing to the frothing, the flask must must have a long neck, and be attached by a long delivery tube to the condenser.

By this means the total volatile fatty acids are obtained in the distillate, while in Wollny's method only a portion of these are obtained; in the latter case an error of 15 per cent. on the total volatile fatty acids is introduced, although the method gives concordant results. From a number of analyses carried out according to the author's method, it appears that from 200 cc. to 1,900 cc. of distillate must be distilled over before the whole of the volatile acids are obtained; the purer the butter is, the longer it takes. With some impure samples, containing 2 to 5 per cent. of butter, the distillation of 200 to 300 cc. is sufficient. The method takes a long time, especially in the case of rich butters, but the author suggests that by only distilling over 600 cc. of liquid, and allowing for the small amount of volatile fatty acids left behind from the results of a series of experiments, the whole analysis might be carried through in four hours. The results are accurate, but always slightly high. In examining margarin, 0·5 cc. of the baryta solution were found to be required for 5 grms. of margarin from three blind experiments, and this must, therefore, be subtracted in each determination. The author calculates from six determinations that 1 cc. of the baryta solution is equal to 0·161 grms. of butter, and knowing this, an idea can readily be got from the titration of the first 100 cc. of the distillate as to the purity of the sample, and consequently how many cc. distillate will be required. The distillation is regarded as complete when the last 100 cc. do not require more than 0·05 cc. of the baryta solution. In conclusion, full details of the method, modified in accordance with the above observations, are given.—C. A. K.

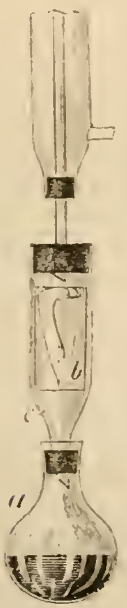
Determination of Ash in Sugar by means of Sulphuric Acid. Danysz. Deut. Zuckerind. **13**, 38.

The sugar, previously moistened with sulphuric acid, is treated with 1 cc. of ether and ignited. The mass is thus carbonised without swelling up, a porous coke being obtained which is incinerated in a muffle in the usual manner.—D. B.

Estimation of Free Acid in Tannin Liquor by Titration.

R. Koch. Dingl. Polyt. J. **267**, 459—465.

Meerkatz has criticised Koch's method (this Journal, 1887, 608), and come to the conclusion that it was useless. The objections were chiefly directed against the application of albumen for decolorisation, and the indicator for ascertaining the point of neutrality. Koch upholds his method, and proves by analytical data that albumen, if used properly, gives trustworthy results. But this is really irrelevant, as in a later communication Koch replaced albumen by gelatin solution. The second objection is of no weight, and can be raised against almost any indicator. After some practice the point of neutrality can be judged with certainty, as the change of colour is perfectly sharp and definite. Koch also points out that his method is the most simple of any yet known, and specially suitable for technical work, for which it was originally devised.—S. H.



The Quantitative Determination of Paraffin.

R. Zaloziecki. Dingl. Polyt. J. **267**, 274.

Ethyl alcohol of 75° Tr. does not dissolve paraffin. The slight solubility of paraffin in amyl alcohol is diminished by the addition of ethyl alcohol. 10—20 cc. (or 10—20 grm.) paraffin is mixed with five times the amount of amyl alcohol, and the same quantity of ethyl alcohol of 75° Tr., and the mixture allowed to stand in a cool place. It is filtered through a dry filter and washed with a mixture of two parts of amyl and one part of ethyl alcohol. The paraffin is then extracted with ether, in an apparatus shown in the figure. The paraffin and filter-paper are put into the flask *a*, which is previously weighed and extracted ¼—½ hour. The flask is then dried at 125° and weighed. With this method the amount of solid paraffin in crude oils may be determined, in which case 10 times instead of 5 times the amount of ethyl alcohol is taken. By the same method, paraffin in fatty acids, neutral fats, resins, and resin oils may be determined.—J. B. C.

On the Purification of Sugar Solutions for Polarisation.

Przegl. techn. **24**, 49.

Besides the means proposed by Degener and Herles, C. Rytel uses chalk for the same purpose. A quantity of finely-powdered and sifted chalk is washed with water by decantation, and dried only so far as to form a mealy powder. This condition offers advantages over perfectly dry chalk, which refuses to become readily wetted. The sugar solution is first treated with lead acetate, and to the resulting opalescent liquid about 1 grm. of the moist chalk is added. After shaking and filtering, a perfectly clear solution is obtained.—G. H. B.

On Sulphate of Quinine. O. Hesse. Pharm. Ztg. **33**, 28.

The author draws attention to the fact that the so-called Chin. sulfur. puriss. of Schäfer may contain admittedly as much as 2½ per cent. cinchonidine sulphate even when passable by the oxalate test. There is, therefore, no sufficient reason for selling this preparation 15—20 per cent. dearer, as Hesse finds that ordinary sulphate of quinine contains only 3·64 per cent. cinchonidine sulphate as a maximum, the usual quantity being 2—3 per cent. Hesse further remarks that the ammonia test, as improved by Kerner and Weller, is fully equal to the oxalate test in the detection of cinchonine, and fulfils practical requirements better.—G. H. B.

On the Titration of Pyridine Bases. K. E. Schulze.

Ber. **20**, 3391.

The author has found ferric chloride to serve as a sufficiently sharp indicator for the titration of the pyridine bases. 5 cc. of pure pyridine are dissolved in 100 cc. of water, and 25 cc. are treated with 1 cc. of a 5 per cent. solution of ferric chloride. The mixture is then cautiously treated with normal sulphuric acid until the reddish-brown precipitate of ferric hydrate just disappears. The last additions of acid are made at intervals of ½—1 minute. The solution at the end of the titration is quite clear.—G. H. B.

On the Analysis of Raw Materials containing Tartaric Acid.

Goldenberg, Geromont, & Co. Chem. Zeit. **24**, 390.

In reply to v. Lorenz's criticisms and proposed new method for estimating tartaric acid in *Zeits. Anal. Chem.* **27**, 8 (see this Journal, 1888, 136), the authors believe that the higher results obtained by him are due to the presence of acetic acid, which clings most tenaciously to the impure slimy precipitate resulting from the acidification of the solution got by digesting the crude tartar with potassium carbonate, and which cannot be removed even by repeated washing. They are convinced that the results by the "improved" method are too high, and that the older process is the more correct. It is true that potassium bitartrate is somewhat soluble in alcohol containing acetic acid, but the addition of 1·5 to 2 grms. of potassium chloride is sufficient to render precipitation complete. A new method adopted gives results confirmatory of the older method.

Analysis of Dry Wine Lees.—6 grams of the finely powdered substance are stirred in a beaker with 9 cc. of HCl. (sp. gr. = 1·10), a like volume of water is now gradually added, and the mixture is digested with frequent stirring for 1—2 hours throughout at the ordinary temperature. The liquid is now made up to 100 cc. with water and passed through a dry filter. 50 cc. are then placed in a well-covered beaker to which 10 cc. of K_2CO_3 solution (containing 3 grms. K_2CO_3) are added; after boiling for some time the CO_2 will be completely expelled and the $CaCO_3$ precipitate will have completely separated in the crystalline condition; after filtering and washing the latter, the solution is evaporated to about 10 cc., acidified with 2—2·5 cc. of glacial acetic acid gradually introduced with constant stirring, mixed with 100 cc. of pure alcohol of 90°—96° Tr. and stirred until the precipitate is distinctly crystalline. After frequent washings by decantation the precipitate is filtered through a 9 cm. filter, which, with precipitate and dish must be thoroughly washed free from acetic acid by means of alcohol. The filter, with the precipitate, is now transferred from the funnel into a beaker; the dish is washed with boiling water which is then added to the substance in the beaker, and the whole is titrated with normal alkali. The number of cc. of alkali used multiplied by five gives the percentage of tartaric acid in the lees. In making allowance for the volume of the residue insoluble in HCl., it is found that 0·7 per cent. should be deducted from a yield of 20 per cent. tartaric acid, or 0·7 + 0·02 *n* from one of 20 + *n* per cent. In analysing tartar and calcium tartrate, 3 grms. of the substance are digested with 9 cc. of the HCl; the solution is then filtered (the residue being well washed) and made up to 100 cc., of which 50 cc. are used for the subsequent stages as above. The percentage of tartaric acid is in this case found by multiplying by 10 the number of cc. of normal alkali used.—W. G. M.

Milk Analysis. H. Schreib. Zeit. f. angew. Chem. 1888, 135.

B. Rose (Zeits. f. angew. Chem. Feb. 1888, 100) intimates that he has found a loss in the amount of fat as determined in the milk residue, if the latter be allowed to stand. Experiments made by the author, in which about 10 grms. milk were evaporated to dryness with 20 grms. sand, give coincident results. All the portions of milk taken were evaporated on the same day. In the case of the 4th, 5th, and 9th portions, the residues were ground up immediately before extraction, the others were ground up on the first day and kept in a desiccator until required for extraction.

Extracted on—

(1)	1st day	3·45	per cent.	fat.
(2)	4th „	3·57	„	„
(3)	5th „	3·50	„	„
(4)	2nd „	3·48	„	„
(5)	5th „	3·57	„	„

A second sample of milk gave :—

Extracted on—

(6)	1st day	4·25	per cent.	fat.
(7)	2nd „	4·35	„	„
(8)	4th „	4·15	„	„
(9)	5th „	4·21	„	„

—J. W. L.

Estimation of Starch by the Barium Method. F. Seyfert. Zeits. f. angew. Chem. 1888, 126—129.

In using this method the author has found it expedient to allow the precipitate to settle well and to draw off an aliquot part of the supernatant liquid for the barium titration, rather than to filter this off. He points out the large error in the percentage of starch which may occur through even a very slight action of the carbonic acid of the atmosphere. Experiments were also carried out to test the question as to whether the time required for the settling of the barium precipitate exercised any influence on the result; the determinations made after standing over 24 and 40 hours respectively showed, however, no difference.

The concentration of the alcohol present in the solution after precipitation with barium hydrate appears to exercise some influence. In two series of determinations of the starch in potatoes, twice the quantity of alcohol was used in the one case as in the other, the total volumes of liquid remaining unchanged. In the former case about 1 cc. less sulphuric acid was required to titrate the excess of barium than in the latter, representing about 14 per cent. of starch. In another series of determinations of starch in potatoes, varying quantities of alcohol were used, when it was found that the results varied between 79·82 per cent. and 105 per cent. starch.

The author concludes that in order to obtain coincident results with this method, the quantity of alcohol used must remain unchanged, and that the quantity suggested by v. Asbóth, viz. 50 cc. of 45 per cent. alcohol, gives the most correct results.—J. W. L.

Benedict-Zsigmondy's Method for the Estimation of Glycerol in Fats and Aqueous Solutions. F. Filsinger. Zeits. f. angew. Chem. 1888, 123—124

Experiments carried out under the author's direction show that Jolles' modification of this method is not reliable. (This Journal 1888, **7**, 136.) A solution of glycerol in soap lye, containing 74·8 per cent. as estimated by means of potassium permanganate, was treated according to Jolles' modification, and the result obtained was much too low. By the application of 15 grms. instead of 8 grms. the result was still considerably too low. The manganate used was obtained from the same source as Jolles recommends, and the author concludes that the permanganate cannot be replaced in this method by the manganate of potash.—J. W. L.

The Adulteration of Butter. P. Bockairy. Bull. Soc. Chim. **49**, 247.

Ten cc. fat freed from extraneous matter by decantation and filtration is dissolved in 20 cc. crystallisable benzene, and to the solution alcohol of 96·7° (Gay Lussac) is added until turbidity appears. It is then left for an hour at a temperature of 12°. If a fat rich in olein is present the precipitate is oily. Stearin, palmitin, and margarin have a flocculent appearance. Of all fats butter requires the most alcohol, and the smallest quantity of liquid separates. According to the author all butter is of doubtful purity which requires less than 35 cc. alcohol for producing turbidity in 10 cc. of butter.—J. B. C.

Quinine Alkaloids. O. Hesse. Annalen, **243**, 131—150.

The author finds that the method of determining the relative quantities of quinine and cinchonidine in cinchona bark extract by the rotatory power of the tartrates of these bases in acid solution is unreliable. The cause of this may, the author thinks, be attributed to the presence of hydroquinine and hydrocinchonidine. A further error may be found in the fact that the preparations have not the same degree of purity, for this is only obtained by recrystallisation, a process which may modify the proportion of the bases present. No comparative determinations are therefore possible. Moreover, the rotatory power of the pure salts differs with different observers. This is probably due to the efflorescent character of the tartrates and to an indefinite knowledge of their constitution. Whereas some observers consider both tartrates to contain one molecule of water of crystallisation, the author shows that in reality quinine tartrate contains two molecules, one of which it loses at 120° and the second at 140°. Two molecules are also present in the mixed tartrates of quinine and cinchonidine. The author finds that certain salts of quinine and cinchonidine when mixed together crystallise in nearly definite proportions, and regards these crystals as chemical compounds. The bisulphates of these bases form compounds of the formula $C_{20}H_{24}N_2O_2.2C_{19}H_{22}N_2O$, *i.e.*, one molecule of quinine and two molecules of cinchonidine. If this body be crystallised from alcohol, it forms a compound containing to one of quinine seven of cinchonidine. Similar results are obtained with the neutral sulphate, tartrate, oxalate, and chromate. In all cases definite double salts of the two alkaloids are obtained, the composition of which varies with the temperature, degree of concentration, amount of the bases or reagents present in solution.

Contrary to *De Vrij's* views, the author considers the method of precipitating quinine as chromate untrustworthy, since, in the first place, nearly all the hydroquinine is carried down and double salts with cinchonidine are formed. Cinchonine and hydrocinchonine are much more soluble and remain in the mother liquor. Conchinine and hydroconchinine react with quinine like cinchonidine, forming double compounds of the free bases.

Pipironic acid combines with cinchonidine to form a salt by mixing the potassium salt of the former with the hydrochloride of the latter. Homocinchonidine and hydrocinchonidine likewise combine.

Cinchonidine and cinchonine when heated with dilute H_2SO_4 in sealed tubes are converted, the first into homocinchonidine, and the second into homocinchonine, as well as an amorphous base, probably dicinchonine. Homocinchonine resembles cinchonine. It forms a neutral sulphate, hydrochloride, &c. The author finds further, that if cinchonine H_2SO_4 be substituted for the dilute acid, other bases are formed, to which he appends the prefix "iso." He has obtained in this way isoquinine, isoconchinine, isocinchonidine, and isocinchonine.—J. B. C.

New Books.

WATTS' DICTIONARY OF CHEMISTRY. Revised and entirely re-written by H. FORSTER MORLEY, M.A., D.Sc., and M. M. PATTISON MUIR, M.A. Assisted by Eminent Contributors. In Four Volumes. Vol. I. London: Longmans, Green, and Co., New York: 15, East 16th Street. 1888.

OCTAVO VOLUME, strongly bound, price 2*l.* 2*s.* The work is to be completed in four volumes of about 750 pages each, it is announced in the Preface. The present volume, Vol. I., contains Preface by the Editors, an "Introduction to the Portion of the Book dealing with Inorganic Chemistry," by Mr. Muir, an Introduction to the Articles relating to Organic Chemistry, by Dr. Morley, a list of the Initials and Names of Special Contributors, a list of "Abbreviations for Titles of Journals and Books" quoted from, and one of "Terms and Quantities, &c. frequently used," and 752 pages of Subject-matter, commencing with A. and ending with C. ("Chemical Change"). The manner of treatment of a subject is strictly systematic, and such that the eye readily catches the divisional headings. Thus, taking the subject ACETONE, there are first the References to Literature, then the "*Formation*," next "*Preparation*," "*Properties*," "*Detection*," "*Reactions*," and finally "*Combinations*." Some of the articles are illustrated by wood engravings, *e.g.*, that on "ANALYSIS," by 17 cuts.

The article on Azo-colours, Azo- and Diazo-compounds, covers some 57 pages, and that on Cellulose 8½ pages, whilst the article concluding Vol. I. covers 23 pages.

A TREATISE ON CHEMISTRY. By Sir H. E. ROSCOE, F.R.S., and C. SCHORLEMMER, F.R.S. The Chemistry of the Hydrocarbons and their Derivatives, or, Organic Chemistry. Vol. III., Part IV. London and New York: Macmillan & Co. 1888.

IN this Volume, the Fourth Part of the Treatise on Organic Chemistry, a description of the Aromatic Compounds containing seven atoms of Carbon is given. The first part deals with the Toluene Group, then follow the Benzyl, Benzoyl, and Hydrobenzyl Groups, and finally the Xylene Group of eight Carbon Compounds.

After the Table of Contents, covering four pages, the text of Subject-matter is completed in 520 pages, followed and concluded by an Alphabetical Index of 22 pages. With the text of Part IV. are interspersed six wood engravings.

The College of State Medicine.

SUMMER SESSION, 1888.

THE following LECTURES will be given in the THEATRE of the CHEMICAL SOCIETY, BURLINGTON HOUSE, on Wednesday afternoon, at Four p.m.

INTRODUCTORY LECTURE.

May 2……………………R. BRUDENELL CARTER, F.R.C.S.

"The Aims and Objects of State Medicine."

May 16……………………Prof. H. G. SEELEY, F.R.S.

"Soil in its Influence on Health."

May 30……Inspector-Gen. JOHN M. MACDONALD, M.D., F.R.S.

"The Organisms occurring in Fresh Water, and the Hygienic Importance of their Presence."

June 13……………………G. FLEMING, Esq., LL.D., C.B., &c.

"Some of the more Important Diseases Common to Man and Animals."

June 27……………………Sir ROBERT RAWLINSON, K.C.B.

"The Rise and Progress of Sanitary Engineering within the Present Century."

July 11……………………Sir J. CRICHTON BROWNE, M.D., LL.D.

"Responsibility and Disease."

All those interested in Public Health Work are invited to be Present.

W. R. CORNISH, *Surgeon-General,*
Hon. Sec.

Office: 26, King William Street, W.C.

Trade Report.

(From the Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

SWITZERLAND.

Classification of Articles in Customs Tariff.

In Category 4 the words "chemically prepared" are inserted between "phosphate of lime" and "artificial manure."

UNITED STATES.

Customs Decision.

Wet wood pulp, although it has not passed through the so-called drying process, is held to be dutiable at the rate of 10 per cent. *ad valorem*, under the provision in Schedule M. (T.I., 393) for "pulp, dried, for paper-makers' use."

BRITISH INDIA.

Imposition of Customs Duty on Petroleum.

See Board of Trade Journal for April, p. 372.

URUGUAY.

New Customs Law.

Kilogramme = 2·204 lbs. avoirdupois. Litre = 1·76 Imperial pints. Peso = 4*s.* 2*d.*

The following is a translation of the new Customs law of Uruguay, which was published in the French *Journal Officiel* of the 21st February last. This law came into operation on the 20th January:—

All articles of foreign origin, not otherwise distinguished, pay, on importation, a duty of 31 per cent. *ad valorem.*

The following articles pay a duty of 51 per cent. *ad valorem*:—

Powder and ammunition. Perfumery.

The following articles pay a duty of 48 per cent. *ad valorem*:—

Drugs.

The following articles pay a duty of 20 per cent. *ad valorem*:—

Roman cement. Tar.
Quicksilver. Resin.
Plaster.

The following articles pay a duty of 8 per cent. *ad valorem*:—

Sulphuric, nitric, and chloric acids.
Phosphorus in sticks.
Dye wood.

The following articles pay a duty of 6 per cent. *ad valorem*:—

Scientific instruments.

The undermentioned articles pay specific duties as follows:—

Articles.	Rates of Duty now Levied.	
		Pes. Cts.
Sugars, refined, gross weight	Kilog.	0·05
„ not refined, gross weight	„	0·04
Petroleum	Litre	0·02
Matches (gross weight)	Kilog.	0·40
Starch („)	„	0·67

The following articles are admitted free of duty:—

Soda.
Potash.
Chlorate of potash for industrial purposes.
Dynamite.
Flowers of sulphur.

The importation of orchal and its derivatives is forbidden.

ITALIAN CUSTOMS DUTIES.

Information has been received at the Foreign Office from Her Majesty's Ambassador at Rome that a notification has been issued by the Italian Director-General of Customs that after the 10th instant invoices were no longer to be accepted as proof of the origin of goods imported into Italy. All goods, in order to enjoy conventional treatment, must be furnished with a certificate of origin, except such as have come straight from the country of production, or which have been merely transhipped in a French port.—*Chemist and Druggist.*

NEW CUSTOMS TARIFF OF ITALY.

The following is a statement showing the rates of import duty hitherto levied in Italy upon chemicals, medicinal products, perfumes, colours, wood, and manufactures of wood, gold and silver wares, clocks, watches, paper, stationery, and books, articles of food, animals (living), stone, unwrought and wrought, and other miscellaneous articles, the produce and manufacture of the United Kingdom, under the old Customs Tariff, as compared with the rates now levied under the new General Tariff of Italy which came into operation on the 1st January last. Under a commercial treaty with Austria, which was concluded on the 7th December last, certain reductions have been effected in the duties on various articles imported into Italy. These reductions, which have in each case been notified in the following statement, will apply to British goods under the most-favoured nation clause.

Note.—Kilogramme = 2·204 lbs. avoirdupois. Hectolitre = 22 gallons. Lira = 9$\frac{6}{10}$*d.*

CHEMICALS, MEDICINAL PRODUCTS, PERFUMES, COLOURS, &c.

OLD TARIFF.					NEW GENERAL TARIFF.		
Classification.	Rates of Duty.				Classification.	Rates of Duty.	
	General Tariff.		Conventional Tariff.				
		Lire.		Lire.			Lire.
Acids:							
Arsenic	100 kilogs.	2·00	(*a.*)		.. ..	Free.	
Boric	Free.		(*a.*)		.. ..	Free.	
Gallic and tannic, impure	Free.		(*a.*)		.. ..	Free.	
Acetic, impure	Free.		(*a.*)		.. ..	100 kilogs.	1·00
Hydrochloric	100 kilogs.	1·00	(*a.*)		.. ..	,,	1·00
Nitric	,,	1·00	(*a.*)		.. ..	,,	1·50
Sulphuric	,,	0·50	(*a.*)		.. ..	,,	0·50
Tartaric	,,	8·00	(*a.*)		.. ..	,,	10·00
Not distinguished	,,	10·00	(*a.*)		Ferric	,,	10·00
					Acetic, liquid (including common vinegar), containing of acetic acid, pure:		
					10 per cent. or less	,,	10·00
					From 10 per cent. to 50 per cent.	,,	60·00
					Above 50 per cent.	,,	80·00
					Acetic, crystallised	,,	110·00
					Not distinguished	,,	10·00
Ammonia, potash, and caustic soda, pure	,,	5·00	(*a.*)		.. ..	,,	5·00
Potash and soda, caustic, impure	,,	0·50	(*a.*)		.. ..	,,	0·50
Alkaloids:							
Salts of quinine and other	Kilog.	5·00	Kilog.	5·00	.. ..	Kilog.	12·00*
Oxide of iron, lead, and tin	100 kilogs.	2·00	(*a.*)		.. ..	100 kilogs.	4·00
,, of zinc	,,	2·00	(*a.*)		.. ..	,,	5·00
Acetate of alum, iron, lead, and copper	,,	1·00	(*a.*)		.. ..	,,	1·00
Carbonates:							
Barytes	,,	2·00	(*a.*)		.. ..	,,	2·00
Magnesia	,,	25·00	(*a.*)		.. ..	,,	25·00
Lead	,,	5·00	100 kilogs.	5·00	.. ..	,,	8·00
Soda	,,	0·50	(*a.*)		.. ..	,,	0·50
Potash	,,	0·50	(*a.*)		.. ..	,,	0·50
Magnesia, calcined or caustic	,,	20·00	(*a.*)		.. ..	,,	50·00
Hypochlorides:							
Of lime, potash, and soda	,,	1·00	(*a.*)		.. ..	Free.	
Chlorides:							
Of lime	,,	4·00	(*a.*)		.. ..	Free.	
Of potash	Free.		Free.		.. ..	Free.	
Of magnesia	100 kilogs.	1·00	(*a.*)		.. ..	100 kilogs.	1·00

(*a.*) Articles not mentioned in the conventional tariff; the duty of the general tariff therefore applies.

* Under the Italian Treaty with Germany these alkaloids pay 5 lire per kilogramme.

Old Tariff.					New General Tariff.		
Classification.	Rates of Duty.				Classification.	Rates of Duty.	
	General Tariff.		Conventional Tariff.				
		Lire.		Lire.			Lire.
Nitrates:							
Of silver	Kilog.	5·00	(*a.*)		.. ..	Kilog.	5·00
Of soda, refined, and potash	100 kilogs.	3·00	(*a.*)		.. ..	100 kilogs.	3·00
Of soda, raw	Free.		Free.		.. ..	Free.	
Borax or borate of soda	100 kilogs.	0·50	(*a.*)		.. ..	100 kilogs.	0·50
Sea and rock salts	Prohibited.		Prohibited.		.. ..	Prohibited.*	
Sulphates:							
Of alum, potash, and other alums	100 kilogs.	0·50	(*a.*)		.. ..	100 kilogs.	0·50
Of barytes	,,	1·00	(*a.*)		.. ..	,,	1·00
Of iron and manganese	,,	2·00	(*a.*)		.. ..	,,	2·00
Of copper, zinc, and bisulphate of copper and iron	,,	2·00	(*a.*)		.. ..	,,	2·00
Of magnesia	,,	1·50	(*a.*)		.. ..	,,	1 50
Of soda	,,	0·50	(*a.*)		.. ..	,,	0·50
Of potash	,,	0·50	(*a.*)		.. ..	,,	0·50
Tartar (bitartrate of potash), lees of wine and argols	Free.		Free.		.. ..	Free.	
Cream of tartar	100 kilogs.	4·00	(*a.*)		.. ..	100 kilogs.	4·00
Sulphuret of mercury (cinnabar or vermilion)	,,	100·00	100 kilogs.	25·00	.. ..	,,	100·00
Phosphorus	,,	4·00	(*a.*)		.. ..	Free.	
Nitro-benzine, raw	,,	150·00	(*a.*)		.. ..	100 kilogs.	4·00
Pyrolignites of iron, lead, lime, and alum	,,	4·00	(*a.*)		.. ..	,,	4·00
Chemical products not distinguished	,,	4·00	(*a.*)		.. ..	,,	4·00
Liquorice roots	Free.		Free.		.. ..	Free.	
Medicinal herbs, roots, &c. not distinguished	100 kilogs.	2·00	100 kilogs.	2·00	.. ..	100 kilogs.	2·00
Camphor:							
Raw	,,	2·00	(*a.*)		.. ..	Free.	
Refined	,,	15·00	(*a.*)		.. ..	100 kilogs.	25·00
Cinchona	Free.		Free.		.. ..	Free.	
Extracts or juices:							
Orange	Free.		Free.		.. ..	Free.	
Citron and lemon, raw	Free.		Free.		.. ..	Free.	
Citron and lemon, concentrated	Free.		Free.		.. ..	Free.	
Liquorice	100 kilogs.	10 00	(*a.*)		.. ..	100 kilogs.	10·00
Aloe and medicinal vegetables not otherwise mentioned	,,	10·00	(*a.*)		.. ..	,,	10·00
Medicinal articles not distinguished	,,	10·00	(*a.*)		.. ..	,,	10·00
Compounded medicines (including the weight of the bottle or wrapper)†	,,	120·00	100 kilogs.	120·00	.. ..	,,	120·00‡
Perfumes (including the weight of the bottle or wrapper):							
Alcoholic	,,	60·00§	,,	37·50§	.. ..	,,	100·00 With the addition of 144 lire for the alcohol contained.
Non-alcoholic	,,	60·00	,,	12·00	.. ..	,,	100·00

(*a.*) Articles not mentioned in the conventional tariff; the duty of the general tariff therefore applies.

* Every mixture of soluble salts is considered as salt in which "*clora*" exists in proportion greater than 15·2 per cent., and "*sodium*" in greater proportion than 9·8 per cent.

† Under this heading are included all patent medicines whether in paste, powder, or liquid; also balsams and effervescing citrates of magnesia, and all substances professing to possess medicinal properties.

‡ Compounded and patent medicines are subject to a surtax in proportion to the spirit which they contain or which has been used in their manufacture.

§ Excise duty has to be paid in addition to these duties.

OLD TARIFF.			NEW GENERAL TARIFF.	
Classification.	Rates of Duty.		Classification.	Rates of Duty.
	General Tariff.	Conventional Tariff.		
	Lire.	Lire.		Lire.
Ether and chloroform	100 kilogs. 4·00 With the addition of the duty on 200 litres of alcohol.	(a.)	(Including the weight of the package.)	100 kilogs. 4·00 With the addition of 420 lire for the alcohol contained.
Volatile oils or essences (weight of package included):				
Rose	Kilog. 10·00	(a.)	.. ..	Kilog. 40·00
Orange and similar fruits	" 1·50	(a.)	.. ..	" 1·50
Clove	" 1·50	(a.)	.. ..	" 7·50
Peppermint	" 1·50	(a.)	.. ..	" 7·50
All other	" 1·50	(a.)	.. ..	" 3·00
Essences of rum, cognac, and others containing spirit	" 0·85 In addition to the duty.	(a.)	.. ..	" 1·02 In addition to the duty.
Woods, roots, barks, leaves, lichens, flowers, herbs, and fruits for dyeing and tanning:				
Not ground	Free.	Free.	.. ..	Free.*
Ground	100 kilogs. 2·00	(a.)	.. ..	100 kilogs. 2·00*
Gambier	Free.	Free.	.. ..	Free.
Indigo, cochineal, and kermes	Free.	Free.	.. ..	Free.
Prussiate of potash, yellow and red	Free.	Free.	.. ..	Free.
Colours derived from tar or other bituminous substances:				
Dry	100 kilogs. 15·00	100 kilogs. 15·00	.. ..	Free.
In liquid or paste	" 10·00	" 10·00	.. ..	Free.
Colouring extracts from dye-woods and all other dye-stuffs	" 12·50	" 12·50	.. ..	100 kilogs. 12·50
Colours in cakes and powders, or in any other form	" 12·00	" 12·00	.. ..	" 12·50
Charcoal	Free.	Free.	.. ..	Free.
Rags of all kinds	Free.	Free.	.. ..	Free.†
Pulp of wood, straw, &c.	Free.	Free.	.. ..	100 kilogs. 2·00‡§
Paper:				
White or tinted in the pulp	100 kilogs. 10·00	100 kilogs. 10·00	.. ..	" 15·00†
White or tinted in the pulp, laid	" 10·00	" 10·00	.. ..	" 20·00†
Ink of all kinds	" 15·00	(a.)	.. ..	" 15·00
Sealing wax	" 30·00	100 kilogs. 30·00	.. ..	" 30·00
Vinegar:			Vinegar:	
In casks	Hectol. 10·00	(a.)	Containing acetic acid to the extent of 10 per cent. or less	" 10·00
In bottles	100 bottles 25·00	(a.)	From 10 to 50 per cent.	" 60·00
			Above 50 per cent.	" 90·00
Starch:				
Common	100 kilogs. 4·50	100 kilogs. 3·00	.. ..	" 8·00
Fine, in boxes	" 4·50	" 3·00	.. ..	" 12·00
Stearic acid	" 10·00	" 8·00	.. ..	" 8·00
Glucose	" 30·00	(a.)	Glucose: Solid	" 65·25
			Liquid	" 40·00
Glue:				
Strong (*forte*)	" 4·00	100 kilogs. 4·00	.. ..	" 4·00
Isinglass (*di pesce*)	" 10·00	" 10·00	.. ..	" 15·00

(a) Articles not mentioned in the conventional tariff; the duty of the general tariff therefore applies.

* Under the Austro-Italian Treaty woods, roots, &c., ground or not, are free of duty.

† Waste paper for re-pulping (*cartacce da macero*) comes under this heading. It will not, however, enter duty free unless rendered useless for other purposes. Large packets of newspapers will only be permitted to enter for re-pulping when they are not of very recent date.

‡ The pulp must be perforated so that it cannot in any case be used as cardboard.

§ Under the Austro-Italian Treaty pulp of wood, straw, &c. pays a duty of 1 lire per 100 kilos.

OLD TARIFF.				NEW GENERAL TARIFF.		
Classification.	Rates of Duty.			Classification.	Rates of Duty.	
	General Tariff.		Conventional Tariff.			
		Lire.	Lire.			Lire.
Graphite	Free.		Free.	.. ..	Free.	
Gunpowder:						
For blasting	100 kilogs.	150·00	(a.)	.. ..	100 kilogs.	150·00
For sporting purposes	„	150·00	(a.)	.. ..	„	250·00
All other explosive material	„	150·00	(a.)	.. ..	„	300·00
Manure	Free.		Free.	.. ..	Free.	
Matches:						
Of wood	100 kilogs.	11·00	Free.	.. ..	100 kilogs.	10·00
Other kinds	„	11·00	(a.)	.. ..	„	15·00
Stones, earths, and metallic minerals:						
Gypsum, lime, &c.	Free.		Free.	.. ..	Free.	
Cement and hydraulic lime	100 kilogs.	0·50	(a.)	.. ..	100 kilogs.	1·25
Varnish:						
Made with spirits	„	30·00 With the addition of 105 lire per hectol. of alcohol contained.	(a.)	.. ..	„	30·00 With the addition of 36 lire per hectol. of alcohol contained on the basis of 70 degrees of strength.
All other kinds	100 kilogs.	12·00	(a.)	.. ..	100 kilogs.	20·00

(a) Articles not mentioned in the conventional tariff; the duty of the general tariff therefore applies.

MISCELLANEOUS TRADE NOTICES.

CONSULAR ASSISTANCE TO BRITISH TRADE ABROAD.

See Board of Trade Journal for April, p. 403.

AUSTRIAN TRADE MARK LEGISLATION.

See Board of Trade Journal for April, p. 412.

TARIFFS AND TRADE OF THE BRITISH EMPIRE.

See Board of Trade Journal for April, p. 414.

THE INDIAN CANDLE TRADE.

See Board of Trade Journal for April, p. 418.

THE SALE OF ADULTERATED FOOD IN THE UNITED STATES OF AMERICA.

See Board of Trade Journal for April, p. 426.

RUSSIAN PETROLEUM.

The Belgian *Bulletin de Musée Commercial* of the 3rd of March, quoting from the *Volkswirthschaftliche Wochenschrift*, states that it is the general impression that the Russian beds of petroleum are limited to the extreme east of the Caucasus, where, in fact, the peninsula of Apcheron is at present the seat of the new petroleum industry. There exist, however, much to the west of this, some important beds of the oil, namely, in the territory of Kertsch. Since the Crimean War these beds have not been heard of, but they are about to hold a considerable place in the trade of Southern Russia. An Austrian company has been working them, in the neighbourhood of the town of Kertsch, hitherto with no very satisfactory results. In 1887, however, there was a marked improvement. The vast expense entailed in bringing the Baku petroleum to the Mediterranean makes it seem probable that, unless the Baku companies can reduce the freights on the Transcaucasian railway, the oil of Kertsch will enjoy great advantages.

PETROLEUM EXPORTS FROM BATOUM TO THE EAST INDIES.

The *Journal de St. Pétersbourg* for the 24th February (7th March) last, quoting from the *Messager d'Odessa*, states that the East Indies are beginning to become one of the most important outlets for Russian petroleum. In 1887 there were exported from Batoum for the East Indies more than 2,000,000 pouds of petroleum, and in the course of January last about 400,000 pouds of this product were shipped for the same destination.

REPORT OF COMMITTEE OF THE SOCIETY FOR THE PROTECTION OF THE INTERESTS OF CHEMICAL INDUSTRY IN GERMANY.

Chem. Zeit. **12**, 249.

The following resolution was unanimously adopted by the committee on spirit: "The committee gratefully acknowledges the facilities hitherto granted to chemical industry, and hope that they may be continued, as far as the interests of the Excise remain unaffected. Further, the wish is expressed that for the present consideration of the question of the denaturation of spirit, a standing parliamentary committee may be appointed, in which the spirit-consuming branches of chemical industry may be represented, especially the tar, soap, and perfumery manufacturers, and the manufacture of pharmaceutical preparations, with the assistance of experts for special cases." The committee further resolved to recommend to the Government to continue to permit the denaturation with oil of turpentine for varnish manufacture, and besides that, to give renewed consideration to the complaints of varnish manufacturers. There was also a proposal on behalf of the percussion cap manufacturers for a spirit mixed with 0·025 per cent. bone-oil or 0·5 per cent. oil of turpentine, and in any case with 0·025 per cent. pyridine bases for the production of fulminating mercury, to the exclusion of wood spirit, which lowers the yield and deteriorates the quality of the product. According to the proposal, the most suitable substance to use in the case of the fulminating mercury manufacture, would be the ethereal distillate which forms a bye-product in the manufacture of fulminating silver, as the presence of bone-oil and oil of turpentine gives rise to an undesirable colouration in the manufactured article. It was further resolved to entreat the Government to continue to allow bone-oil as the means of denaturation for manufactories of sugar of lead and white lead, and to continue the means hitherto permitted to the industries connected with pharmaceutical preparations and coal-tar colours, as the employment of pyridine bases is not practicable in these cases.—G. H. B.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

ITALY.

German Chemicals in Italy.

A Leghorn report states that, generally speaking, the chemical industry and trade in Italy are much depressed by low prices and excessive competition between German, French, and British firms. Quite recently American makers have also commenced to compete in certain articles, especially bromides, in which they run the Germans hard. France is making vigorous efforts to regain the field which it has lost in Italy, but thus far without much success.

It is expected that the new steam communication between Hamburg and the East will assist the former market in gaining ground, as it has already done last year, upon London. Firms cultivating Italian business are particularly cautioned against giving large and prolonged credits or treating directly with the insignificant and generally weak firms in the small provincial towns.

The Sumach Trade.

The trade in one of the chief products of Sicily, sumach (*Rhus Coriaria*), has grown in the course of the year 1886 and is receiving increased attention. Sumach appears in the markets in England and America in the form of a more or less coarse powder packed in bags of from 50 to 60 kilos., and produced by the grinding of the twigs and leaves when dried. To France the twigs and leaves are exported while in a dried state. The powder serves both as a dye and as a mordant to fix other dyes, and for purposes of tanning. Good sumach contains from 30 to 40 per cent. of the dyeing or tanning principle. The shrub is said to have been originally transplanted from Asia; it flourishes most in high and dry soils and requires little attention after first planting. The plants when once set out will last for a century or two. For the first three years the leaves have little value, but after that time they acquire their due proportion of their peculiar qualities. The plant is a low perennial shrub with long slender leaves. The harvest is made by cutting off the leaves every year, after which the plant throws forth feed-shoots. Sicilian sumach, especially that about Palermo, enjoys a high reputation, as does also the sumach of Spain and Portugal. The soil of Dalmatia is also peculiarly fitted for this plant, and the cultivation of it is fostered by the Austrian Government. The largest and most luxuriant plants do not produce the greatest amount of tannin, and even in Sicily there is great difference in the quality of the powder produced from this plant. The Sicilian sumach powder is of two sorts: the best is of a rich green colour and carefully sifted; it is soft to the touch, of a rather pleasant smell, and of a strong astringent taste. The second has these qualities in an inferior degree, while its colour degenerates and takes a reddish hue. The sumach grown in Continental Italy is much inferior to the Sicilian, and has a yellowish colour tending both to green and red. None of the inferior sorts are prepared with such care as the best Sicilian, and are known by the prevalence of unground fibres and minute chips, indicative of less pains taken in sifting. Various adulterations are practised in preparing sumach for the market; the most obvious, that of mixing it with mineral dust, can be discerned by steeping the suspected powder in water, when the mineral portions will fall to the bottom. When vegetable substances are used, chemical analysis must be resorted to.—*Chemist and Druggist.*

BULGARIA.

Soap.

According to the report of tho French Consul at Varna, the imports of soap here are mostly obtained from Turkey, although small quantities are obtained from both England and Austria. The Consul expresses surprise that the French have up to the present made no attempt to compete, French soap being almost entirely unknown. Two factories having been established in the neighbourhood of Varna, the imports from foreign countries are likely to diminish, as these factories are already beginning to supply the wants of the country.

JAPAN.

Drugs and Chemicals.

According to German official reports England still holds the premier position in regard to exporting drugs to this country. The value of those exported from Germany during the year 1886 was only 26,000*l.*, the value of English exports being 98,000*l.*; but according to the same reports, more than a quarter of the latter was really of German origin, though shipped from England, nearly the whole of the salicylic acid and morphia stated to be shipped from England really coming from Germany. The value of goods so passed through England is estimated at 34,000*l.*, and in the German reports anxiety is expressed to call attention to the fact that this amount considerably reduces the disproportion in the figures as stated above. In dye-stuffs, although England is credited with having shipped to the value of 4,000*l.*, the German reports state that the bulk of these shipments are of German manufacture, and that the value of the English goods does not really exceed 600*l.*

PERU.

Opium.

Her Majesty's Minister at Lima states that a Bill has been passed constituting the opium trade a Government monopoly.

PHILIPPINE ISLES.

Character of the Market.

It is pointed out that the character of the markets here is not liable to variation, and uniformity in class and quality are the things most requisite to protect articles against the effects of competition with the goods of other countries.

Drugs, &c.

The greater part of the trade in drugs with these islands is confined to the Germans, but in some things, such as chlorate of potash, citric acid and powdered mustard the superiority of the English is fully maintained. The value of the imports of drugs for 12 months is put down at 87,235*l.*, but the largeness of this amount is partly due to the fact that many things are included under this heading which are not, strictly speaking, drugs. Patent medicines and specifics are in great demand, and are largely imported from France, although both England and the United States compete to a great extent.

UNITED STATES.

Chemicals.

The British Consul at Baltimore reports that the receipt of chemicals—which come almost exclusively from England—shows a slight increase; this, however, is not a branch of business in which fortunes are to be made in this country, the importer and wholesale merchant being forced to grant large credits, which the depressed condition of agriculture often renders very difficult to realise.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

IMPORTS INTO THE UNITED KINGDOM FROM SPAIN.

PRINCIPAL ARTICLES.		February 1887.	February 1888.
Chemical products unenumerated	Value £	7,032	4,733
Copper ore and regulus	Tons	3,406	7,498
	Value £	67,756	122,245
Manganese ore	Tons	..	..
	Value £	..	..
Pyrites of iron or copper	Tons	59,295	46,152
	Value £	104,212	86,942
Quicksilver	Lbs.	600,000	750,600
	Value £	58,500	88,824
Rags, Esparto	Tons	8,300	6,426
	Value £	40,234	36,319

Total Value	1887.	1888.
February	£890,692	£885,003
March	£906,072	£1,172,198

EXPORTS OF BRITISH AND IRISH PRODUCE FROM THE UNITED KINGDOM TO SPAIN.

PRINCIPAL ARTICLES.		February 1887.	February 1888.
Alkali	Cwts.	18,647	17,729
	Value £	6,559	5,604
Caoutchouc manufactures	Value £	1,363	1,110
Cement	Tons	330	301
	Value £	940	557
Chemical products (including dye stuffs)	Value £	4,609	5,631
Coal, products of (including naphtha and paraffine)	Value £	4 800	2,627
Glass manufactures	Value £	660	566
Grease, tallow, and fat	Cwts.	1,598	3,666
	Value £	1,502	3,294
Manure	Value £	16,044	22,612
Painters' colours and materials	Value £	2,371	1,786
Paper of all sorts	Cwts.	975	531
	Value £	2,099	1,441
Soap	Cwts.	286	264
	Value £	287	205

Total Value	1887.	1888.
February	£297,122	£309,828
March	£327,115	£313,690

STATISTICS.

BOARD OF TRADE RETURNS.

IMPORTS.

—		March 1886.	March 1887.	March 1888.
Drugs, unenumerated..	Value £	60,328	58,868	106,802
Chemical manufactures and products, unenumerated	„	119,577	117,152	120,456
Chemicals and dye-stuffs, unenumerated	„	164,847	154,300	194,242
Oils, not enumerated...	„	76,944	59,388	85,038
Alkali	Cwt.	4,517	4,571	5,219
	Value £	3,096	3,424	3,380
Brimstone	Cwt.	44,943	38,521	74,757
	Value £	10,566	8,686	16,451
Nitrate of soda	Cwt.	131,017	226,220	177,076
	Value £	78,884	115,597	91,407
„ of potash......	Cwt.	26,510	39,839	20,684
	Value £	23,676	34,937	24,797
Quicksilver	Lbs.	538,425	313,500	1,088,299
	Value £	42,724	30,575	112,082
Cinchona bark.........	Cwt.	8,500	16,670	15,017
	Value £	50,924	80,385	63,095
Gum Arabic	Cwt.	8,385	2,794	4,000
	Value £	27,554	14,969	17,650
Lac, seed, shell, stick, and dye	Cwt.	11,104	10,913	15,726
	Value £	32,820	28,475	42,528
Bark (for tanners' or dyers' use)..........	Cwt.	23,501	24,805	8,235
	Value £	7,926	10,335	2,702
Aniline	Value £	19,424	27,950	21,898
Alizarine	„	24,149	20,706	26,707
Other coal-tar dyes	„	418	244	976
Cochineal..............	Cwt.	1,095	695	744
	Value £	6,299	3,878	4,727
Cutch and gambier	Tons	3,248	3,924	3,165
	Value £	74,900	93,742	80,367
Indigo.................	Cwt.	19,389	17,642	16,384
	Value £	424,904	371,841	363,097
Madder, madder-root, &c.	Cwt.	1,977	1,460	1,431
	Value £	3,525	1,678	1,932
Cocoa-nut oil	Cwt.	8,467	19,096	37,399
	Value £	10,838	27,524	46,770
Olive oil	Tuns	3,473	2,707	1,970
	Value £	134,413	99,087	77,005
Palm oil	Cwt.	97,326	80,131	83,090
	Value £	99,944	81,334	81,395
Petroleum oil	Gals.	6,294,481	4,768,355	6,114,118
	Value £	215,023	150,873	171,874
Oil seed................	Tons	970	1,494	1,449
	Value £	24,672	34,147	35,452
Turpentine	Cwt.	11,153	8,714	34,053
	Value £	16,620	11,359	47,463

EXPORTS.

—		March 1886.	March 1887.	March 1888.
British and Irish produce—				
Drugs and medicinal preparations, unenumerated	Value £	71,108	81,750	86,284
Sundry chemicals	„	162,831	185,795	189,128
Painters' colours and materials	„	118,226	119,707	117,813
Alkali	Cwt.	537,764	543,104	420,868
	Value £	156,680	154,709	127,961
Bleaching materials .	Cwt.	137,583	164,480	113,237
	Value £	44,074	62,512	42,285
Seed oil.............	Tons	7,416	8,601	7,980
	Value £	157,448	171,379	160 337
Soap.................	Cwt.	40,716	33,457	51,578
	Value £	44,415	38,117	48,125
Foreign and Colonial merchandise :				
Chemicals, unenumerated	Value £	12,404	22,022	35,104
Cinchona bark	Cwt.	9,928	17,416	9,977
	Value £	66,727	71,673	29,016
Cochineal...........	Cwt.	851	704	422
	Value £	5,497	4,521	2,635
Cutch and gambier .	Tons	1,154	483	685
	Value £	26,719	12,471	18 300
Gum Arabic	Cwt.	4,404	2,595	3,019
	Value £	17,094	10,865	12,914
Indigo..............	Cwt.	12,624	9,865	8,170
	Value £	281,700	222,238	172,239
Lac, seed, shell, stick, and dye	Cwt.	5,979	6,644	5,207
	Value £	18,174	18,134	13,386
Cocoa-nut oil	Cwt.	5,435	6,250	6,515
	Value £	7,558	8,914	9,394
Olive oil	Tuns	347	166	190
	Value £	15,083	8,020	8,586
Palm oil	Cwt.	28,234	39,437	58,082
	Value £	30,101	39,756	57,466
Petroleum oil	Gals.	56,156	31,294	36,076
	Value £	2,628	1,242	1,468
Quicksilver.........	Lbs.	768,496	361,113	180,768
	Value £	59,439	33,730	19,845
Nitrate of potash ...	Cwt.	2,212	2,460	1,120
	Value £	1,942	2,268	925

THE MINERAL PRODUCTION OF CANADA IN 1887.

We have received from Mr. E. Coste, of the Geological Survey of Canada, the following statement of the mineral production of Canada in 1887:

Name of Product.		No. of Returns (a).	1887. Quantity (b).	1887. Value (c).
				Dollars.
Antimony ore	Tons	1 + N. S.	434	18,960
Arsenic	..	1	30	1,200
Asbestos	..	11	4,573	227,716
Baryta	..	N. S.	400	2,000
Brick	Thousands	210	139,185	725,694
Building stone	Cub. Yds.	90 + N. S.	223,835	450,934
Cement	Bbls.	6	69,843	81,900
Charcoal	Bush.	6	1,610,900	88,823
Chromic iron ore	Tons	1	38	570
Coal	..	23 + N. S. & B. C.	2,368,041	5,208,429
Coke	..	N. S.	32,198	86,244
Copper (d)	Lbs.	4	3,260,424	342,345
Flagstone	Sq. Ft.	4	110,925	10,811
Gold (e)	Ozs.	6 + N. S. & B. C.	62,289	1,111,877
Granite	Tons	11	15,098	98,995
Graphite	..	1	300	2,400
Grindstone	..	5 + N. S.	2,772	35,368
Gypsum	..	9 + N. S.	151,008	157,277
Iron (f)	..	8	31,527	1,057,728
Iron ore	..	10 + N. S.	76,330	146,197
Lead (fine, contained in ore)	Lbs.	1	204,800	9,216
Lime	Bush.	102 + N. S.	2,303,667	389,369
Limestone for iron flux	Tons	3	17,171	17,500
Manganese ore (g)	..	3 + N. S.	1,680	39,672
Marble and serpentine	Tons	2	242	7,845
Mica	Lbs.	3	22,083	29,816
Miscellaneous clay products		7	..	78,670
Ochre	Tons	1	100	1,500
Petroleum (h)	(Barrels of 35 Imp. Galls.)	..	594,411	463,641
Phosphate (i)	Tons	16	23,690	319,815
Pig-iron	..	3	24,827	366,192
Platinum	Ozs.	1	1,400	5,600
Pyrites	Tons	2	38,043	171,194
Salt (j)	..	18	60,173	166,394
Sand and gravel (exports)		..	180,860	30,367
Silver (k)		..	..	322,602
Slate	Tons	2	7,357	89,000
Soapstone	"	1	100	800
Steel (l)	"	5	7,326	331,190
Sulphuric acid	Lbs.	4	5,477,950	70,669
Superphosphate	Tons	3	498	25,943
Tile	Thousands	69	8,355	136,112
Whiting	Bbls.	1	500	600
Total	..	..	..	12,959,073

(a) These numbers show the number of mines, quarries, or works producing in 1887, and of which returns have been received. They are believed to represent very nearly the total number of the producers in every case, except for coal, iron, and steel, marble, building stone, lime, bricks, tiles, and cement. A return of the total quantity of each mineral produced in the Provinces of Nova Scotia and British Columbia has been furnished by the Department of Mines of these Provinces. The number of producers was not stated, and the letters N. S. and B. C. indicate where the returns are included.

(b) Quantity marketed except when otherwise specified. The tons are of 2,000 pounds.

(c) Market value less charges of transport from point of production.
Nova Scotia and British Columbia values have not been received, but are estimated as above, except for grindstones.

(d) Quantity of fine copper manufactured from the ore of Capelton plus fine copper contents calculated from assay value in the other returns.

(e) Nova Scotia gold is estimated at 19·50 dollars an ounce, and British Columbia gold at 17 dollars an ounce.

(f) This includes six rolling mills, one forge, and also the Londonderry Iron Works. The returns from the four Montreal rolling mills and from another mill at St. John, N.B., have not been received, and unfortunately render this statement incomplete.

(g) The value of the Nova Scotia ore is estimated at only 25 dollars per ton, as the returned quantity is thought to include a certain amount of low grade ore used in making paint.

(h) Crude equivalent of the quantity (7,905,666 imp. gallons) of refined oils inspected, calculated at 100 gallons crude for 35 gallons refined. The direct returns received from 13 refineries gave the quantity of illuminating oils and benzine and naphtha manufactured during the year as 10,732,395 imp. gallons, worth 1,022,739 dollars, and the actual corresponding consumption of crude returned as 763,933 barrels.

(i) Direct returns: the value is taken at an average of 13·50 dollars a ton at the mines. This production is divided as follows:—

	Tons.
From Ottawa County mines	18,955
From Ontario mines	4,735
Total	23,690

which agrees very nearly with the Customs Department figure of export, which is for the calendar year 1887, 23,152 tons, with a declared value of 433,217 dollars.

(j) In barrels of 280 pounds it would be 429,807 barrels. The value is that of the salt alone, exclusive of packages.

(k) Export returns plus 116,318 dollars estimated silver contained in the copper pyrites of the Capelton mines—altogether the total production is probably from six different mines.

(l) Return probably not quite complete.

—*Engineering and Mining Journal, New York.*

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

4139. J. J. Hicks, London. Means or apparatus for ascertaining the specific gravity of liquids. March 17.

4216. E. Akroyd, Bradford. Smoke consuming furnaces. March 20.

4217. E. Akroyd, Bradford. Steam-boiler furnaces. March 20.

4398. T. G. Pascall, London. A combined evaporating and propagating pan. March 22.

4402. W. P. Thompson.—From the Porcelain Dental Art Co., United States. Hydrocarbon furnaces. March 22.

4590. R. A. Dent, Sheffield. Apparatus for prevention of incrustation in steam-boilers. March 26.

4661. R. Shackleton, Bradford. Improvements in the method of and apparatus for consuming smoke. March 27.

4677. R. Reichling, London. A vapour condenser and water purifier or heater. March 27.

4689. A. Rathbone, London. Apparatus for cooling, heating, or condensing fluids. March 27.

4698. W. Bergh, London. Centrifugal fluid separating machines. March 27.

4766. S. H. Johnson and C. C. Hutchinson, London. Filter presses. March 28.

4851. J. K. Kilbourn, Liverpool. Compression pumps for gaseous fluids. March 31.

4871. W. Stuart and G. Young, Dundee. Apparatus for regulating the surface flow of liquids from tanks or coolers. March 31.

4917. H. Roberts, E. F. Roberts, and W. Holliday, Batley. Removing scale from steam-boilers, &c., and preventing such formations. April 3.

5083. J. A. Walker, London. An improved apparatus for generating steam and heating purposes by liquid fuel. April 5.

5246. J. H. Breze, London. Apparatus for condensing, cooling, and heating fluids, and machinery employed in the construction thereof. April 9.

5354. W. Bartholomew, London. Crucible tongs. April 11.

5369. F. Wrigley, Manchester. Apparatus for straining liquids containing material in suspension. April 11.

5418. W. Schmidt, Berlin. Improvements in the method of cooling or condensing vapours, and in the apparatus therefor. April 12.

5426. J. S. Sawrey and H. Collet, London. Apparatus for separating liquids from solid matters in suspension therein. April 12.

5508. A. T. Hunter.—From C. W. Stewart, United States. Fireplace for burning liquid fuel. April 13.

5527. R. Le Las and A. Robin, London. Apparatus for supplying furnace fires with moistened air. April 13.

5808. R. Cooper, H. F. Clayton, and G. H. Holroyd, Huddersfield. An improved filter, and apparatus connected therewith. April 18.

5812. R. Shackleton, Bradford. Improvements in the method of and apparatus for superheating steam. April 19.

5829. W. Fairclough, Manchester. Means for automatically removing scum, impurities, and deposits from boilers, separators, economisers, filters, &c. April 19.

* *COMPLETE SPECIFICATIONS ACCEPTED.*

1887.

5998. J. Ruscoe. Self-sealing retort lids, cross-bars and fastenings. March 24.

7466. T. Nelson. Filters. March 24.

14,169. J. J. Hicks. Hydrometers and saccharometers. April 7.

1888.

1836. O. H. Jewell. Apparatus for purifying and filtering water. March 24.

3976. H. H. Leigh.—From J. Bernström. Apparatus for heating liquids to be treated in centrifugal separators. April 21.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

4114. G. H. Lilley, London. Improvements in Lilley's porous blocks (for effecting the combustion by absorption of liquid hydrocarbons) by partially covering said masses or blocks with metal or glass, to regulate the consumption of light and heat emanating therefrom on applying a light thereto. March 16.

4129. W. A. Harrison and J. Bowing, London. Improvements in the manufacture of patent fuel. March 17.

4158. R. B. Avery, London. Improvements in apparatus for generating and burning gaseous fuel. March 17.

4162. J. H. Glew, London. Improved compound or admixture of materials for the production of fire-lighters. March 17.

4372. W. Foulis and A. J. Liversedge, Glasgow. Improvements in the manufacture of gas, and in apparatus used therefor, the said apparatus being adapted to other manufactures. March 22.

4412. S. W. Ludbrook, London. Improved front and door for gas retorts. March 22.

4484. J. E. Wren, London. Improvements in the manufacture of illuminating gas for domestic and other purposes. Complete Specification. March 23.

4833. W. Lindsay, London. Improvements in the manufacture of artificial fuel. March 29.

4885. J. H. R. Dinsmore, Liverpool. Improvements in or connected with the manufacture of gas from coal. March 31.

4953. C. Westphol, London. An improved means for the production of water gas. Complete Specification. April 3.

5017. J. M. C. Paton.—From W. A. van Dyk and S. Wilkinson, Java. Manufacturing gas for heating and illuminating purposes from molasses and other saccharine substances. April 4.

5102. E. P. Williams and W. J. Thomas, London. Improvements in and connected with gas lighting or burning apparatus. Complete Specification. April 6.

5259. J. V. Capek, London. Improvements in electrical heating. April 9.

5283. E. Brook, London. Improvements in gas producers. April 10.

5466. A. Treeby, London. Improvements in apparatus for carburetting or enriching air, gas, or other vapour, or for vapourising hydrocarbons, chiefly designed for use as a lamp or lighting apparatus. April 12.

5689. J. Swallow and N. Proctor, London. Improvements in artificial fuel. Complete Specification. April 17.

5734. H. H. Lake.—From O. C. L. Praëm, Denmark. Improvements in candles. April 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

1767. J. H. R. Dinsmore. Manufacture of gas, and apparatus therefor. April 14.

5035. H. Jefferies. Hydraulic apparatus or valve to be used in the manufacture of coal and other gases. March 31.

6342. G. Downing.—From T. Bauer. Coke ovens. March 31.

6652. B. H. Thwaite. Combustion of oil spray or gas from liquid hydrocarbons for heating or lighting, and apparatus therefor. March 24.

7067. W. H. Beck.—From A. Krieger. Automatic apparatus for production of carburetted air gas. March 24.

7156. J. Keith. Apparatus for manufacturing oil gas. March 24.

7713. J. H. R. Dinsmore. Washing and purifying coal gas, and apparatus therefor. April 21.

7714. J. H. R. Dinsmore. Manufacture of illuminating gas from coal. April 21.

7811. W. Bäcker. Treating tar for the purpose of producing illuminating and heating gas and coke. April 21.

7908. A. E. Barthel. Gasometers. April 21.

8414. J. A. Yeadon and R. Middleton. Apparatus for drying small coal or coke, or for desiccating granular substances. April 14.

1888.

2597. H. H. Lake.—From A. C. Humphreys. Apparatus for the manufacture of gas. March 31.

3082. N. Fouquemberg. Machinery for agglomerating fuel, &c. March 31.

3802. A. Tack and F. Girard. Manufacture of coke for metallurgical and other purposes. April 21.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

3830. W. H. Pitt and G. H. van Vleck. Improved process of distilling petroleum. April 21.

7867. W. M. Fraser and J. Snodgrass. Primary distilling apparatus for shale or other oil-yielding mineral. March 31.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

4217. W. P. Thompson. — From The Actien Gesellschaft fur Chemische Industrie, Rheinau, Germany. Improvements in the manufacture of colouring substances by the reaction of aromatic hydrazin sulphonic acids on retenchinon. March 19.

4476. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. Improvements in the manufacture of blue colouring matters suitable for dyeing and printing. March 23.

4625. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrication of Berlin. The manufacture of a new alpha-naphtholdisulphonic acid. March 26.

5494. H. H. Leigh.—From R. G. Williams, New York. Improvements in the manufacture of colouring matters. April 11.

5484. J. Dawson and R. Hirsch, Kirkheaton. Manufacture of a new alpha-naphthylamine-mono-sulpho acid. April 13.

5784. E. de Pass.—From Messrs. Ewer and Pick, Germany. Improvements in the production of azo colouring matters. April 18.

5852. S. Pitt.—From L. Casella and Co., Frankfort-on-Main. New blue colouring matters, and manufacture of the same. April 19.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5257. C. D. Abel.—From The Farbwerke vormals Meister, Lucius, and Bruning. Production of colour-like bodies, and of dialkylised amidobenzophenones therefrom. March 24.

6687. C. D. Abel.—From The Actien Gesellschaft fur Anilin Fabrikation. Production of azo colours that dye cotton direct from a soap bath. March 24.

6688. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Production of yellow, orange, and red colours by the action of phenanthrenechinone, isatine, or methyl-isatine upon the sulpho-acids of aromatic hydrazines. March 24.

7812. A. Liebmann and A. Studer. Producing a new mono-sulpho acid of alpha-naphthol. April 7.

7833. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Treatment and preparation of naphthazarine (dioxynaphthaquinone), production of a soluble derivative thereof, and application of same in dyeing. March 31.

8265. S. Pitt.—From L. Cassela and Co. Manufacture of a new naphtoldisulphonic acid and of dye-stuffs therefrom. April 14.

8296. L. Paul. Production of colours from tetrazodiphenyldicarbon acid and from its methyl and ethyl ethers. April 21.

8504. C. A. Bennert. Manufacture of colouring matters. April 21.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

4786. J. Petrie and F. W. Petrie, Rochdale. Improvements in machinery or apparatus for washing or cleansing wool or other fibrous materials. March 29.

4968. J. Papleux, Hitchen. Improvements in apparatus for ungumming rhea or other textiles. April 3.

5032. J. McNish. *See* Class XIX.

5338. C. D. Abel.—From F. E. Koethe, Germany. Apparatus for treating textile fabrics with steam. Complete Specification. April 10.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

5035. C. H. G. Schmidt, London. Improved apparatus for subjecting textile materials to the action of fluids for washing, dyeing, bleaching, and other processes. Complete Specification. April 4.

5038. R. Haddon.—From E. Decock, France. A new or improved machine for dyeing skeins of textile material. Complete Specification. April 4.

5153. Brin's Oxygen Company, Limited.—From L. Q. Brin, France. Improvements in bleaching. April 12.

5543. E. Knecht and C. Rawson, Bradford. An improved method of mordanting wool with chromium compounds. April 14.

5550. A. McNab, Glasgow. Improvements in boiling or bleaching and washing textile fabrics and yarn, and in apparatus therefor. April 14.

5761. W. Birch, Manchester. Improved feeding apparatus to be applied to machines for washing, soaping, dyeing, or otherwise treating woven fabrics. April 18.

5828. W. Green and J. Douglas, Belfast. Improvements in printing and dyeing cambric and other similar materials. April 19.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

7556. K. Lockwood and E. L. Adamson. Method of and means for dyeing yarns. March 31.

7911. W. Brierley.—From R. Perzina. Automatic dyeing coppers or vats. April 14.

9027. W. Crowther and J. Crowther. Process for mordanting or fixing mordants on worsted or woollen fibre, and on mixed fibres. April 21.

9211. R. Crompton. Colouring and drying tissue paper and other paper, and apparatus therefor. April 14.

1888.

3753. A. Harmel, M. Harmel, and F. Harmel. Apparatus for dyeing wool, &c. in bobbins and hanks. April 21.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

4262. A. Boake, F. G. A. Roberts, A. Shearer, and W. B. Giles, London. Improvements in the manufacture or production of sodium-meta-sulphite. March 20.

4284. M. R. Wood, London. Improvements in apparatus for the manufacture of mono-carbonate and bicarbonate of soda and allied products. Complete Specification. March 20.

4648. E. W. Parnell and J. Simpson, Liverpool. Improvements in the production of sulphur from sulphuretted hydrogen. March 27.

4653. G. E. Davis, Manchester. A new process for producing carbonates and hydrates of the alkalis. March 27.

4699. W. D. Bohm, London. Improved apparatus for the expulsion of chlorine or other noxious gases from its solutions. March 27.

4767. C. T. Kingzett, London. Improvements in the manufacture of chlorine. March 28.

4843. W. W. Staveley, Liverpool. Improvements in or appertaining to the manufacture of carbonates, sulphites, bisulphites, or hyposulphites of the alkalis, or sulphite, bisulphite, or hyposulphite of calcium, and also of phenol or phenoloid bodies. March 31.

4959. J. J. Lewis, London. Improvements in apparatus for the extraction of ammonia gas from ammonia liquor or tar water. April 3.

5031. J. H. Selwyn. *See* Class X.

5086. W. J. A. Donald, London. Improvements in the manufacture of chromates. April 5.

5212. I. S. McDougall and J. T. McDougall, London. Improvements in means to be employed in the production of solutions containing sulphurous acid or its salts. April 7.

5371. G. J. Geary.—From A. Keiller, Sweden. Improvements in the manufacture of sulphide of zinc for pigment or other purposes. April 11.

5515. H. W. Deacon and F. Hurter, London. Improvements in the obtainment or preparation of hydrochloric acid gas for use in the manufacture of chlorine. April 13.

5600. E. W. Parnell and J. Simpson, Liverpool. Improvements in the production of sulphuretted hydrogen in connexion with the manufacture of alkali by the ammonia process. April 16.

5762. M. N. D'Andria, Manchester. Improvements in the manufacture of ammonia salts. April 18.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5124. G. I. J. Wells.—From S. Pick. Evaporation of liquors containing salts, and separation of those salts. April 7.

6029. W. N. Hartley and W. E. B. Blenkinsop. Manufacture of metallic sulphate. April 21.

6909. C. F. Claus. Obtaining sulphur from iron pyrites, copper pyrites, zinc blende, and other metallic sulphides. April 21.

7504. P. G. W. Typke. Utilisation of bye-products resulting from the manufacture of phosphorous compounds. March 31.

7859. L. A. Staub. Manufacture of carbonate of soda and carbonic acid from the bi-carbonate, and apparatus therefor. April 14.

7906. R. Schneider. Producing hydrate of baryta from sulphate of barium. April 14.

8129. L. A. Staub. Manufacture of carbonates of soda. April 14.

8922. W. N. Hartley and W. E. B. Blenkinsop. Preparation of cobalt sulphate, and its separation from other sulphates. April 21.

1888.

1693. A. Nicolle. Manufacture of phosphorus. April 14.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

4075. A. D. Brogan and A. M. Malloch, Glasgow. Improvements in producing designs or patterns upon casting tables for the manufacture of figured rolled plate and sheet glass. March 16.

4204. A. Taylor and N. Brooke, London. Improvements in the method of, and apparatus for, moulding and pressing earthenware and fire-clay baths, sinks, wash-tubs, mangers, lavatory basins, closets, and other similar appliances. March 19.

4239. J. W. Hartley, Stoke-on-Trent. Improvements in potters' wheels, portions of which improvements may be applied to other purposes. March 20.

4303. W. Cleise, Whetstone, and T. Walters, London. An improved manufacture of beer, wine, and like bottles. March 20.

4502. A. F. Wenger, London. An improved process for decorating pottery, porcelain, glass, enamel, and other vitrified surfaces with metallic ornamentation. March 24.

4632. H. A. Cawkwell, London. Improvements in the manufacture of tiles. Complete Specification. March 26.

4777. T. Button and J. Binner, Barnsley. A machine for chipping glass marbles or stoppers as used in the manufacture of glass bottles. March 29.

4877. J. Prince, Leeds. An invention for use in the making of bricks and tiles, to which he gives the title of "Improved metallic dies for brick and tile making." March 31.

5214. W. D. Gooch, F. H. Varley, and F. B. Lidstone, London. Improvements in the manufacture of porous artificial stone for use as indestructible wicks or burners for lamps, or as filter partitions, and the like. April 7.

5253. F. Beer, London. An improved plastic composition for moulding and other purposes. April 9.

5416. E. Powell, J. W. Bishop, and J. Stonier, London. Improvements in china or earthenware dishes for containing vegetables and the like. April 12.

5482. The Worcester Royal Porcelain Company, Limited, and S. Runford, Worcester. A new process for obtaining decorative effects on china, earthenware, pottery, and glass. April 13.

5488. F. J. Wythes, Birmingham. Improvements in machinery for the manufacture of castor bowls, or other circular solid articles, of potters' clay, or like plastic substance. April 13.

5502. C. Wittkowsky, Berlin. Improvements in the manufacture of mosaic-work. April 13.

5620. R. W. Willis and A. J. Willis, London. A new and improved composition for the manufacture of enamelled earthenware articles. Complete Specification. April 16.

5660. W. F. Murray and W. Cathcart, Glasgow. Improvements in moulding clay or other plastic material to form spouts and other tubular or partly tubular articles, and in apparatus therefor. April 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2380. W. B. Fitch. Manufacture of glass bottles, and apparatus therefor. March 24.

7609. F. Siemens. Ceramic kilns. March 31.

8835. L. A. Fry. Decorating clay ware. April 7.

16,142. G. J. Atkins. Producing a crystalline effect on the surface of glass, &c. April 21.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

5062. F. Radcliffe, Greenwich. Improvements in revolving furnaces for roasting cement and for other purposes. April 5.

5079. J. Birkett, London. Improved form of paving blocks for street crossings and gutters, and composition of waste materials to be used for same, and for blocks for paving and rough building purposes. April 5.

5115. E. Fisher and J. P. Cramp, London. An improvement in the treatment of slag for road making. April 6.

5333. T. H. Lodge, London. Improvements relating to the manufacture of Portland cement and apparatus therefor. Complete Specification. April 10.

5808. A. C. Ponton, London. Improvements in the manufacture of artificial marble, granite, and other stone. April 18.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5814. T. H. Lodge. Apparatus for drying slip or slurry from which Portland cement is produced. April 11.

5815. T. H. Lodge. Manufacture of Portland cement and apparatus therefor. March 31.

6701. B. H. Thwaite, D. L. Collins, and D. Wilson. Manufacturing Portland cement, and apparatus therefor. April 7.

7243. L. G. Knemeyer. Cement for artificial stone work and for coating walls with surface suitable for weather-proof painting. March 24.

7441. A. Busch. Manufacture of cement for building purposes. March 24.

16,529. S. Bond. Apparatus for manufacture of bricks, tiles, and quarries. March 31.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

4072. J. Muller, Manchester. Improvements in miners' safety lamps. March 16.

4086. J. C. Bull, London. Improvements in the manufacture of metallic alloys or compounds. March 16.

4155. E. A. Jones and F. F. Jones, London. An improved method or process of separating or sorting oxides of iron. March 17.

4183. W. Lloyd, Wigan. An improved Davy and Clanny miners' safety lamp. March 19.

4187. T. Bayley, Birmingham. Improvements in the manufacture of oxide of iron. March 19.

4254. E. W. Gillon, F. P. Smith, and G. W. Wales, London. Improvements in the method of treating and tempering open hearth or Bessemer steel wire. March 20.

4263. B. D. Martin, Birmingham. Improvements in the founding or manufacture of chill rolls. March 20.

4281. J. Beasley and A. J. Wood, London. Improved lining and fettling for furnaces used in the manufacture of iron or steel. March 20.

4286. C. F. Croselmire, London. An improved process of extracting pure zinc from zinciferous ores. Complete Specification. March 20.

4290. H. H. Lake.—From the Hon. E. Wiman, United States. Improvements in apparatus for crushing or pulverising ores or other substances. March 20.

4350. H. F. Taylor and W. P. Struvé, London. Improvements in apparatus for coating with tin, lead, or other metals or alloys. March 21.

4418. C. D. Abel, London.—From M. M. Rotten, Germany. Improvements in the extraction of gold and other precious metals from minerals and ores containing them. March 22.

4430. G. J. Atkins, London. Improvements in the treatment of metallic ores, and in apparatus employed therein. March 22.

4594. J. A. B. Bennett, Birmingham. Improvements in the methods of mixing metals of lower boiling points with other metals or alloys or compounds boiling or volatilising at higher temperatures. March 23.

4595. J. A. B. Bennett, Birmingham. Improvements in the mode of manufacturing aluminium chloride. March 23.

4707. H. H. Lake.—From P. H. Adams, United States. Improvements in and relating to apparatus for generating steam, chiefly designed for utilising the heat of slag from blast and other furnaces. Complete Specification. March 27.

4708. H. H. Lake.—From O. B. Peck, United States. Improvements in and relating to apparatus for generating steam, chiefly designed for utilising the heat of slag from blast and other furnaces. Complete Specification. March 27.

4709. H. H. Lake.—From O. B. Peck, U.S.A. Improvements in and relating to apparatus for generating steam, chiefly designed for utilising the heat of slag from blast and other furnaces. Complete Specification. March 27.

4710. H. H. Lake.—From O. B. Peck, U.S.A. Improvements in and relating to apparatus for generating steam, chiefly designed for utilising the heat of slag from blast and other furnaces. Complete Specification. March 27.

4842. G. A. Jarvis, Liverpool. Improvements in or relating to the manufacture of sodium or potassium. March 31.

4951. G. Lindenthal, London. Improvements in the process of refining iron. Complete Specification. April 3.

4975. A. M. Warner, London. Improvements in the manufacture of iron. April 3.

5016. W. P. Thompson.—From C. Kellogg, United States. Improvements in rolling tubes, columns, and other hollow cylindrical articles from hollow ingots, piles, and the like. April 4.

5031. J. H. Selwyn, London. Method or process of treating pyritiferous or other base ores for the extraction of metals therefrom, and production of nitric acid. April 4.

5061. H. Müller, London. Safety fuse and igniting apparatus for setting fire to explosive charges without danger from the presence of fire-damp. April 5.

5084. T. Twynam, London. Improvements in the manufacture of ingot iron and steel. April 5.

5116. J. Willis and Co., Sheffield. Anti-corrosive steel propeller blades and castings for marine, mining, and other purposes. April 6.

5171. J. T. Key, Sheffield. The manufacture of miners' safety lamps. April 7.

5293. B. D. Martin, Birmingham. Improvements in the founding or manufacture of chill rolls. April 10.

5316. S. Pearson, J. Liddon, aad J. H. Pratt, London. Improvements in the manufacture of aluminium and alloys of aluminium. April 10.

5386. T. Twynam, London. Improvements in the manufacture of ingot iron and steel, and in treating the slag resulting from such manufacture for the production of alkalis and alkaline salts. April 11.

5461. W. Cross, London. Improvements in the manufacture or production of aluminium and aluminium alloys. April 12.

5561. C. Wolf and H. Friemann, London. Improvements in miners' lamps. Complete Specification. April 14.

5541. H. J. Allison.—From R. J. Gatling, United States. Improvements in the method of and apparatus for casting ordnance. Complete Specification. April 17.

5665. W. Evans, London. Improvements in blast furnaces. April 17.

5673. C. Cheswright, London. Improvements in the treatment, purification, softening, and separation of zinc, tin, bismuth, and lead, their alloys, waste, manufactured waste, and mode of separating same in a state of fusion and combination. April 17.

5717. P. F. Dillon and J. J. Doyle, London. Improvements in moulds for casting metals. April 17.

5740. H. H. Lake.—From M. M. Bair, France. Improvements relating to the roasting or calcination of lead ores and analogous substances, and to the condensation of the resulting vapours, and to apparatus therefor. April 17.

5856. H. Y. Castner, London. Improvements in the manufacture of sodium and potassium. April 19.

5857. H. Y. Castner, London. Improvements in the manufacture of anhydrous aluminium chlorides. April 19.

5858. H. Y. Castner, London. Improvements in and connected with apparatus for the reduction of aluminium and other metals. April 19.

5859. A. Gutensohn, London. Improvements in the process of and apparatus for coating iron, steel, or other metal plates with tin or other metal. Complete Specification. April 19.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

6028. A. Schanschieff. Miners' safety lamps, to indicate the presence of fire-damp. March 31.

6120. W. Patterson. Miners' safety lamps. 21 April.

6165. R. S. Casson. Manufacture of steel or ingot iron and phosphate of lime. March 24.

6173. R. A. Hadfield. Hardening or toughening steel or steel articles. March 31.

6768. C. Bramall. Portable combined smelting and converting furnace and apparatus. March 31.

7278. J. S. MacArthur, R. W. Forrest, and W. Forrest. Treating ores to obtain gold, silver, lead, zinc, copper, and other metals. March 24.

7494. P. C. Gilchrist. Manufacture of steel or ingot iron by the basic process. March 24.

7495. P. C. Gilchrist, Manufacture of iron and steel. March 24.

7761. E. A. Jones and F. F. Jones. Preparation of oxides of iron, and apparatus therefor. April 14.

7828. G. H. Lloyd, A. L. Lloyd, and A. Bewlay. Method and apparatus for welding boiler flues. April 7.

7908. M. Kennedy and G. Green. Apparatus for washing ores. April 7.

8207. H. Burrows. Open-hearth steel furnaces. April 14.

8276. A. L. Dowie. Treating iron and castings thereof. April 7.

10,659. W. P. Thompson.—From G. L. Robert. Improvements in converters. April 7.

11,868. J. Gilligan. Working up scrap iron or steel in a puddling furnace. April 21.

14,415. W. H. Edwards and C. Britton. Improvements in miners' safety lamps. April 21.

1888.

2584. W. A. Baldwin. Extracting aluminium from substances bearing alumina, and combining same with other metals directly from such substances. March 24.

2692. N. M. Henderson. Miners' safety lamps. March 31.

2896. J. Riley. Basic-hearth steel furnaces. March 31.

2899. J. Riley. Regenerator furnaces for steel making, &c. March 31.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

2313A. S. Z. de Ferranti, London. Improved means for obtaining a uniform continuous current from dynamo-electrical machines. February 15. Previously included in No. 2313 of that date.

4153. F. King, London. Improvements in means for regulating or controlling the secondary current derived from continuous electric current transformers. March 17.

4274. W. P. Thompson.—From C. D. P. Gibson, United States. Improvements in or relating to storage batteries. Complete Specification. March 20.

4275. W. P. Thompson.—From C. D. P. Gibson, U.S.A. Improvements in or relating to storage batteries. Complete Specification. March 20.

4485. F. Maddick and J. Greenwood, London. Improvements in extracting gold and silver from refractory and all other ores by electro-chemical chlorination, and also in recovering the whole of the chlorine by the same process. March 23.

4626. C. Hoepfner, London. Improvements in the electrolytic production of metals. March 26.

4673. P. M. Justice.—From C. Heisler, United States. Improvements in and connected with apparatus for the generation and utilisation of electric currents. Complete Specification. March 27.

4929. W. Gillett and G. Haseltine, London. Improvements in magneto-electric generators. Complete Specification. April 3.

4949. T. Parker, Manchester. Improvements in and relating to alternating current dynamo-electric machines. April 3.

5162. W. M. Mordey, London. Improvements in electric generators. April 7.

5191. H. Edmunds, London. Improvements in storage batteries. April 7.

5393. A. F. St. George and C. R. Bonne, London. Improvements in galvanic batteries. April 11.

5528. E. Hermite, E. J. Paterson, and C. F. Cooper, London. An improvement in voltaic batteries. April 13.

5723. W. Webster, London. The production of chalybeate waters by electrolytic action, and apparatus therefor. April 17.

5790. H. Steinach, London. Improvements in and relating to the preparation of non-metallic porous bodies for electro-metallurgic deposits. April 18.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4832. H. Liepmann. Manufacture of carbon "plates" or electrodes for primary batteries, electro-metallurgical, and electrolytical purposes. March 31.

5958. A. M. Clark.—From L. Maiche. Dynamo-electric and magneto-electric machines. March 24.

6754. R. E. B. Crompton and J. Swinburn. Dynamo-electric machines. March 24.

7021. G. Scarlett. Electro-dynamic and dynamo-electric machines. March 24.

9853. H. Watt. Dynamo-electric machines. April 14.

12,017. P. L. Verchere. Manufacture of carbons for voltaic batteries, &c. April 14.

16,709. T. A. Edison. Electrical generators. April 14.

1888.

633. C. Coerper. Dynamo-electric machines. April 14.

734. J. Noad. Galvanic batteries. April 14.

2308. C. Coerper. Dynamo-electric machines. April 7.

3097. B. M. Drake and J. M. Gorham. Improvement in holding the plates of secondary voltaic batteries. March 31.

3995. H. H. Lake.—From H. Walter. Galvanic batteries. April 21.

4274. W. P. Thompson.—From C. D. P. Gibson. Storage batteries. April 21.

4275. W. P. Thompson.—From C. D. P. Gibson. Storage batteries. April 21.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

4507. W. Stewart, Glasgow. Decolorising animal and vegetable oils and fats. March 24.

4899. M. von Schmidt, London. Improvements relating to the treatment of fatty substances, chiefly designed to adapt them for use in the manufacture of candles. March 31.

5613. W. Rödiger, London. Improvements in the manufacture of soap. April 16.

5794. G. A. Clowes and L. Briant, London. Improvements in the manufacture of soap. April 18.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

16,329. F. Rainbow. Manufacture of soaps and cleansing compositions. March 31.

1888.

3771. J. L. Wade and J. L. Wade and Co., Limited. Manufacture of lubricating solidified oil or grease. April 21.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

4354. S. J. Cluff, Dublin. Improvements in paint, printers' ink, and the like. March 21.

4419. S. B. Boulton. *See* Class XVIII.—C.

4635. G. F. Redfern.—From P. Febregues, France. The manufacture of an improved plastic composition. March 26.

5227. G. J. Foulston, Birmingham. Improved method of and preparation for protecting and preserving bright metallic surfaces. April 9.

5371. G. J. Geary.—From A. Keiller. *See* Class VII.

5399. R. Stone, London. Improvements in the manufacture of paint. April 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

3987. J. A. Bigsby. A gummy varnish, coloured or otherwise, for decorative purposes. March 24.

7376. F. Crane.—From J. Hale and W. D. Field. Lacquers and varnishes. March 24.

7377. F. Crane.—From J. Hale. Varnishes. March 24.

8031. R. Gould. Composition for distempering. April 7.

8253. F. Crane.—From W. D. Field. Pyroxyline compounds and varnishes. April 21.

17,925. L. A. Groth.—From C. Collin and L. Errani. Black liquids for dyeing, printing, painting, and varnishiog. March 31.

1888.

1101. J. O. Wallace and W. Ward. Anti corrosive and anti-fouling ompositions for submerged surfaces. April 21.

3795. F. D. Coninck. Manufacture and application of incombustible paint. April 21.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

4151. A. F. S. Grant and W. Francis, London. Improvements in the process of and means for tanning leather. March 17.

4211. V. Rivière, London. Re-tanning hides and leather. Complete Specification. March 19.

4608. A. E. Arnold, London. Improvements in the manufacture of compressed leather. March 26.

4765. A. H. Hobson. *See* Class XV.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

17,103. E. I. Lanvin-Schraen. Tanning, and apparatus therefor. March 31.

1888.

2353. W. Zahn. Process of tanning. March 31.

3393. T. P. Milligan. Preparing glue-stock for production of gelatine and size. April 7.

XV.—AGRICULTURE, MANURES, ETC.

APPLICATION.

4765. A. H. Hobson, London. Improvements in the treatment of bones and animal waste or refuse generally for the purpose of rendering the same more suited for fertilising purposes, and for obtaining gelatine, glue, and size. March 28.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8528. D. McGregor and J. McArthur, jun. Absorbing moisture from and deodorising refuse matter, and utilising the whole as a manure. April 14.

1888.

3013. P. C. Jensen. An improved fertiliser. March 31.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATIONS.

4178. W. T. Crooke, Stratford. Improvements in pockets or bags employed in the manufacture of sugar and like substances, together with an improved process for cleansing the same. March 19.

4209. A. Chapman, London. Improvements in sugar-cane mills. March 19.

4893. H. V. R. Read, London. Improvements in sugar-cane mills. March 31.

5308. J. A. Wheeler, London. Improvements in the construction of apparatus for crystallising fondants and other kinds of confectionery goods. April 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

6261. J. Buchanan, jun. Apparatus for drying and granulating sugar, salt, &c. March 31.

6936. P. J. E. Heffler. Clarifying and saturating sugar solutions, especially beet-root rob, by means of tannic acid or tannin. April 7.

7813. F. Bosshardt.—From G. Bocquel. Filtering and refining sugar. March 31.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

4616. K. Bernreuther and W. Kumpfmiller, London. An improved apparatus for ascertaining the degree of maceration of barley when malting. March 26.

5612. W. Gerdes, London. An improvement in the production of spirit from waste products of breweries. April 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

7277. J. Takamine. Manufacture of alcoholic liquids. March 24.

9363. G. E. Jacquemin. Manufacture of wine from barley and other grain. April 7.

1888.

2361. W. J. S. Pearce. Apparatus for drawing off the surface of liquids from cooling vats and other vessels. March 24.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

4108. H. W. Hart, London. A new food compound. March 16.

4220. D. Sprungli and Son, London. Process for rendering cocoa soluble or assimilable. March 19.

4423. W. Malcolmson, London. Improvements in cooling and desiccating milk. March 22.

4495. T. Adair, Belfast. Certain improvements in the manufacture of butter and cheese, and in the better flavouring, colouring, and preserving of the same, and in the cleansing, flavouriog, colouring, and preserving of rancid butter, margarine, and all other artificial butters, and apparatus therefor. March 24.

4631. S. M. Caffyn, London. Improvements relating to the preparation of liquid extract of meat. March 26.

4927. T. W. Duffy, London. A new or improved method for preserving bakers' yeast and other analogous purposes. April 3.

5012. J. White, Limerick. A process for manufacturing flaked Indian corn, either white or yellow. April 5.

5078. R. Russell, Glasgow. A new compound to be used in the manufacture of bread, biscuits, and such like articles of food. April 5.

5341. W. H. F. Barbe and W. Benit, London. Improvements in the preservation of milk and cream. April 10.

B.—SANITARY CHEMISTRY.

4215. G. F. Redfern.—From E. Senoraus, France. Improvements in treating decomposed organic substances for rendering them innocuous, and apparatus therefore. March 19.

4267. G. Rodger, Liverpool. Improvements connected with apparatus for purifying and clarifying water and other liquids. March 20.

4517. T. L. Seaton, Sheffield. Improvements in vessels, apparatus and appliances for separating solid matter from water or other liquids during the process of purifying or softening the same by treatment with chemicals or other reagents. March 24.

5321. G. F. Restall, London. Improved apparatus applicable for deodorising and disinfecting drains, sinks, and other outlets, and the like, and for mixing liquids. Complete Specification. April 10.

5861. G. W. Bremner, London. The preparation of mineral substances and their combination with chemical ingredients, or gases therefrom, and fixed air, for precipitating and disinfecting sewage matter. April 19.

C.—Disinfectants.

4419. S. B. Boulton, London. Improvements in antiseptic or preservative compounds, and the application thereof to the preservation of timber, and as pigments or paints. March 22.

5451. W. Black and W. L. Rennoldson, London. Improved manufacture or preparation of antiseptics. April 12.

5631. J. Johnson, Liverpool. Improvements in compositions or powders for cleaning, polishing, purifying, and disinfecting knives, plate, and other culinary or table utensils. April 16.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1887.

8298. J. H. Lock. Treatment, preparation, and preservation of certain alimentary substances. April 21.

1888.

3161. S. Henderson and A. Henderson. A new food compound in the form of bread and biscuits. April 7.

B.—Sanitary Chemistry.

1887.

8441. J. Hanson. Apparatus used in disinfecting, deodorising, and purifying foul matters. April 14.

8800. F. W. Lacey. Apparatus connected with the treatment of sewage. April 21.

C.—Disinfectants.

1887.

8217. G. H. Bolton, J. R. Wylde, and H. Auer. Manufacture of permanganate of soda or a mixture thereof with other disinfecting or oxidising matter. April 21.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

4701. W. P. Bruce, London. Improvements in the manufacture of paper and in apparatus therefor. March 27.

4931. J. Turnbull, jun., Glasgow. Improvements in apparatus for use in boiling esparto grass and other fibrous materials. April 3.

5032. J. McNish, London. Improvements in glazing paper and other textile fabrics. April 4.

5156. J. McNish, London. Improvements in glazing paper, tinfoil papers, and tinfoil. April 6.

5267. J. Davidson, London. Improvements in apparatus used in the manufacture of paper. April 9.

5344. I. S. McDougall and J. T. McDougall, London. Improvements in boilers for use in preparing paper-making materials or for analogous purposes. April 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

6987. G. Hibbert. Apparatus for straining pulp for paper making. March 24.

7980. K. Ktie. Preparation of paper for drawing purposes. April 7.

8591. R. Wood. Apparatus for straining paper pulp. April 14.

8782. J. Wood and R. Wood. Apparatus for straining paper pulp. April 14.

8817. H. J. Simpson, G. MacKirdy, and A. Taylor. Manufacture of wood pulp from a certain tree, bark, and wood. April 21.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

COMPLETE SPECIFICATION ACCEPTED.

1887.

8387. I. Traube and G. Bodlander. Separating fusel or ethereal oil from substances containing the same. April 14.

XXI.—PHOTOGRAPHIC MATERIALS and PROCESSES.

APPLICATIONS.

1887.

18,039. M. H. C. W. Farjasse, London. Improved apparatus for taking positives from photographic negatives. April 12. Antedated 12th November 1887 under International Convention.

1888.

4112. J. J. L. Guyard, London. Improvements in photographic apparatus. March 16.

4180. S. Delicate, Birmingham. Improvements in the construction of dark slides for photography. March 19.

4248. F. Nowlan, London. Improving the form of camera for obtaining photographs of moving and other objects, which he calls "the mitrailleuse camera." March 20.

4537. J. B. Germeuil-Bonnaud, London. A process of photographing in colours. March 24.

4692. A. H. Reed.—From E. H. Riedel, United States. A new or improved photographic dark chamber. Complete Specification. March 27.

4874. E. S. Williams, Dublin. A method for producing photographic emulsions not requiring a base or support as photographic films. March 31.

5140. J. Hines, E. Howell, and A. Howell, Glasgow. Improvements in the modes and means and apparatus for taking and producing photographs, and in appliances connected therewith. April 6.

5189. A. I. Lichtenhein, London. Improvements upon a photographic shutter known as the "Eclipse pneumatic shutter." April 7.

5419. E. Marlow, Birmingham. Improvements in photographic cameras. April 12.

5590. R. J. Appleton, Bradford. Improvements in roller slides for holding and using photographic tissue. April 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4915. W. Trenemen. Production of photographs in colours. March 31.

5903. T. R. Dallmeyer and F. Beauchamp. Instantaneous photographic shutters. April 21.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

4309. E. Turpin, London. Improvements in the manufacture of explosives. March 20.

4310. E. Turpin, London. Improvements in the manufacture of explosives. March 20.

4311. E. Turpin, London. Improvements in the manufacture of explosives. March 20.

5027. R. S. Lawrence, London. Improvements in shells or projectiles containing high explosives, such as dynamite, protecting the same, and fuses therefor. April 4.

5524. F. W. Pleydell Bouverie and W. Balch, London. Improvements in pyrotechnic signals for naval, military, and other purposes. April 13.

5624. C. A. McEvoy, London. Improvements in fuses. April 16.

5686. J. Nicholas and H. H. Fanshawe, London. Improvements in explosives. April 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

7608. H. H. Lake.—From Wohanka and Co. Manufacture of explosives. March 31.

16,672. A. Brock and H. Brock. Ships' signal lights, rockets, Roman candles, &c. April 14.

Printed and Published by Eyre and Spottiswoode, East Harding Street, London, E.C., for the Society of Chemical Industry.

THE JOURNAL
OF THE
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No. 5.—Vol. VII.]

MAY 31, 1888.

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. Ludwig Mond has been nominated to the office of President; and Prof. Jas. Dewar, F.R.S., has been nominated Vice-President under Rule 11.

Sir I. Lowthian Bell, F.R.S., Mr. R. Forbes Carpenter, and Dr. John Evans, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. B. E. R. Newlands and Mr. Alexander M. Chance have been nominated Ordinary Members of Council under Rule 17 in the place of Mr. R. Forbes Carpenter and Dr. John Evans, F.R.S., nominated Vice-Presidents.

The Treasurer has been nominated for re-election, and Dr. F. Hurter has been nominated Foreign Secretary in the place of Mr. Ludwig Mond.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18:—"No such nomination shall be valid, unless it be signed by at least ten members of the Society, who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's office, at least

one month before the date of the commencement of the Annual General Meeting, and the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

Change of Date of Annual General Meeting.

Members are requested to take special notice that the Annual General Meeting in Glasgow will be held on Wednesday, Thursday, and Friday, the 4th, 5th, and 6th July next, instead of the 18th, 19th, and 20th, as notified in the April issue. This change is due to the fact that the Glasgow Fair holidays, during which many works are closed for repairs, begin on the 12th July and last about ten days. A programme of proceedings and other particulars are enclosed herewith, and members' tickets will be issued with the ballot list.

Notice is hereby given that the numbers for January, 1882, 1883, and 1886, and February, 1886, are exhausted, and no orders for those copies can be executed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January, 1882, and February, 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once with Mr. Cresswell.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

CHANGES OF ADDRESS.

Allen, W. H.; Journals to Peninsular Laboratory, Detroit, Mich., U.S.A.

Aubrey, W. H., l/o Plumstead; 19, Ryecroft Road, Courthill, Lewisham, S.E.

Bailey, E. M., l/o Ardrossan; Laboratory, Pumpherston Oil Co., Ld., Midcalder, N.B.

Brin, A.; Journals to 9, College Street, Belvidere Road, Lambeth, S.E.

Cameron, Ian; Journals to 41, Travessa de Sao Nicolau, Lisbon.

Dagger, J. H. J., l/o Liverpool; Phœnix Smelting Works, Neath, Glamorganshire.

Dixon, M. Theodore, l/o Newcastle; Post Office, Johannesberg, Transvaal.

Dott, D. B., l/o Castle Street; c/o Duncan, Flockhart & Co., 104, South Canongate, Edinburgh.

Glover, John, l/o Rothbury Terrace; 2, Jesmond Dene Terrace, Newcastle-on-Tyne.

Glover, Wm., l/o Manchester; Rio Tinto Mines, Huelva, Spain.

Hall, Geo., l/o Rio Tinto; La Carolina, San Luis, Argentine Republic (Journals), and c/o T. M. Hall, 70, King Street, South Shields (subscription).

Hart, T. G., l/o Chelsea; The Improved Safety Gunpowder Co., Ld., 50, Frith Street, Soho, W.C.

James, John H., l/o Streatham; 33, Old Broad Street, London, E.C.

Knipler, F., l/o Cork; c/o R. Harper & Co., Melbourne, Victoria.

Mayenfeld, Dr. E. von Salis, l/o Mannheim; Spalenthorweg 27, Basel, Switzerland.

Molineaux, John (C.B.), l/o Somerset House; Selsley House, Albert Road, Battersea, S.W.

Nishigawa, T., l/o Tokyo; Sappovo Brewing Co., Sappovo, Hokkaido, Japan.

Norman, F. J.; Journals to Lyndhurst, Higher Runcorn, Cheshire.

Redwood, Dr. Theophilus, l/o Bloomsbury Square; 2, Fisher Street, Red Lion Square, W.C.

Reeks, Trenham H., l/o Chelsea; 20, Perham Road, West Kensington, W.

Rothwell, C. F. Seymour; Journals to c/o Edm. Potter & Co., Dinting Vale, near Glossop.

Saint, W. J., l/o Erlangen; Hörmannstrasse 5, Schwabing, München, Bavaria.

Sansone, A.; Journals to 8, Bignor Street, Cheetham, Manchester.

Taylor, G. Crosland, l/o Chester; Ravensear, Helsby, near Warrington.

Tsukiyama, S., l/o Imperial Paper Mills; Printing Department, Ministry of Finance, Tokyo, Japan.

Wells, G. I. J., l/o London; Kinderton Lodge, Middlewich, Cheshire.

Will, W. Watson, l/o Ossory Road; The Laurels, Galveston Road, Putney, S.W.

Williams, Chas., l/o London; Staffel a/Lahn, Germany.

Wright, Jas. C., 8 (not 4, as stated in April issue), Portland Terrace, Redcar, Yorks.

CHANGE OF ADDRESS REQUIRED.

Eaton, W. H., l/o Chemical Works, Queen's Ferry, Flint.

LIST OF MEMBERS ELECTED, 23rd MAY, 1888.

Allen, G. J., 27, Bolton Road, Pendleton, Manchester, chemical student.

Bloxam, Arthur G., Royal Agricultural College, Cirencester, demonstrator of chemistry.

Caldwell, Alfred S., Greenfield Lodge, Lasswade, Midlothian, paper maker.

Cameron, Peter, Bath Bridge Colour Works, Bristol, colour works manager.

Couldridge, Ward, Emmanuel College, Cambridge, teacher of chemistry.

Doherty, Daniel, Laboratory, Somerset House, Strand, W.C., assistant analyst.

Farmer, Prof. Moses G., Eliot, Maine, U.S.A., professor of physics, retired.

Hartford, Jas., 3, Cedar Street, New York, U.S.A., aniline and coal tar products merchant.

Lloyd, Jas. D., jun., Sandwich, Mass., U.S.A., calico printer.

Lund, Jas., c/o Cochrane Chemical Co., Potter Street, East Cambridge, Mass., U.S.A., ammonia works superintendent.

Parker, Chas. E., Vine House, Penketh, Warrington, tanner.

Pemberton, Henry, jun., Laramie, Wyoming Ter., U.S.A., manufacturing chemist.

Ramsay, Wm., 20, Brock Street, Kirkdale, Liverpool, chemical student.

Rigby, John S., 35, Bagot Street, Wavertree, Liverpool, manufacturing chemist.

Stowe, Wm. Thos., Laboratory, Somerset House, Strand, W.C., assistant analyst.

Webber, Geo. W., Oswald Hill, Broomhill Drive, Partick, Glasgow, chemist.

Wood, Milton R., c/o Church & Co., 36, Ash Street, Brooklyn, N.Y., U.S.A., chemical engineer.

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Bevan, A., Bryn Chemical Works, Llanelly, South Wales.

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C. R. Alder Wright.

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Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

SESSION 1887-88.

Prospective Arrangements.

June 4th (1st Monday).—Messrs. B. E. R. and J. A. R. Newlands. "The mode of using Char in Sugar Refining."
Mr. Thos. T. P. Bruce Warren. "The Adulteration of Olive Oil and methods of detection."

Notice will be given in the Journal and other Scientific Papers of other Meetings and papers.

Communications to be addressed to the Local Secretary.

Meeting held Monday, May 7th, 1888.

MR. D. HOWARD IN THE CHAIR.

STANDARDS OF LIGHT.

BY W. J. DIBDIN, F.I.C., F.C.S., CHEMIST AND SUPERINTENDING GAS EXAMINER TO THE METROPOLITAN BOARD OF WORKS.

It will be within the recollection of the members of this Society that in April 1885 I had the honour to submit the results of a series of tests on various proposed substitutes for the present legal candle as a standard of light; and that I then stated that the only way to obtain results of a strictly comparative nature would be to make an extended series of tests with the proposed standards on a four-way photometer, by which means one central light would be tested simultaneously by four different standards. Since then I have had an opportunity of fully trying this method, and I now propose to submit an account of the work done and the results arrived at by that system.

The apparatus employed consisted of an arrangement of four open bar photometers, arranged in the form of a cross, so that the central flame afforded by an Argand burner was placed at the terminal of each bar, and the standards to be tried at the free ends of the bars.

As in my former experiments, the gas supplied to the central burner was obtained from a 100-ft. holder, kindly lent for that purpose by the Gas Light and Coke Company. By this means the quality of the gas used remained uniform for each day's work. The walls and ceiling of the room in which the experiments were conducted were distempered dark brown to avoid reflection, and the temperature was maintained fairly uniform by means of hot-water apparatus heated by gas, which was regulated by passing it through an arrangement of mercury thermostats placed in the room, so that when the temperature rose the gas supply was reduced, and thus lessened the heat of the water. By this system the temperature of the room during the winter months was kept, with one exception, December 16th, 1886, to which I shall refer hereafter, at an average of about 65° F., a highly satisfactory result, considering the difficulty incurred by the constant burning of five sources of light, and the presence of three or four operators in a small room for several hours. In consequence of this success under such severe trial, the "thermostatic battery," as I have called it, has been introduced in the Metropolitan Gas Testing Station with marked advantage, both to the accuracy of the work and the comfort of the examiner, as formerly it was not at all an uncommon circumstance, on a change of weather taking place, for the examiner to find the temperature of his station from 75° to 80° F. after the hot-water apparatus had been set for a cold day, and the absence of any automatic regulator other than the ordinary governor.

The results of the 2,120 tests made, involving over 20,000 recorded observations, have been already published in my report to the Metropolitan Board, and I do not now propose to give them in detail, but rather to point out the main features brought to light, and the obvious conclusions to be derived therefrom.

Summarising, therefore, the general conclusions, it appears that the Pentane air-gas flame of Mr. A. Vernon Harcourt most thoroughly answers to all the requirements of a practical standard. In fact, I have nothing to add to the observation contained in my last paper before this Society, viz., it "is very satisfactory in its results, and is easy to work."

The Methven slot has, in the opinion of many, the merit of extreme simplicity, and this is an undoubted advantage; but the uncertainty as to the height of the flame is the chief objection I have to it, as leaving too much to the discretion of the operator. This point is one of great importance when the carburetted gas is used, as slight variations lead to considerable differences in the readings. This objection is entirely overcome in the "ten-candle test" of Mr. Sugg, but here again we meet with the difficulty of the quality of the gas. For the purpose of overcoming this I propose that a modified burner should be used, by which means air simply carburetted by passing over Pentane in a Methven carburetter should be used in place of the coal gas. By these means we have a standard flame independent of the gas supply, an advantage from the popular point of view, and one also free from the defects due to a slight variation in the height of the flame, because, as I have already shown, a variation of an inch and a half does not affect the quantity of light emitted from beneath the screen, cutting off the top of the flame. This proposed practical standard has been by some confounded with the Methven, but it is essentially different, and is identical with the arrangement I used in 1879 and 1880 for standardising the Keates lamp. In it the top of the flame only is cut off, and the whole of the light emitted from the lower and blue part of the flame included in that of the "standard" portion. This admits of the variation of the height of the flame, as, when the flame is lowered, it has less "body" beneath the screen, which is, however, compensated for by less "blue," and inversely, when the flame is lengthened, the "body" of white light is increased, and at the same time the amount of "blue" is also increased, and thus a compensating action takes place, as I formerly pointed out.

In the course of the discussion on my former paper, Mr. M. W. Williams showed and explained Herr von Hefner-Alteneck's amyl acetate lamp; and since that time this proposal has received no little well-merited attention on the Continent. I fully described this lamp in my report which has been published in the columns of the "Journal of Gas Lighting," and elsewhere, and gave it most careful attention. Its great simplicity and convenience at first bid fair to warrant its taking the first rank in the competition of standards; but it was soon noticed that the dull colour of the flame rendered observation at times very difficult, and I concluded that any serious departure from the colour of the light afforded by a standard Argand flame would be open to grave objection, especially when it was used by operators more or less affected with defective vision or colour-blindness. I also found that the prescribed height of the flame, viz., 40 millimetres, was insufficient to afford light equal to an English sperm candle, and that it required to be increased to 51 millimetres to yield a normal "candle."

The many attempts at the production of an electric standard have, unfortunately, up to the present resulted only in failure, and not one proposal of this kind was sent in for examination, although several promises were received. The much-talked-of molten platinum unit of M. Violle is apparently as far off as ever. I thought it, however, advisable to try a scheme which occurred to me, by means of which platinum foil was melted with an oxy-hydrogen flame, and observations taken, at the moment of melting, of the amount of light afforded by a unit surface. At first I hoped for great things from this, but repeated trials have not yet resulted in sufficiently constant results to warrant their publication. The objection seems mainly to consist of the difficulty of uniformly heating the exposed area, and in the "buckling" of the foil. Spectroscopic observation of the various flames gave fairly uniform results with each, except in the case of the amyl acetate, which showed a decided diminution in the violet end of the spectrum, and considerable modification in the yellow.

The very numerous observations with candles brought to light a fact which I had often noticed, and with others had attributed it to a defect in the candles themselves, viz., that when the temperature of the room was unduly high the indications of the value of the opposed flame were at times materially increased. In order to test this I conducted a special experiment on December 16th, 1886. From 11.0 a.m. to 1.0 p.m. the temperature of the room varied only 3° F., viz., from 68° to 71° F., and the indications of the value of the central flame were as follows:—

Candles.	Keates' Lamp.	Pentane.	Methven.
16·8	16·5	16·2	16·1

The temperature was then raised, and from 2.25 p.m. to 4.15 p.m. it rose from 74° to 77°, during which period the following results were obtained:—

Candles.	Keates' Lamp.	Pentane.	Methven.
18·3	16·3	16·5	16·0

Although this was a striking result, the extraordinary variations of the candles under similar conditions render it difficult to formulate a law, and thus apply a correction, especially as a vitiated atmosphere may affect the candles even to a greater extent than increased temperature. If, however, the condition of the atmosphere was solely responsible for these high results, one would assume that the other flames would have been affected in like manner, instead of continuing to give, as they did, almost identical results under the varied conditions.

In selecting the Pentane air-gas for recommendation as the new standard, I have been guided by three main conditions which apply to the present standard, viz.:—

1. That it is a definite combustible material.
2. That the condition in which it exists at the time of use is under control and capable of after inspection for verification.
3. That the rate of combustion, and the manner in which it is effected, is readily observed.

Condition No. 2 is in excess of the capabilities of candles, as it provides for inspection subsequent to the testings by parties feeling aggrieved at the results obtained, a condition which candles by no means comply with; as all photometrists know that a second test even with the same candle is no guide to what may have been obtained in the previous operation.

With respect to the steadiness of the Pentane flame, I have recently had an opportunity of testing this under very stringent conditions. The Gas Testing Station at Blackfriars Road is situated on the second floor of a house in the main thoroughfare through which very heavy and constant traffic passes. I accordingly chose this place as a suitable one for trying the Pentane flame for steadiness. The photometer used there is the new "Imperial," which is a combination of the "Bar" and "Evans" photometers as suggested by the late Mr. Keates. When the Pentane was burnt in this instrument the vibrations caused by the traffic in the street was perceptible only at the extreme tip of the flame, and then only noticeable on careful observation. The readings of the disc were very sharp, and no hesitation was experienced in placing it at the point of equal illumination.

For the purpose of facilitating the comparison of the various tests conducted during the long inquiry, I have drawn the average results of each day's work in diagram form. Diagram No. 1 shows the maximum variation of each proposed standard from the average of its own indications on each day; while Diagram No. 2 shows the percentage number of tests with each standard falling within one per cent. of the mean of its indications. The first diagram shows at a glance that a variation of 10 per cent. was a normal condition of candles with an occasional variety of 18 per cent. The third portion of this diagram is very instructive as showing the improved results afforded by Pentane as greater practice was obtained by the operators, a natural result emphasised by the testings with the Pentane lamp, shown at the bottom of diagram. Had the lamp been as systematically used from the first, and all preliminary results shown, they would certainly not have been so uniform. The second diagram has more the appearance, in the first portion allotted to candles, of a bombarded fence, the few palings of which still standing entire may be taken to represent all that is trustworthy in candles; while the latter tests with Pentane show an almost unbroken front. The following table (A) shows the total number of tests made and the total and percentage numbers within one per cent of the mean.

Diagram 1.

STANDARDS OF LIGHT INQUIRY.

Diagram showing per centage maximum variation from the average of each series of tests.

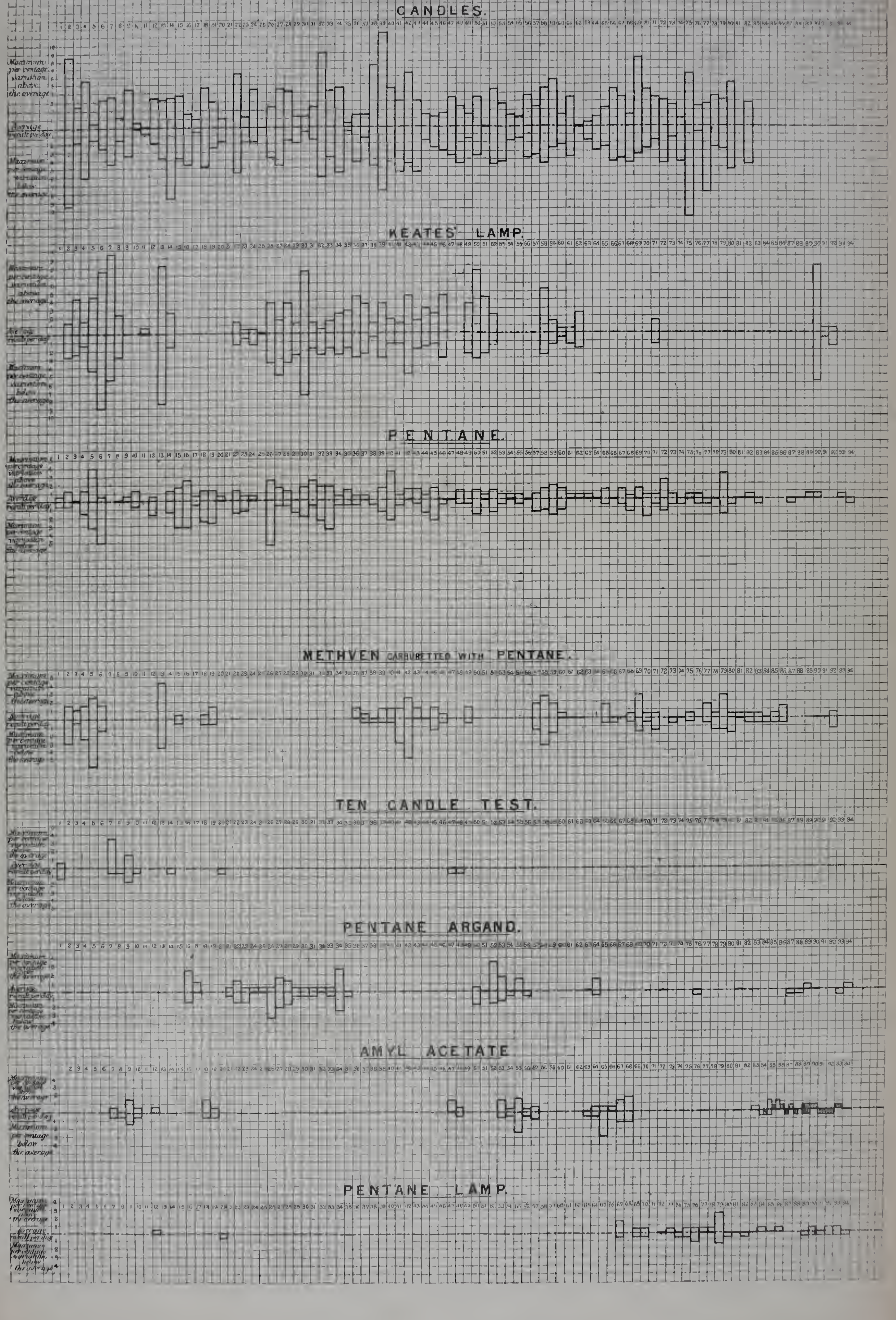
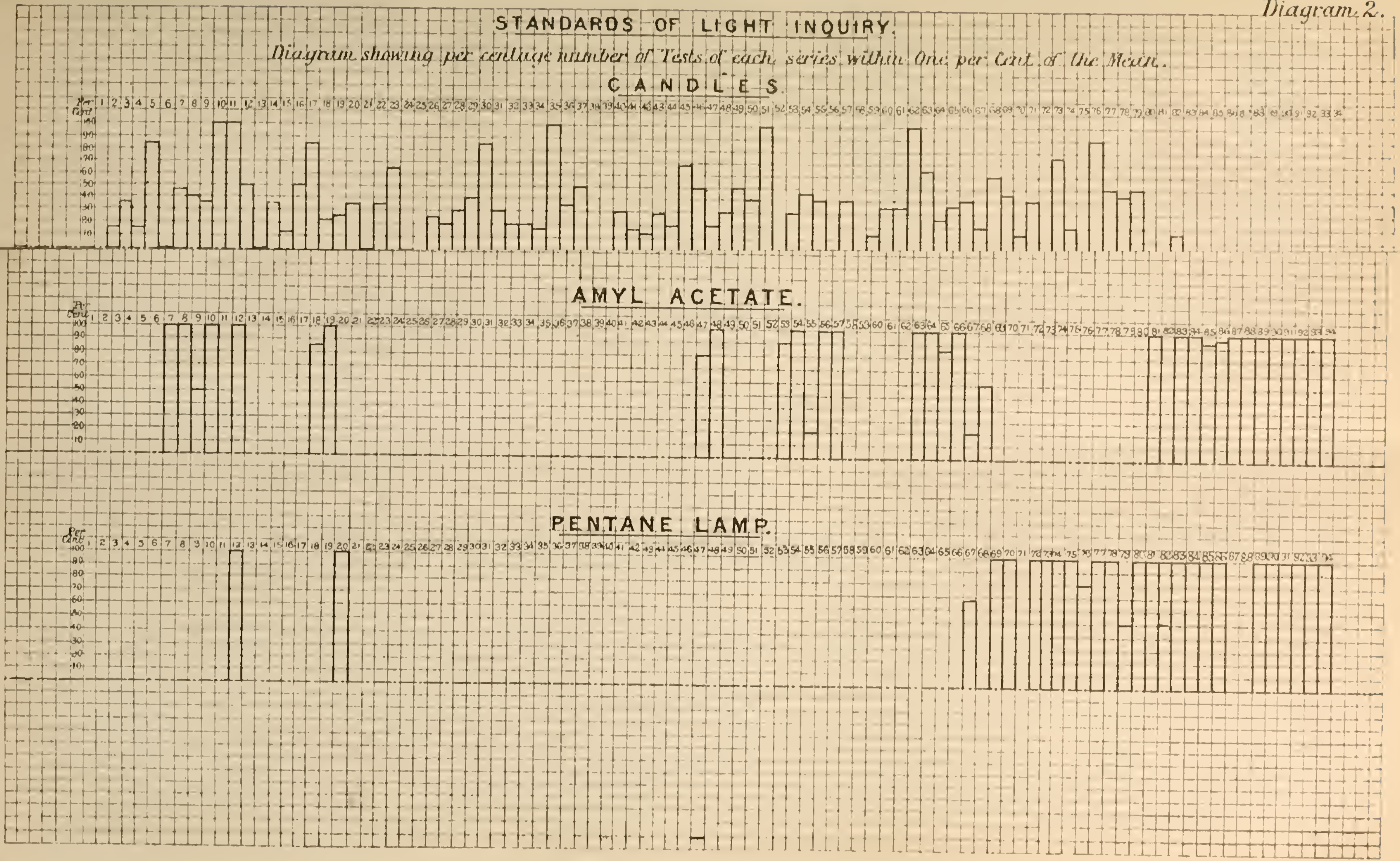


Diagram 2.

STANDARDS OF LIGHT INQUIRY.

Diagram showing per centage number of Tests of each series within One per Cent of the Mean.



STANDARDS OF LIGHT INQUIRY.

Diagram showing per centage number of Tests of each series within One per Cent of the Mean.

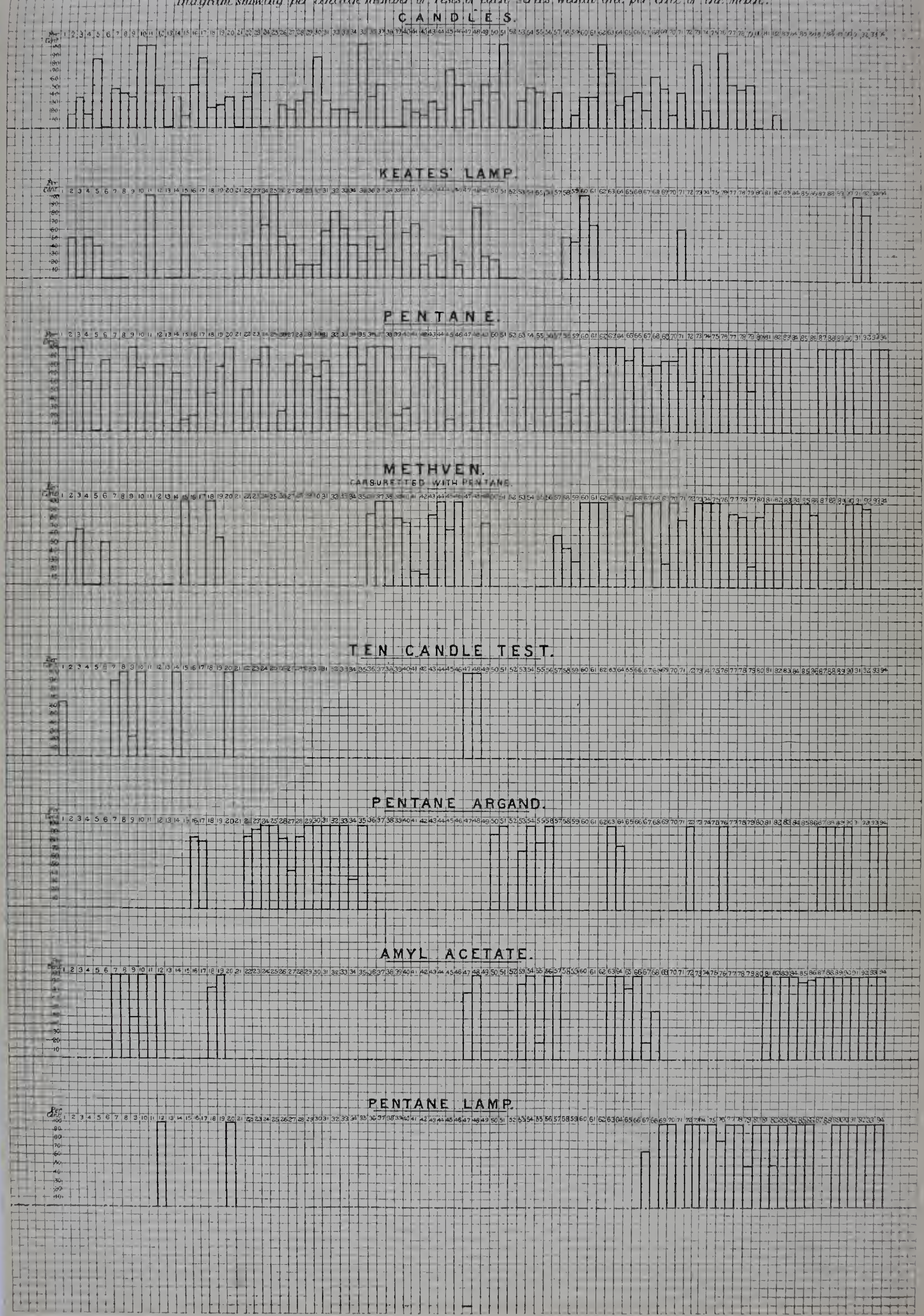


TABLE A.

TABLE showing the TOTAL NUMBER of TESTS made, and the TOTAL and PERCENTAGE NUMBERS within one per cent. of the MEAN (exclusive of those given in the first Report).

Standard.	Total No. of Tests.	No. within 1 per Cent. of the Mean.	Percentage No. within 1 per Cent. of the Mean.
Candles	454	154	34
Keates' Lamp	244	98	39
Pentane	468	373	80
Methven..............	283	211	74
Ten-Candle Test	49	43	88
Pentane Argand	243	212	87
Amyl Acetate....... .	225	206	91
Pentane Lamp........	154	159	97
Total.........	2,129		

One result of these testings is very satisfactory, and that is the establishment of the complete agreement of the two rival proposed standards, viz., the Pentane and the Methven slot. After a most prolonged and laborious investigation by an independent body of skilled observers, we have the average results of the tests by these two systems agreeing to a tenth of a candle, the actual figures being :—

Candles.	Keates' Lamp.	Pentane.	Pentane Lamp.
17·0	16·8	16·3	16·4
Methven.	**Ten-Candle Test.**	**Pentane Argand.**	**Amyl Acetate.**
16·3	16·8	16·4	16·8

An examination of the table of average results here given, Table B. will show that amongst the candle tests are a considerable number so high as to completely discredit the value of an average figure, as out of 81 averages no less than 14 are above 17·5 candles, and 37 above 17·0 candles: results admittedly far too high for an Argand flame only three inches in height.

TABLE B.

AVERAGE RESULTS.

Date.	No.	Barometer Inches.	Thermometer. Fahrenheit.	Candles. Illuminating Power ascribed to Standard Flame.	Keates' Lamp. Illuminating Power ascribed to Standard Flame.	Pentane. Illuminating Power ascribed to Standard Flame.	Pentane Lamp. Illuminating Power ascribed to Standard Flame.	Methven. Illuminating Power ascribed to Standard Flame.	Ten-Candle Test. Illuminating Power ascribed to Standard Flame.	Pentane Argand. Illuminating Power ascribed to Standard Flame.	Amyl Acetate. Illuminating Power ascribed to Standard Flame.	
1888. Mar. 2	1	29·30	64	16·2	..	15·9	..	..	17·3	..	..	..
„ 3	2	29·60	62	18·1	17·6	16·1	..	16·3	..	..	..	..
„ 4	3	29·88	62	16·9	16·9	16·2	..	16·2	..	..	..	..
„ 5	4	29·33	64	16·7	16·6	15·5	..	16·0	..	..	..	..
„ 14	5	30·13	63	17·4	17·3	16·1	..	16·9	..	..	..	..
„ 15	6	29·84	65	16·2	18·9	15·8	..	16·3	..	..	..	..
„ 17	7	29·90	62	17·3	16·9	..	..	..	17·5	..	17·5	..
„ 18	8	30·01	62	17·2	17·7	..	..	..	17·5	..	17·5	..
„ 24	9	30·06	68	16·0	..	16·6	..	..	16·4	..	16·4	..
„ 25	10	30·02	69	16·7	..	16·6	..	..	17·7	..	17·5	..
Apr. 13	11	30·32	64	16·0	16·6	16·1	16·1	..	..	..	..	..
„ 14	12	30·30	63	16·6	..	16·4	16·4	16·2	..	..	18·8	..
„ 15	13	30·32	66	17·5	17·2	16·3	..	16·7	..	..	18·8	..
„ 20	14	29·90	64	16·8	17·3	16·1	15·8	..	16·3	..	..	..
May 11	15	29·60	65	16·0	15·7	15·5	..	14·9	17·7	..	..	..
„ 19	16	30·02	65	16·3	..	16·1	..	..	..	..	..	..
„ 20	17	29·95	69	16·1	16·2	16·1	..	..	..	..	..	..
„ 25	18	29·70	68	16·7	..	16·3	..	16·7	..	..	16·8	..
„ 26	19	29·68	69	16·5	..	16·0	..	16·2	..	..	16·4	..
„ 27	20	29·53	67	16·7	..	16·0	16·1	..	16·4	..	..	..
„ 28	21	29·75	64	17·5	..	16·4	..	..	..	16·5	..	..

TABLE B—*cont.*

Date.	No.	Barometer Inches.	Thermometer. Fahrenheit.	Candles.	Keates' Lamp.	Pentane.	Pentane Lamp.	Methven.	Ten-Candle Test.	Pentane Argand.	Amyl Acetate.	
				Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	
1886.												
June 1	22	29·86	67	16·8	16·4	16·5	..	..	..	16 5	..	..
,, 2	23	29·97	71	16·5	16·8	16·2	..	..	..	16·3	..	..
,, 3	24	30·15	70	16·6	16·7	16·4	..	..	..	16·4	..	..
,, 7	25	29·91	68	16·1	16·4	..	..	..	..	16·4	..	..
,, 8	26	29·95	68	16·7	15·2	15·4	..	..	..	15·3	..	..
,, 9	27	29·82	70	16·9	15·7	16·2	..	..	..	15·8	..	..
,, 10	28	27·83	71	17·2	17·2	16·5	..	..	..	16·3	..	..
,, 16	29	30·12	63	16·3	15·7	15·8	..	..	..	15·7	..	..
,, ,,	30	30·14	66	16·1	18·1	15·7	..	..	..	16·0	..	..
,, 17	31	30·08	65	17·3	17·3	16·9	..	..	..	17·3	..	..
,, 22	32	29·96	65	16·8	17·1	16·5	..	..	..	16·6	..	..
,, 23	33	29·80	67	16·9	16·9	15·8	..	..	..	16·9	..	..
,, 24	34	30·04	66	18·4	17·5	17·0	..	..	..	17·2	..	..
,, 25	35	30·07	68	16·8	17·0	16·6	..	..	..	16·8	..	..
,, 29	36	30·28	70	17·2	17·1	16·8	..	16·5	..	..	..	..
,, 30	37	30·02	73	17·2	16·5	16·8	..	17·1	..	..	..	..
July 6	38	30·20	78	17·5	17·7	16·4	..	16·7	..	..	..	..
,, 7	39	29·87	78	19·7	17·5	16·5	..	16·8	..	..	..	..
,, 8	40	29·86	74	17·1	16·8	16·2	..	16·2	..	..	..	..
,, 13	41	30·00	71	16·8	16·8	16·5	..	16·3	..	..	..	..
,, 15	42	29·85	69	15·7	16 3	16·3	..	15·9	..	..	..	..
,, 20	43	30·11	73	16·7	16·1	16·2	..	16·3	..	..	..	..
,, 21	44	29·90	75	17·3	16·6	16·5	..	16·3	..	..	..	..
,, 22	45	29·90	76	16·9	16·0	15·9	..	16·6	..	..	..	..
,, 27	46	29·84	69	17·1	16·7	16·4	..	16·6	..	..	..	..
,, 28	47	30·15	65	16·9	..	16·5	..	..	16·6	..	17·1	..
,, 29	48	30·12	66	17·5	..	16·5	..	..	16·6	..	17·0	..
Dec. 6	49	29·75	60	16·4	16·6	16·2	..	15·3	..	..	..	..
,, 7	50	29·55	65	16·8	16·7	16·4	..	..	..	16·8	..	..
,, 9	51	29·63	57	15·9	16·6	15·0	..	..	..	16·2	..	..
,, ,,	52	28·83	61	17·4	16·3	16·5	..	..	..	..	..	..
,, 10	53	29·31	58	17·2	..	16·5	..	..	..	16·6	16·9	..
,, 13	54	29·72	56	17·2	..	16·4	..	..	..	16·3	19·9	..
,, ,,	55	29·68	58	17·1	..	16·0	..	..	..	16·1	18·9	..
,, 15	56	29·15	61	15·7	..	15·7	..	..	..	15·7	18·8	..
,, ,,	57	29·15	65	16·1	..	15·5	..	15·5	..	..	15·4	..
,, 16	58	29·44	60	16·8	16·5	16·2	..	16·1	..	..	..	..
,, ,,	59	29·50	76	18·3	16·3	16·5	..	16·0	..	..	..	..
,, 17	60	29·60	68	17·8	16·5	16·5	..	16·0	..	..	..	..
,, 20	61	30·05	52	16·8	16·7	16·0	..	16·0	..	..	..	..
,, ,,	62	30·09	56	17·5	16·8	16·0	..	16·0	..	..	..	..
1887.												
Jan. 6	63	28·90	63	15·9	..	15·6	..	..	..	15·6	15·7	.
,, 7	64	29·03	66	17·4	..	16·6	..	..	..	16·6	16·5	..

TABLE B—*cont.*

Date.	No.	Barometer Inches.	Thermometer. Fahrenheit.	Candles.	Keates' Lamp.	Pentane.	Pentane Lamp.	Methven.	Ten-Candle Test.	Pentane Argand.	Amyl Acetate.	
				Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	Illuminating Power ascribed to Standard Flame.	
1887. Jan. 10	65	29·90	65°	17·5	..	16·6	..	16·3	..	..	16·9	..
„ 11	66	29·93	68	17·4	..	16·5	..	16·7	..	..	16·7	..
„ 12	67	30·40	70	18·6	..	16·6	16·7	16·7	..	..	16·8	..
„ 17	68	30·03	63	19·1	..	17·0	..	17·4	..	..	17·2	..
„ 19	69	30·11	67	19·5	..	16·6	16·7	17·0	..	..	..	..
„ 20	70	30·55	64	18·1	..	15·9	15·9	16·6	..	..	..	..
„ 25	71	30·28	59	17·9	17·2	15·9	..	16·5	..	..	..	..
„ 26	72	30·35	62	17·9	..	16·7	16·6	..	..	16·6	..	..
„ 27	73	30·37	61	17·3	..	16·7	16·6	16·6	..	..	..	..
„ „	74	30·37	63	19·2	..	16·6	16·6	16·6	..	..	..	..
„ 28	75	30·38	63	18·2	.	16·3	16·4	16·3	..	..	..	.
„ „	76	30·45	65	17·0	..	16·5	16·5	..	..	16·2	..	..
Feb. 17	77	30·49	63	15·8	..	15·8	15·7	15·0	..	..	..	..
„ 21	78	30·10	65	16·8	..	16·7	16·7	16·8	..	..	..	..
„ 22	79	30·18	65	15·2	..	15·8	15·9	15·8	..	..	..	..
„ 23	80	30·20	68	18·0	..	16·1	16·1	16·0	..	..	..	..
„ „	81	30·29	68	..	..	16·1	16·1	16·0	..	..	16·0	..
„ 24	82	30·13	65	16·6	..	16·3	16·4	16·4	..	..	..	..
Mar. 1	83	30·59	56	..	..	16·4	16·4	16·4	..	..	16·3	..
„ 2	84	30·65	63	..	..	..	16·0	16·1	..	..	16·0	16·0
„ 4	85	30·46	66	..	..	..	16·0	16·3	..	..	16·4	16·0
„ 7	86	30·34	64	..	..	..	16·3	16·2	..	..	16·3	16·2
April 18	87	30·52	62	..	..	16·9	..	..	..	16·9	16·8	16·9
„ 19	88	30·29	63	..	..	16·4	..	..	..	16·4	16·4	16·4
„ 20	89	30·16	64	..	..	16·5	16·4	..	..	16·3	..	16·3
„ „	90	30·16	67	..	17·5	16·5	16·4	16·4	..	16·4	..	16·3
„ 21	91	29·95	65	..	16·8	..	16·5	16·5	..	..	..	16·5
„ „	92	29·84	65	..	16·9	..	16·4	16·5	..	..	..	16·4
„ 22	93	29·63	65	..	..	16·2	16·1	..	..	16·0	..	15·9
„ 25	94	29·83	63	..	..	16·8	16·8	..	..	16·7	..	16 5
Mean -	..	..	..	17·0	16·8	16·3	16·4	16·3	16·8	16·4	16·8	
Mean of Candle Tests, less the results above 17·5 candles, of which there were 14 out of a total of 81				16·7	..	..	..	..	..	..	..	

The next question which presents itself is "how can a change in the law be obtained so as to permit the use of Pentane, or a qualified higher power substituted for it, in the place of the present candles?" It might possibly be considered that the present vexed questions of local government, &c. block the way, but there is no connexion whatever between the two subjects, as the standard of light controversy is entirely of a non-political character, and can be virtually settled by mutual agreement between the Board of Trade and the gas authorities. The fact that one of the new Metropolitan gas testing stations is being fitted at my suggestion with the Pentane, and at the request of the gas company with the Pentane-Argand, in addition to candles, will, it is to be hoped, only be the forerunner of a speedy alteration at all the other stations. In placing the results of the work done by myself and colleagues on this important question before this Society, I desire to invite the full criticism of its members in order that no points should be left in uncertainty or doubt. I have worked systematically at the question for over 10 years, and sincerely trust that the labours and anxieties of photometrists in this matter are approaching a speedy end by the adoption of a standard reliable under all working conditions.

DISCUSSION.

The Chairman said that in listening to this paper and to the previous paper on the same subject, he had been struck by how very far photometric science had advanced beyond the standard on which it was founded. It was something like using an Oertling's balance with Dalton's weights which were exhibited at Manchester, so inferior was the standard itself to the measurements to be made with it. He should await with great interest the promised further investigations into these standards. The interesting results already brought forward seemed to promise that the extreme uncertainty of the standard candle might be fully done away with. The importance of the subject was especially evident to those who had followed its history. He supposed that in the early days, when very vague results were all that could be arrived at, an error of 10 per cent. in photometry would not have been considered fatal. Even the burners then used were most uncertain in their action. But now that the science had attained to such perfection, and represented not only perfection in itself, but also wonderfully perfect results in the manufacture of gas, it was evident that the standard required that accurate verification of which there was now the opportunity. The Pentane lamp certainly seemed to offer what was required if, in other and less skilful hands, it would give the same constant results shown by Mr. Dibdin. The standard should not need a master's hand, and it was necessary to inquire whether, when brought into practical work, the test was calculated to stand the rougher manipulation to which it would be subjected.

Mr. R. Harris had listened with great interest to the statements made by Mr. Dibdin, and thought he should only express the universal opinion of the meeting when he said that candles as a standard had proved to be somewhat—or indeed very—unreliable. At the same time, if it were contemplated to substitute for the candle test something superior, he considered it necessary to be very careful in what was done. So far as candles were concerned, all were well acquainted with the difficulties attending their manipulation. With respect to the other proposed standards, they had been tried by eminent scientists, and were said to be very superior to candles. But he could not help thinking that there was some little error in the comparison. The proposed standards had been manipulated by men accustomed to very delicate experiments, whereas the results obtained from candles had been got by men who, however expert and able in their duties, were merely carrying on the work of every-day commercial life, and not a purely scientific investigation. It was quite possible, therefore, that the candles should have been credited with qualities worse than they really possessed. In saying that he did not wish to detract in the least from the ability with which they were manipulated. It was well known that he was continually testing these candles, and he could not say that there had been those excessive variations that were sometimes recorded as the result of public examination. Notwithstanding that, he did not wish to uphold candles, but if a change was to be made, it was necessary to see that they got a proper standard, and that it could be compared with the candles as they had been in existence and as gas had been tested for commercial purposes. A purely scientific and accurate standard might be useful for deposition at the Standards Office. But the one which was wanted for every-day work was one that could be easily manipulated and available if a question arose as to what was the illuminating power of the gas at any particular time. One great difficulty that was found in the practical testing of gas was that when the test was once made it was impossible to try it over again and prove whether it was right or wrong. He had not himself made any examination as to which of the proposed standards was the best, but judging from the experience that had been laid before him at various times, he was of opinion that the best one would be a modification of the Methven standard, in which some constant gas should be used as the source of light, of which a definite portion only should be allowed to pass on to the photometer disc, the surplus being cut off by an obstructing screen. A standard as nearly as possible 16 candles, which was the standard of gas in London, would be far the best. It might be something in the form of the 10-candle standard brought forward by Mr. Dibdin, only with a larger flame and a less portion cut off, the object being that those atmospheric conditions which were frequently found to affect the testings should be equal on both sides of the central disc.

A Gentleman, whose name did not transpire, desired, although he could not speak with authority on gas photometry, to put in a plea for candles, because he thought he could shed some light on the extreme variations of luminosity that had been found in candle standards of light. He could assure the lecturer that if spermaceti, derived from the sperm whale, were always used, no difference would be found in its luminosity. The variations found were probably to be accounted for by the candles having been made from spermaceti derived from the bottle-nosed whale found in the Northern seas, the luminosity of which was greatly inferior to that of the spermaceti of the true sperm whale of the Southern fisheries. Doubtless also the variations were to some extent due to adulteration.

Mr. Otto Hehner said there was only one point in the subject under discussion on which those taking part in it could be said to agree, viz., that candles were the worst test. Every one who had made these tests must have soon come to the conclusion that the composition or the genuineness of the candle had nothing to do with the matter. He had frequently subjected to analysis candles which had given widely varying luminosity tests, and had always found them to be virtually genuine sperm. In his opinion the luminosity indicated by the candles was dependent not so much on the spermaceti as on the character of the wick. It entirely depended on the twist of the wick, its hardness, and the amount of chemicals put into it in order to make it burn, whether the candle indicated a high or a low power. Sometimes the wicks were so highly charged with borax that little particles of it collected at the ends of the wicks, in which case they would show a high illuminating power—occasionally of 18 candles. Then sometimes out of the same packet, on the same evening, and with the same gas, there would be some which would indicate only about 16 candles. It must be within the knowledge of everyone practically concerned in the matter, that it was in the power of the gas examiner, if he chose, to select a candle which would give either a low or a high power, as he wished. He was quite sure that an examiner could frequently get in one evening 16 or 18 candle gas from the same supply, and that without any wide stretch of selection. Averages kept fairly constant, but that was simply because the tests were so numerous, as many as thirty tests being made every evening, so that a fair average would generally result. Considering the labour that was spent every day in London alone on the testing of gas, and the badness of the method employed, no one could fail to deplore the energy which was thus wasted. It being agreed on all hands that the candle test was bad, the question now was which of the new standards should be chosen. It appeared to him that Mr. Dibdin, in his extensive and careful investigations, had looked at the matter from two points of view; the one on which he started was: which method gave the best and most concordant results? Having made a considerable number of tests and shown that several of these new standards gave constant results, he had laid down some arbitrary rules as to what conditions these illuminants ought to fulfil, namely, that their composition should be constant, that they should be under control, capable of inspection, and that the rate of combustion should be easy of observation. He would like to know how the standard chosen by Mr. Dibdin—namely, the Pentane one-candle flame—fulfilled this first condition. Taking a meter filled with Pentane gas and air in certain proportions, how could the examiner or referee prove whether it was really standard Pentane? It could not be readily analysed, and it seemed to him not to fulfil the condition that the composition of the standard should be capable of exact verification. The use of Pentane gas in the proposed lamp had the disadvantage of throwing upon the gas examiner the additional onus of making his own standard. Hitherto examiners had had nothing to do with the production of the standard; and if, as had been said, they were men frequently not of the highest stamp (which remark certainly did not apply to Metropolitan examiners), it was exceedingly undesirable that they should have the power of making a standard not readily admitting of after verification. That seemed to him a fatal defect in the Pentane standard, however excellent the results it gave might be. As to the other standards, he thought that of all those depicted on the diagrams the one which gave the best results was the ten-candle test in its two modifications, he did not care which. Mr. Dibdin had excluded them because they had not fulfilled his arbitrary conditions; but he held that they should be judged by their deeds. They had given constant results; and he thought that, quite apart from any conditions, that test should be selected which gave the most constant results and was of the easiest application. What could admit of more ready inspection than a carburettor which, while it contained fluid Pentane, must yield gas of the right composition. The inspector had only to open the carburettor to know if it was giving gas of the standard composition. He had no responsibility in making the gas; he had only to put the Pentane in unlimited amount into the carburettor. He hoped that some standard of that kind would be adopted, throwing no additional responsibility on the examiners—they having quite sufficient responsibility as matters stood at present.

Professor Foster said that when he heard a discussion taking a one-sided view, he felt inclined to say something on the weaker side. It was now nearly 20 years since he was appointed a Metropolitan gas examiner, and at that time the candles were burnt in a way which was not favourable to good results. The official photometer, which he believed was still in use, was nothing more nor less than a closed box, for a description of which he would refer members to an article in the *Chemical News*, published either in 1871 or 1872. The candles were placed in that box, and the readings steadily rose in value. Assuming the gas to be constant, the lighting power of the candles must alter. With reference to the standard now proposed, he thought that, being of the nature of a fluid, it would be more controllable than a solid which had to change its state and be volatilised. If a fluid like Pentane gas could be got of fairly constant composition, that would be of great advantage; and we were told by Mr. Harcourt that he could obtain a gas which, if not of constant composition, would at any rate admit of ready correction. He thought, however, that Mr. Harcourt's one-candle unit showed a weakness, and was glad to find that Mr. Dibdin had modified it and furnished a higher unit. A unit should bear some comparison in point of size and the amount of light it would give to the thing measured. To attempt to measure a 50-candle power light by a one-candle standard would not be advisable. Therefore, in devising a standard for ordinary use, it would be well to remember that a one-candle standard was not desirable on the ground of size, and that if a 16-candle standard could be got it would be better. With reference to the use of slots, he rather objected to a rectangular slot like that shown. Theoretically, he preferred a straight piece of flame—that was to say, a flame with the upper portion only cut off. He thought there were objections to a slot of that kind, shown on the table (Methven screen), if the disc were shifted up and down, nearer or further away from the slot. Though he had found it useful, he thought if one had a light of varying character to determine, if the disc and the slot were in close proximity, the amount of light passing through the slot might vary, and give rise to variations in the results. If there were simply a transverse plate cutting off the light, and one could control the quality of the standard substance being consumed, one would be much more likely to get a reliable standard of light. Whatever was used, it should, he thought, be burnt freely in the air, as was the gas which was being tested. To bottle up the standard in a box where the temperature might rise, and where the supply of air might vary, was not satisfactory. He had a letter from Dr. Letheby, stating that the reason why he, Dr. Letheby, did not take part in a public discussion on the photometer question, was that, having a rival instrument, he thought it would not be graceful to advance his own views on the subject.

Mr. F. Livesey said that those who had followed Mr. Dibdin's work would know what praise was due to him for the trouble he had taken and the results he had obtained. He had proved that candles were not reliable, and that there was but little use in maintaining them. He judged from the lecture that Mr. Dibdin had got the best results from carburetted air, or air passing over Pentane burnt in a 10-candle standard. That method seemed to be exceedingly simple, for, as Mr. Hehner had said, there was no gas to make. Mr. Dibdin had stated that whether the flame was 4 inches or the normal 3 inches, it made no difference in the illuminating power when passing underneath the horizontal screen. If that were so, and, of course, they were bound to believe it, he could see no difficulty in that method; it seemed to be simplicity itself. But he would like to urge, as Mr. Harris had done, that the 10-candle standard should be converted into a 16-candle one, because it was known that an increase of temperature increased the volume of the gas. There were tables given to allow for that difference, and indeed Mr. Dibdin had himself endeavoured to keep the temperature of the room at 60°. Of course, with a temperature of 80° outside, it was difficult to do that; it could be brought up from 30° to 60°, but not down from 80° to 60°. If a 16-candle standard was used, and the gas burnt at both ends of the bar and equi-distant from the disc, no correction would be required. That was what he would like to see done.

Mr. W. Sugg said that one or two points had cropped up in the discussion which he would like to remark upon. Mr. Helmer did not see the way to make the Pentane gas, or thought it would be difficult for the examiner to do it with absolute certainty. He thought there was a simple way of getting over that difficulty. If a certain quantity of Pentane was sealed up in a bottle, it might be put into the gasholder, and the mere act of screwing down the cap of the case in which it was placed would break the bottle and let out the contents. Thus the exact quantity required would be placed in the gasholder without the risk of losing any of the liquid or the gas. He might be excused for preferring to use his own 10-candle or 16-candle test to any other for the purpose of a standard of light, because he had used it for a very long period, and because there was a considerable range in the height of the flame within which the standard would be constant. The examiner (provided he had the flame up beyond 3 inches in height) was sure to have his 10-candle standard. He thought they would be glad to hear that they now had a burner which gave 16-candle light, exactly similar to the one shown by Mr. Dibdin that gave 10 candles. Though this burner was new, and had not been much tried as a standard, it seemed to work out as correctly as did the 10-candle, and it gave no more trouble in the preparation of the Pentane gas. With regard to using the air in the gasholder and carburetting that air, he thought that Mr. Dibdin's experiments had fully demonstrated that there was no difficulty in it. With regard to the control of the Pentane gas—if an examiner had two gasholders, and used one on one night, and left some gas in it, it would be easy to ascertain whether or not that gas by which the test had been made was up to the standard. It could be done by the old duration test of Dr. Fife, by which a constant flame of two or three inches, burning a certain fixed quantity of the gas from a meter, would last so many minutes more or less according to whether the gas was up to the standard or above or below it. With regard to candles (which were very greatly improved in the manner of using them now that their use was likely to be discontinued), he had pointed out some time ago that their accuracy did not depend so much upon the material itself. Such candles as those used in testing gas were not made from the oil of the bottle-nosed whale but from the spermaceti whale with a very small quantity of wax. If the best material in the world was used the same difficulties would occur. Sometimes the wicks would be stretched tight and sometimes slack; sometimes tightly twisted and sometimes not. In burning, the flame would turn round the wick, the bent part of the wick either approaching the disc or receding from it. They used two candles now in order to reduce that error, as when one was used the variations would make a difference of something like a candle or a candle and a half. One system which had been tried was to use two candles burning one wick one way and one the other, but it was found that the wicks, no matter how carefully set, would often get round the contrary way, and thus double the error. The middle of the flames of the two candles ought to be aligned so as to always be square with the end of the bar of the photometer, and there was a means now of screwing them up to the right gauge, so that the operator could align the flames exactly. But do what one would with them, candles would always be an inconstant standard.

Mr. J. Methven said that the only point he wished to refer to was the large number of recorded tests made with candles. Before a new standard could be introduced it was necessary that it should be compared with and rated according to the actual light of an average sperm candle or of a multiple thereof. While agreeing with the other speakers in congratulating Mr. Dibdin upon the results of his laborious investigation, he must in a friendly way express his regret that in making the candle determinations he had not followed the customary practice of excluding all those results in which the consumption of sperm was either above or below the prescribed limits of the referee's instructions. He regretted it because the large number of those experiments, if they had been carried out according to the true letter of the referee's instructions, would have been considered a valuable means of ascertaining the power of the proposed standards. He found that Mr. Dibdin had made 454 candle tests, of which 165, or 36 per cent., had consumed their sperm either above or below the prescribed limit. They certainly had consumed the sperm below the prescribed limit to a marked extent; 5¾ per cent. of the tests had a consumption of sperm exactly 120 grains per hour, 77 per. cent. consumed under 120 grains, and 17 per cent. over 120 grains. The committee appointed by the Board of Trade in 1880 found, as the result of 120 carefully conducted candle experiments, where the consumption of sperm was well within the prescribed limits, that the Harcourt Pentane test was equal to one standard sperm candle. They had compared also the Methven screen, which was found to possess a value of two Harcourts, or two sperm candles. Again, in 1884, the committee appointed by the Gas Institute found that the Methven screen was equal to two candles. In 1885, he believed Mr. Dibdin also found that the Harcourt and the Methven results agreed very closely with the standard candles; he then used the Harcourt with one and the Methven with two. The results given in the present paper showed that the power both of the Harcourt and the Methven was 4½ per cent. more than the average of the candle experiments. He could not but regret this, because he thought it was probably due to the omission he had referred to, viz., that the candles had not been used in accordance with the universal practice of photometrists, and as prescribed in the instructions of the Gas Referees. There was one point with reference to the other standards to which he would refer. He wished to remove the sentimental feeling referred to by Mr. Dibdin, that it was impossible to get a good and satisfactory result by burning coal gas over the Pentane vapour. He had stated in a paper read before the Gas Institute several years ago that if atmospheric air, or coal gas equal to 9, 15, 20, or 30 candles, or hydrogen was passed over the vapour of Pentane, the resulting gases would give an identical light. He thought therefore that the idea of rejecting such a convenient combustible for sentimental reasons was not quite right.

Mr. Dibdin said, in reply: I must congratulate myself not a little upon the reception of the paper I have submitted to the meeting. I really have hardly anything to answer. Mr. Harris considered that the candles were rather unfavourably treated in my experiments, as they showed considerably higher results than are obtained in practice. I certainly agree with that to some extent, because if I took the same candles that were used in these experiments, and burnt them in an open photometer in an open room, I should get very different results. But I used an apparatus which is well known as the Letheby bar, and conducted the experiments in absolutely the same way in which are conducted the ordinary nightly legal testings of gas. If we manipulate candles, or vary the method of using them or the place of using them, we get different results, and in that fact lies their greatest condemnation. If I take a candle and burn it here, in a quiet atmosphere, it gives a different result to what it would if burnt in the photometer, in the Letheby bar, which I have used, and different also in what is known as the Imperial standard. I therefore admit the truth of Mr. Harris's remark, and agree with him that he would probably get different results under other circumstances. Mr. Harris also considered that what is wanted is a standard easily reproduced and not too delicate. I can only reply, here it is. You have here three such standards, and that being so, you have, I think, a choice not of evils but of good things. In the case of candles, Mr. Harris seemed to think that the test once made cannot be verified. In the case of the Pentane test, that is exactly what we can do. With respect to the other standards, the experience that most of us have had of the Methven shows that it can be reproduced; and the Pentane Argand test can also be reproduced, the only difference being that we burn a definite gas instead of a coal gas of varying luminosity. It does seem to me that the Pentane devised by Mr. Harcourt is, if anything, more under control in the way of verification than the others, because you can leave some gas in the holder and use another, and anyone coming next day can test the sample of gas used. As to the desirability that the standard should be 16 candles, I must remind the meeting that I have held that view for a long time. It was one of the principal reasons why I tried so steadily to show the desirability of using the 16-candle lamp of Keates. I have had to abandon it. I am sorry, but it is gone; and I have not the slightest hesitation in accepting the 16-candle standard obtained by gas. The Pentane Argand is now enlarged from 10 to 16 candles standard. The "plea for candles" made by one speaker was rather amusing to me, as an old photometrist. As I have said, the same candle tested under different conditions gives different results. There is nothing whatever in the fact that the candles are pure or impure; the result depends on the wick and the temperature in which it is burnt. Mr. Hehner considers that the composition of Pentane gas and its standard quality is a difficult question. I do not agree with him in that respect, because the method of making the gas is one of the simplest things in chemistry. I had some difficulty when I first started, but since I have used the Pentane pipette which I introduced to the notice of this Section some time since, I have met with no difficulty; in fact, it involves less trouble than the nightly cleaning of the chimneys in any one of the Argand burners, and anyone who cannot manipulate it could not manipulate candles. As for the quality of the gas when made, that has been settled by Mr. Harcourt. He says, if the gas is properly made, a 2½-inch flame requires half a cubic foot of gas per hour. The gas is passed through the meter, and the measurement is at once obtained. I am obliged to Mr. Hehner for his favourable opinion of the Pentane Argand, as being preferable to the other standards; but I take the view that the Pentane devised by Harcourt would be best as the standard of reference, and a modification of it for ordinary work.

Professor Foster reminds us of the error of candles, as shown by the continual increase in the set of 10 readings. It is a great satisfaction to those who work with the Evans photometer that the Referees will no longer sanction that instrument now that they can supply a much better one. There is now the Imperial standard photometer, which gives identical results with a simple open bar, and which combines all the good qualities of the open bar and the closed Evans. Mr. Livesey would like to see a 16-candle standard, and, as I have said before, there is no difficulty in that. Mr. Sugg referred to the flame of the candle being at the end of the bar, and thought it probable that some of the results would not have been so erratic if the centre of the candle flame had been carefully adjusted to the end of the bar. I must say, in justice to those who assisted me, that every possible precaution was taken to ensure the utmost accuracy in the tests—and this applies also to what Mr. Methven said—that the men who worked these experiments are men who nightly carry out the instructions of the Gas Referees, who know all the peculiarities of candles, all the little tricks to which we might resort to get good results; and they carried out these tests in the most conscientious manner, doing all that was possible to get the most accurate results while working in accordance with instructions of the Gas Referees. The detailed results have been fully set forth in my published report; if I had picked them I might have accommodated them to what we wished. I have given them in my report, which Mr. Methven has seen, and I have not selected one single figure. You have before you the actual result of each test, and you will find the same thing all round — a general condemnation of candles.

Mr. Methven said he had not intended to cast any reflection on those who had carried out the experiments.

Mr. Dibdin: I quite believe that, but I wish to show that nothing has been done which would not have been perfectly legal if they had wished to receive the certificate of the Gas Referees. I would like those gentlemen who consider my results somewhat erratic to take a hundred tests, good, bad, and indifferent, of a 3-inch Argand flame. How many of those results will be under 16 candles, and how many above? You will find that of those tests which are not 16 candles, 99 per cent. are above 16; for it is characteristic of candles that when they go wrong they always give high results; the exceptions to that rule are very few. The last point raised was the sentimental objection to coal gas as a standard. With those who understand photometry such an objection will only raise a smile. There can be no such objection. We know the conditions, and when we work under them the results are correct. But we have to consider, in these days of widespread education and technical knowledge, that we must be careful how we speak, for if it were to go out that we were testing the gas by itself it would be said: "Ah, that is just what these experts always do!"

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Liverpool Section.

Chairman: Prof. J. Campbell Brown.
Vice-Chairman: Dr. F. Hurter.
Committee:
J. Affleck.
E. G. Ballard.
Ernest Bibby.
H. Brunner.
J. C. Gamble.
D. Herman.
J. W. Kynaston.
E. K. Muspratt.
Jas. Simpson.
A. Norman Tate.
A. Watt.
Hon. Local Sec. and Treasurer:
W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held April 4th, 1888, at University College, Brownlow Street.

DR. J. CAMPBELL BROWN PRESIDING.

ADDENDUM TO DISCUSSION ON MR. W. F. LOWE'S PAPER ON THE ANALYSIS OF BUTTER AND OTHER FATS. (*See* March Number, pp. 185—186.)

Mr. Lowe, in reply to the Chairman's remarks, said—

Firstly, as to the total fatty acids, no doubt it requires care in order to obtain good results, but the same precautions are needed in the ordinary Hehner method if both the insoluble and soluble acids are to be estimated. I do not consider the data obtained for the total acids quite so reliable as that for the volatile acids, but it is very useful and helps to confirm the latter result.

That carbonic acid does not interfere to anything like the extent it is supposed to do, is, I think, clearly shown by the blank experiment mentioned in my paper, only ·05 cc. of $\frac{N}{10}$ KHO being required to produce a permanent colouration with the distillate. The experiments with mutton suet also, I think, prove that the interference must be very slight. The object of taking two grams only of the fat, is that this quantity can be saponified with 10 cc. of normal KHO, and I have obtained as good results as when a larger quantity is taken. If the insoluble fatty acids are to be estimated, I prefer 5 grams and saponify with 50 cc. of $\frac{N}{2}$ KHO. The insoluble acids can be better titrated, or can be dried and weighed in the flask.

I fail to see altogether why the terms dirty and inelegant should be applied to the method of estimating the volatile fatty acids; the former term appears to be applied to the filtering off of the small amount of insoluble acids that pass over with the steam. This is certainly the first time I have seen the commonest operation of analytical chemistry described in this way.

As to the accuracy of the process, the results, and especially those for the volatile and insoluble acids, speak for themselves. I consider it quite as accurate as the ordinary method of butter analysis.

As to the suggested improvement, I think Dr. Campbell Brown must have forgotten that the filtrate, say from about 5 grams of butter, by the ordinary Hehner process would occupy some 700 to 1,000 cc., and it would be necessary to distil this volume of liquid in place of only 75 cc.

As to the action of the KHO on the glass, this objection applies equally to the ordinary method of analysis, but the action, especially with only two grams of fat and 10 cc. of KHO, is not sufficient to produce any appreciable error.

The Chairman said that it was the process of distillation he referred to as dirty, not that of filtration. Some of the fatty acids carried over with the steam adhered to the inside of the Liebig's condenser. It was not necessary nor desirable to include all the washings for distillation of the volatile fatty acids. Taking 5 grams of fat, and then half of the filtrate with half the earlier washings, he found 250 cc. was a convenient quantity of liquid to distil.

DISCUSSION ON MR. THOMPSON'S PAPER ON RAYE'S PROCESS FOR THE UTILISATION OF THE ACID TAR RESIDUES OF PETROLEUM MANUFACTURES. (*See* April Number, pp. 303—305.)

Dr. J. Campbell Brown said that there was a very considerable market for a varnish which would stand high temperatures. At present there was no good cheap varnish suitable for such purposes as japanning locomotives, and he would be glad to hear whether these hydrocarbons would stand the temperature of a high-pressure boiler. He was sorry to see a city like Liverpool, which produced enormous quantities of tar products, leaving their full differentiation to be accomplished almost entirely abroad. It was true that they had two large works, which effected a partial separation, but the great bulk of their crude tar was differentiated elsewhere.

Mr. N. Tate had had great difficulties with this very product some years back, and his experience was that when they tried to burn it, it corroded and wore away their stills; when they would have distilled it, it created a nuisance; and when they made an attempt to utilise it for flooring it refused to set. The most interesting part of the process to him was the mixing of the metallic particles with the tar to get rid of the sulphuric acid, which had always been one of his great difficulties. There had been some mention of a profit to be derived from the sulphate of iron so produced, but that was problematical. The great point was, that once the sulphuric acid was removed, the material became available for many purposes to which ordinary pitch products could not be applied, such as varnish or asphalte, and he therefore considered the author's method of removing the acid as well worth attention.

Mr. McArthur said he had been much interested in the paper, as he had been acquainted with a similar product in connexion with the Scotch oil industry. There they had acid tars from refining shale oils somewhat similar to those produced in refining American petroleums, and almost identical with the German petroleum acid tars. In Scotland it was worked up by steaming with water and open steam, the bulk of the sulphuric acid being at once removed, so that the steamed tar only contained 6 or 8 per cent. of sulphuric acid. This dilute sulphuric acid was used on the spot, generally for making sulphate of ammonia, which was also produced from the shale.

As to the tar which remained after steaming, it was a very difficult matter to make it marketable, and the great bulk of it was burned under stills or steam boilers by means of steam injectors. By distilling it, either with or without neutralising, with some of the waste soda tars, the product could be sold, but at a very low price. The lighter part was a very crude oil, used for gas making. The heavier part, amounting to 30 to 50 per cent. of the material, was used as cart and axle grease, but to refine those products into sweet-smelling oils seemed to be almost impossible.

By not pushing the distillation quite so far, a pitch of various degrees of hardness might be obtained, but this was seldom good enough to make into varnish. Even when hard and brittle in itself, after dissolving in naphtha, the film always remained dull and sticky when at all warm; even the heat of the hand made it sticky. Another product had been tried in Scotland, viz., a somewhat soft pitch, just hard enough to bear transport, which could be sold to gasworks for mixing with ordinary coal for gas making. This was much superior to the best cannel coal, giving a larger quantity of good gas which was easily purified, as the bulk of the sulphur remained in the coke. As regards the neutralisation of the acid in Rave's process by iron, it seemed to him that seeing that 75 per cent. of the acid could be separated by simple steaming, and the dilute acid used for the manufacture of dissolved bones or sulphate of ammonia, the iron method was costly and unnecessary, unless the nascent hydrogen produced acted chemically on the tarry matters, forming a more readily marketable substance. He knew that by merely steaming the Scotch tars and removing the sulphuric acid by soda, the pitch obtained after distillation could not be made into good varnish; but the material which had been described in the paper might be somewhat different from that, 1st, because made from American petroleum which contained less basic matter than the Scotch; 2nd, it might be altered chemically by the action of the nascent hydrogen. If this were so, the iron method was essentially an improvement, otherwise the large quantity of iron necessary would appear to be rather costly, when the bulk of the acid might be obtained by simple steaming.

Mr. Thompson thought that the last speaker's idea about hydrogen must be correct, as although oxide of iron would act to some extent, they preferred the much more costly iron borings simply because they gave a much better result.

Mr. N. Tate said there was a very great difference in tarry products, whether they came from shale oils or from Russian or American petroleum. He had himself found that the tarry products from American petroleum were of rather a thicker character than those which came from shale, consequently there would be more difficulty in the steaming process in removing the sulphuric acid. He did not know whether Mr. McArthur had noticed that from his own experience?

Mr. McArthur replied that the crude Scotch tars were thinner, and contained much more basic material than the American. As to the sulphate of iron produced in the Rave process, was there any difficulty experienced from the presence of pyridine and other bases which would tend to crystallise out to a certain extent? Was the sulphate of iron not contaminated with them?

Mr. Thompson said the inventor spoke of sulphate of iron and *other salts* crystallising out, and he (Mr. Thompson) was wondering what these other salts were, but believed they were organic substances.

Mr. Tate said he did not think there was any doubt on that point. When water or steam was brought into contact with the thick tarry mass they were washed out, and the tar left in a more pure condition.

The Chairman said that American and Russian petroleum, coal, and shale would all yield different materials, although there would be a generic resemblance between their distillation products. He would be very much gratified if it could be proved that nascent hydrogen did hydrogenise hydrocarbons. He had never seen it done, and, without casting any doubt on its possibility, he thought it should not be accepted without careful trial and convincing evidence. It was scientifically possible to increase the carbon by several means, such as the elimination of a portion of the hydrogen or otherwise, but he had never heard of the converse being accomplished on a manufacturing scale.

Mr. McArthur asked where the process was in operation?

Mr. Thompson replied that it was being worked in Belgium. He added that he would send a translation of the discussion to Mr. Rave, and would lay his reply before the next meeting.

Subsequently Mr. Thompson communicated the following observations by Mr. Rave in reply:—

Dr. Campbell Brown has observed that it would be interesting to obtain from these products a varnish capable of resisting high temperatures. He lays stress on the little progress made in England with respect to the utilisation of tarry bye-products, whilst their study has already been carried so far on the Continent.

Varnishes manufactured from the bitumens obtained by our treatment of acid residues produced in refining heavy *petroleum* oils do not satisfy the requirement set forth by Dr. Campbell Brown. The varnishes and coatings which we produce from these tars are excellent for the following objects: waterproof coatings and varnishes, manufacture of impervious materials, such as cloth, paper, pasteboard, &c., resisting the influence of acid baths. Their use is acknowledged an excellent one for electrical apparatus, as they constitute first-rate insulating substances.

We manufacture also, with the bitumens obtained from these residues, a neutral fuel, rich in gas, giving a large amount of heat, and burning like a solid fuel. We have called it *petroleum* coal.

Lastly, the applications of this bitumen comprise those for which ordinary bitumens, such as Trinité Val de Travers, are used.

But petroleum is not the only source of tars or residues from which industrial useful products can be extracted; other abundant local sources exist on the Continent, and also, to a large extent, in England.

These tars or residues, whether they are obtained through distilling or refining, all yield, when subjected to a certain treatment, bituminous products having different properties, according to the origin of the substance under treatment.

There are between petroleum oils of various sources sensible differences. These are more especially appreciable in the bye-products. However, these differences are not such that a common origin, that of the natural hydrocarbon, *naphtha* or *petroleum*, cannot be assigned to them.

It is not the same with the bye-products originating from other sources. We may quote, amongst others, the tars from shales, lignite, boghead-coal, those from a vegetable or animal source, &c. All these products, treated and brought into the bituminous state, possess properties differing very greatly one with another, and rendering them suitable for the most varied applications. One of the sources of these tars yields a bitumen suitable for the manufacture of a varnish resisting a high temperature, and applicable to the uses named by Dr. Campbell Brown, namely, japanning parts of locomotives, &c. This bitumen has a great analogy with the bitumen of Judea. It dissolves in petroleum naphtha and in sulphide of carbon like natural bitumen.

Other sources of carburetted bye-products yield, when subjected to our method of treatment, pure and very dense bitumens, which have a high melting point, are easily reduced into a powder (this is not the case with other bitumens), and are suitable for numerous important applications. These bitumens are not soluble in naphtha, nor in sulphide of carbon either.

It results from the foregoing that those products which were formerly cumbersome and valueless become, when treated by the method we are recommending, a source of useful products and important profits.

The method employed by us for the purpose of separating the acids combined with the bye-products is highly preferable to those mentioned in the course of the discussion. These well-known processes do not give favourable results. The process consisting in evaporating the acid, besides destroying the vessels wherein the operation takes place, chars the useful product, and deprives it of the qualities it should possess. Washing in water is not practicable, and the neutralisation by means of alkalis and oxides is costly, and does not yield, by a long way, such products as those we obtain by the treatment with a metal.

The expenses connected with our method of treatment are small; the salts obtained compensate the cost of manufacture, and great quantities can be managed without difficulty.

Our method of chemical decomposition by means of metals, and more especially by means of iron, and by maceration, is based upon the influence of hydrogen in the nascent state, said hydrogen being sheltered from the action of oxygen, and in direct contact with the carbon. Without going into a detailed scientific explanation of the operation which takes place, we can, however, affirm that the hydrogenation of the carbon is evident.

We may quote the following fact in support of this theory:—

If we take tars, remove the acid contained therein by the means known hitherto, such as neutralisation, evaporation, &c., and subject the product thus obtained to distillation, we obtain only a small quantity of tarry substance possessing little fluidity. If, on the contrary, we treat by distillation the bitumen refined by our metallic treatment, we obtain as much as 50 per cent. of oils of various densities (naphthas), about 8 or 10 per cent. of oils similar to lamp petroleum, and lastly, some heavy oils.

Where do these numerous hydrocarbons come from? Are they not the result of a new fixation of the nascent hydrogen acting on the carbon?

We repeat it, the operation which takes place under the conditions we have set forth is a mysterious one. It would seem to confirm the opinion of chemists who ascribe the formation of natural hydrocarbons to the combined action, under special conditions, of carbon, hydrogen, sulphur, and other metallic substances. In our method of working all these elements are present, and the decomposition which takes place is worthy of the study of scientific men more authorised to speak on this matter than the author of this reply. I merely limit myself to mentioning the simple material fact, as I was only trying to discover an industrial result, which I have at last obtained.

Glasgow and Scottish Section.

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G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Sixth Meeting for this Session was held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, April 10th, 1888.

MR. J. J. COLEMAN IN THE CHAIR.

DISCUSSION ON PROFESSOR MILLS' AND MR. BUCHANAN'S PAPER ON THE PHOTO-CHEMICAL ESTIMATION OF GRADED TINT. (JOURNAL VII., 309.)

MR. RODGER asked if the Eastman paper, to which reference had been made, was always found to be evenly coated with silver, because he had some doubts as to its being perfectly uniform; further, if any variety of colours had been tried in the same way as the logwood dye mentioned—say alizarine with an iron mordant which would give a colour somewhat like that shown, or alizarine with ordinary alumina mordant, which gives a red shade—and if so, had it been found that the isochromatic plates were quite as reliable for the red and other colours at the red end of the spectrum as for the darker tints Dr. Mills had referred to?

Professor MILLS, in reply, said that in photographing these particular tints they naturally placed themselves at the greatest advantage possible. The experiments were carried out upon something ready to hand, and also something that would be likely to affect the plate very favourably, even if the plate were faulty, although they had no reason to suspect that there existed any fault in the plate. No doubt for reds and for the blue shades of alizarine, and also for alizarine with chrome mordant, plates could be constructed — taking suitable methods — which would give perfectly accurate results. In using the Eastman paper they took the whole of the paper employed from a single envelope. Regarding the photographing red, magenta dye on wool had been tried, but it so happened that the theoretical results would have been so complicated, owing to a particular phenomenon observed with this dye, that they thought it prudent to leave that over till another occasion.

Journal and Patent[*] Literature.

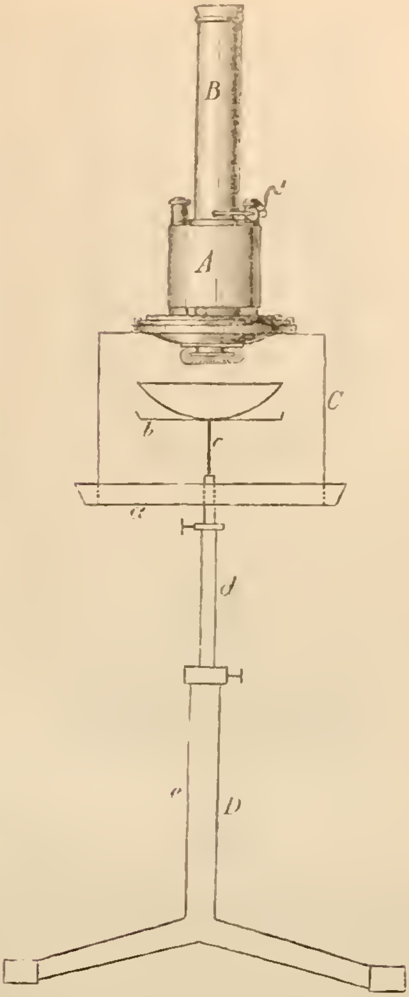
I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

A New Magnetic Rotator. Chem. Zeit. Rep. 12, 96.

H. Lamprecht in Stuttgart has constructed a magnetic rotator for removing particles of iron or steel from cereals, chemicals, colours, cement, bones, fine Thomas slag, &c. The apparatus is wholly of iron, contains 64 magnets, and is provided with fixed and loose pulleys. The material operated upon passes regularly through the machine, and the particles of iron and steel which adhere to the magnets are mechanically removed.—A. R.

On the Application of the Siemens' Regenerative Burner for the Evaporation of Liquids in Laboratories. W. Hempel. Ber. 21, 900.

Evaporation by means of the water-bath is a very tedious operation. If heat be applied from the top, evaporation can be enormously accelerated, and the operation can also be performed without loss by spirting. The accompanying drawing shows the application of this principle by the use of an inverted Siemens' burner. A is the regenerative burner with chimney B. C is a glass cylinder luted with fine sand on the plate *a*. D is a stand, and allows of moving the plate *a* up or down at will. The dish stands on the moveable plate *b*, whereby the position of the liquor to be evaporated can be regulated without opening the apparatus. At first the flame must be very small; the dish is then placed inside the cylinder and the flame is increased. Evaporation commences at once, and, in spite of a very rapid concentration, no loss is incurred. Liquids which bump violently over a free flame can be concentrated without loss. Since the flame does not come into actual contact with the dish, the latter can be made of any material, even papier-maché or wood. If the flame be kept near the surface of the liquor, no sulphuric acid (from the products of the combustion of the gas) is taken up by the latter. The metal parts of the burner are not attacked by acid gases if care be taken to keep them hot.



Comparative Results of Different Modes of Evaporation.

	Per Hour.
Evaporation on the water-bath	50 cc.
Evaporation over the free flame, which was regulated to avoid loss by spirting	70 cc.
Evaporation with the regenerative burner	320 cc.

A Bunsen burner consumes about 100 to 120 liters of gas per hour, whereas the regenerative burner consumes from 300 to 400 liters of gas in the same time.—S. H.

A Laboratory-Turbine. H. Rabe. Ber. 21, 1200—1201.

For laboratory purposes a mechanical agitator is often needed. The author has therefore devised a water-turbine (shown in sectional plan and elevation, one-half natural size) for use in laboratories possessing a good water supply. A is a cast-iron casing containing the brass paddle-wheel E, with paddles F on spindle D, mounted in bearings B and C. The water enters at G and leaves at H; with an opening at the jet G of 1 mm. diameter, the water consumption is 1 cb. m. per 12 hours. The spindle D also carries the

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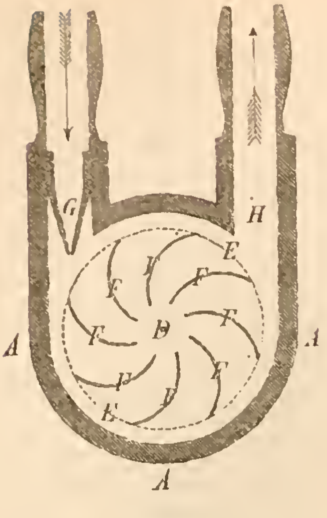
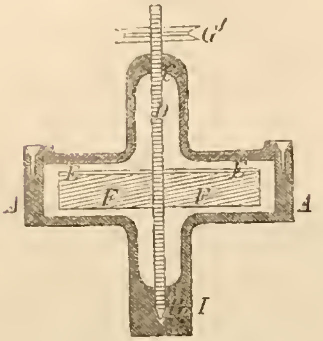
[*] Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*.	½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*.	1*d*.
„ 1*s*. 6*d*., „ „ 2*s*. 4*d*.	1½*d*.
„ 2*s*. 4*d*., „ 3*s*. 4*d*.	2*d*.





pulley G′ which transmits the motion by a driving cord to the agitator. The turbine can be clamped in any position at I, without loss of power.—O. H.

II.—FUEL, GAS, AND LIGHT.

On the Calculation of Pyrometric Effects, and on the Influence of Pressure on the Temperature of Combustion. W. Lang. Chem. Zeit. **12,** 475—476.

The author calls in question the calculations made by Otto in a paper (*Chem. Zeit.* **12,** 122) dealing with his patented crucible furnace with forced draught. Otto, assuming that the combustion in his furnace takes place at constant volume, calculates the theoretical temperature by dividing the calorific power of carbon (8080) by the product of the weight of the flue gases into their specific heat at constant volume, thus obtaining the number 3037°. But he considers that 8080 does not represent the true calorific power of carbon at constant volume, seeing that in the calorimeter it is determined at constant pressure, in which case a portion of the heat is converted into mechanical energy in expanding the gaseous products, and that the true calorific power at constant volume should, therefore, be 10,663. This argument, however, the author shows to be fallacious, because although, in the first place, a portion of the heat of combustion is so expended, yet since before leaving the calorimeter the gases have returned practically to the normal temperature (and therefore to their original volume), this amount of heat is again rendered sensible, and is accounted for in the 8080 obtained. In the second place the author points out that the combustion must occur at constant pressure; that combustion at constant volume means the introduction of the fuel and the necessary air into a hermetically-sealed chamber wherein they are retained until complete combination is effected, and that, therefore, *continuous* combustion at constant volume is impossible. Moreover, Otto himself states that the pressure of the gases, both on entering and on leaving the combustion chamber, is equal to that of five atmospheres: thus the process is conducted at constant pressure, and, substituting the specific heat under these conditions for that quoted above, the pyrometric value of the carbon will not be 3037° but 2172° C. Nevertheless, since combustion is never perfectly complete at high temperatures owing to the tendency of the products of combustion to dissociate, and since it has been shown by Deville and others that increase of pressure tends to check dissociation and therefore to render the combustion more perfect, it is clear that furnaces supplied with air under pressure have an advantage over those depending upon natural draught. And, further, this is so because combustion under forced draught is more rapid, and a greater amount of heat is evolved per unit of space in each unit of time, so that less heat is lost by conduction and radiation through the furnace walls. Thus a furnace such as Otto's is capable of giving a higher temperature than those ordinarily used, not because the theoretical maximum of temperature is in any sense higher, but because it has a greater degree of efficiency, so that the actual temperature approaches more nearly to that theoretically attainable.—W. G. M.

Recent Improvements in the Gas Industry. Dingl. Polyt. J. **268,** 136—142.

New Material for Purifying Gas.—M. Hempel (D. R. P., 39,497, July 1, 1886) impregnates hydrated oxide of iron with an alkaline solution, and places the mixture in a solution of a salt of magnesia. The mass is thus made to contain an intimate admixture of carbonate or hydrate of magnesia, the voluminous nature of which imparts increased porosity to the oxide of iron for use in the ordinary way. —G. H. B.

The Petroleum Wells of Germany. G. Kraemer and W. Böttcher. Ver. z. Beförd. des Gewerbefl. 1887, 549—572. Prize Essay.

The following are the results of analyses of the crude oils of the three districts, compared with the well-known standard oils:—

Locality.	Sp. Gr.	Spirit − 150°.	Sp. Gr.	Petroleum − 250°.	Sp. Gr.	"Solar" Oil − 300°.	Sp. Gr.	Paraffin and Lubricating Oil.	Sp. Gr.	Residue.
1. Tegernsee	0·812	20·04	0·723	26·12	0·782	14·02	0·825	35·91	0·856	3·07
2. Pechelbraun ..	0·888	1·30	0·720	16·37	0·778	17·07	0·824	47·88	0·893	16·28
3. Oelheim......	0·885	0·74	0·750	11·05	0·805	9·75	0·852	73·91	0·900	3·92
4. Pennsylvania.	0·814	14·34	0·725	25·35	0·811	13·75	0·820	40·99	0·850	5·57
5. Galicia	0·842	14·21	0·723	16·93	0·786	12·30	0·831	47·58	0·882	8·95
6. Baku.........	0·880	0·63	0·762	21·73	0·811	15·55	0·853	57·97	0·903	4·10

From 1 and 4 (fraction over, 250°) 4 per cent. of well crystallised paraffin was obtained, 2 and 5 yielded 1·5 per cent.

The oils contain small quantities of oxygen compounds, acids of the formula $C_nH_{2n}O_2$, traces of phenols, and sulphur in the following proportions:—(2), 0·136 per cent. (3), 0·081 per cent. (6), 0·064 per cent.

The hydrocarbon constituents are divided into "heavy" and "light" oils according to their resistance (or otherwise) to the action of HNO_3 1·49 sp. gr., or H_2SO_4 (66° B). According to the authors, the latter influence the illuminating, the former the calorific value of the oils. A method of determining their constituents is fully described in the original, and recommended as essential to an estimation of commercial value.—C. F. C.

PATENTS.

Improvements in Self-Sealing Retort Lids, Cross Bars and Fastenings. J. Ruscoe, Hyde. Eng. Pat. 5993, April 25, 1887. 8*d.*

The cross bar has one end hinged to one side of the mouthpiece, while the other end fits into a catch on the other side. It is provided with a central hole and, on each side of this, an angular slot. Through the central hole works a screw with a T or lever handle. The retort lid has three bosses cast upon its outer surface. The central one has a countersunk hole, and corresponds in position to the central hole in the cross bar, as do also the other two bosses to the angular slots. From these two latter bosses project pins with screwed ends, which work into the angular slots and allow the lid to be fastened to the cross bar. It will now be seen that when the unhinged end of the latter is fastened in the catch, the lid may be closed to any degree of tightness by means of the screw working through the cross bar into the countersunk hole on the lid.—A. R. D.

An Improved Method of and Apparatus for the Treatment of Peat. E. Zohrab, London. Eng. Pat. 6704, May 7, 1887. 8*d.*

Ordinary bog peat is crushed or ground and then kneaded and moulded into blocks. These blocks are dried and may then be employed as fuel in many cases where the use of unprepared peat is inadmissible, or may be advantageously converted into charcoal. The apparatus consists mainly of a crushing mill, a kneading mill and a drying machine; the material passing from one to the other, and through the last, on travelling bands. The crushing mill is a vertical cylindrical vessel having projecting steel blades fastened to its periphery (inside). It is open at the top, but provided at the bottom with a perforated plate. In this vessel works a vertical shaft provided with steel blades, and terminated at the bottom by an Archimedean screw. When the shaft revolves, its blades work between the fixed blades projecting from the casing and effect the grinding or crushing of the peat, which is then forced out by the screw through the apertures in the bottom plate. The kneading mill resembles the last described in its main features, but the material is forced out through a lateral opening at the bottom, so constructed as to give it the definite shape required. A suitable device is provided near this aperture for cutting the mass into blocks. The drying machine consists simply of a long chamber through which a current of dry air passes, preferably in direction opposite to that of the blocks on the travelling band.—A. R. D.

Improvements in and connected with the Burning of Oils or other Hydrocarbon Fluids as Fuel in Furnaces. J. Lyle, Paisley. Eng. Pat. 6774, May 9, 1887. 8*d.*

The liquid fuel is driven through an injector by compressed air or steam into a combustion chamber widening out into the boiler fire-box. The fire bars are removed from this latter, and the ashpit closed by a plate to which are attached the injector fittings. The original specification should be consulted as the improvements mainly have reference to detail.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On Tetramethylbenzene. A. Tohl. Ber. **21**, 904—908.

The author describes some derivatives of the tetramethylbenzene—

$$C_6H_2(CH_3)_4[1 \cdot 2 : 3 : 4]$$

discovered by Jacobsen.

It forms a fairly stable compound with picric acid, which crystallises from hot alcohol in yellow needles, and melts at 92—95° C.

Mononitrotetramethylbenzene—

$$C_6H(CH_3)(CH_3)(CH_3)(CH_3)(NO_2);$$
$$[CH_3 : CH_3 : CH_3 : CH_3 : NO_2 = 1 : 2 : 3 : 4 : 5]$$

is prepared by the action of excess of nitric acid on the hydrocarbon. It can be distilled with steam, is easily soluble in ether, alcohol, petroleum ether, and glacial acetic acid, and crystallises in flat needles melting at 61° C.

Amidotetramethylbenzene [*prehnidine*] is obtained from the nitro compound by reduction with iron filings and acetic acid. It is soluble in alcohol, ether, and petroleum spirit, crystallises in large colourless plates, and melts at 70° C., and can be readily distilled with steam. Its hydrochloride is easily soluble in water, difficultly in concentrated hydrochloric acid. The sulphate is difficultly, the nitrate easily soluble in cold water. Its acetyl compound, formed in the usual way, is soluble in alcohol, and melts at 172° C.

Nitroacetprehnidine melts at 225° C.

Nitroprehnidine, obtained by reducing dinitrotetramethylbenzene with alcoholic ammonium sulphide, crystallises from alcohol in red needles, melting at 131°.

Tetramethylphenylenediamine melts at 140° C. Ferric chloride colours the dilute aqueous solutions of the hydrochloride dark red.

Tetramethylphenol, obtained in the usual way from the sulphonic acid of the hydrocarbon, melts at 86°—87° C. and boils at 266° C.

On oxidation with potassium permanganate, the hydrocarbon yields, as a final product, prehnic acid, $C_6H_2(CO_2H)_4$.
—A. L.

Pyridine Bases from Coal Tar. J. Mohler. Ber. **21**, 1006—1015.

The author has succeeded in isolating β-picoline and symmetrical collidine (trimethyl pyridine) from coal tar.

Pyridine ferrocyanide $(C_5H_5N)_2, H_4Fe(CN)_6.\ 2\ H_2O$, crystallises in yellow, monoclinic prisms in combination with domes. It is more sparingly soluble than the ferrocyanides of the homologous bases, and can be easily freed from the more soluble salt of α-picoline by washing with cold water. For this reason the ferrocyanide offers an excellent means for preparing pure pyridine from raw coal tar pyridine.

200 cc. of raw pyridine are precipitated by 400 cc. of concentrated hydrochloric acid and 1,000 cc. of 30 per cent. potassium ferrocyanide solution. The yellow granular precipitate is filtered and washed with water, the yield being 260 grms., equal to 106 grms. of pyridine. By decomposing the ferrocyanide with concentrated soda, pyridine, containing only a small quantity of water, is obtained. The ferrocyanides of the picolines are very soluble, that of αα- and αγ-lutidine somewhat less soluble. The aqueous solutions of these salts can be kept for some time in the cold, but they gradually become blue; on heating to 70° they undergo rapid decomposition.—F. S. K.

Some Derivatives of Acenaphthene. F. Quincke.
Ber. **21**, 1454—1463.

The author attempted to prepare the mononitro-acenaphthene, melting at 155°, described by Jandrier (Compt. Rend. **104**, 1858), but only obtained a mononitro-acenaphthene melting at 101°—102°.

Acenaphthene was nitrated in glacial acetic acid solution, and the product extracted with petroleum ether. The extract consisted of mononitro-acenaphthene melting at 101°—102°. The residue repeatedly recrystallised from glacial acetic acid, gave dinitro-acenaphthene crystallising in yellow needles which carbonise and melt at 206°. From 80 grms. of acenaphthene, 50 grms. of pure mononitro-acenaphthene and 20 grms. of pure dinitro-acenaphthene were obtained.

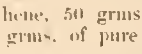
Monamido-acenaphthene, obtained by reducing the former, crystallises in white needles melting at 108°, and gives the isonitrile reaction. Its salts are difficultly soluble in water and concentrated acids. The picrate, hydrochloride, platinum and tin double salts were prepared; the monobenzoyl-compound, thio-urea and mustard oil are also described. The mono-acetyl compound melts at 176°, the di-acetyl compound at 122°.

Diamido-acenaphthene forms white needles and is very unstable. Its salts are likewise unstable.

On oxidation, mononitro-acenaphthene yields nitro-naphthoquinone and nitro-naphthalic acid.

Nitronaphthalic acid crystallises in yellow needles, scarcely soluble in ether, alcohol and petroleum ether, but soluble, on continued boiling, in glacial acetic acid. On heating to 140°—150° it decomposes, and the anhydride melts at 220°. The salts are readily soluble in water.

Nitro-γ-naphthoquinone forms yellowish-red needles melting at 208°. It has the composition $C_{10}H_5NO_4$, and is consequently the nitro-derivative of a naphthoquinone $(NO_2.C_{10}H_5:O_2)$ formed by the oxidation of the CH_2 groups of acenaphthene—



$$C_{10}H_6\left\langle\begin{array}{l}CH_2\\ \vdots\\ CH_2\end{array}\right.;$$

and as α naphthoquinone has the oxygen atoms in the 1:4 position, and β-naphthoquinone in the 1:2 position, this γ-naphthoquinone must have them in the 1:1′ position.

The anilide was obtained by treating the nitro-naphthoquinone with aniline. It forms dark-violet needles which melt and decompose at 128°.

The diphenylamine compound, $(C_{12}H_8N)C_{10}H_4(NO_2)O_2$, decomposes at 80°.—O. H.

IV.—COLOURING MATTERS AND DYES.

Morindon. T. E. Thorpe and W. J. Smith. J. Chem. Soc. 1888. 171—175.

Direct evidence that ruberythric acid and morindin are not identical, as formerly supposed, was first adduced by Stein (J. Prakt. Chem. **97**, 234), who demonstrated the dissimilar colours of their barium compounds and their different behaviour towards caustic potash. The products obtained also on hydrolysing the two bodies give different colour reactions. According to Graebe and Liebermann the decomposition of ruberythric acid on hydrolysis is represented by the equation—

$$C_{26}H_{28}O_{14} + 2\ H_2O = C_{14}H_8O_4 + 2\ C_6H_{12}O_6.$$

Liebermann and Bergami, who have traced the existence of cane sugar in madder, have proposed the formula—

$$C_{14}H_6O_2(OH)\{O.C_{12}H_{14}O_3(OH)_7\}.$$

By hydrolysing morindin, morindon is formed. When morindin is heated to a high temperature it chars and yields a red crystalline sublimate, which is also morindon, and this body is, according to Stenhouse, identical with alizarin. A quantity of morindin and morindon was obtained from the roots of *M. citrifolia*, and the former was converted into the latter by hydrolysis. On distillation over hot zinc-dust, methylanthracene was obtained, and this on oxidation with chromic acid in glacial acetic acid solution furnished anthraquinone carboxylic acid. On oxidation of morindon by alkaline permanganate solution, oxalic acid was obtained, instead of phthalic acid, as is obtained when alizarin is similarly oxidised. Hence (as well as from the analytical results) it is shown that (1) morindon is not identical with alizarin, and (2) that it is a trihydroxymethylanthraquinone.—W. S.

On the Supposed Identity of Rutin and Quercitrin. E. Schunck. J. Chem. Soc. 1888, 262—267.

Rutin, a crystalline yellow colouring matter contained in the leaves of garden rue, *Ruta graveolens*, was discovered by Weiss. It was subsequently examined by Bornträger, by Rochleder, and Hlasiwetz, who obtained it from capers, the flower buds of *Capparis spinosa*; by Stein, who found it in Chinese yellow berries, the flower buds of *Sophora japonica*; and by the author himself, who extracted it from the leaves of buckwheat, *Polygonum fagopyrum*. By most of these chemists it was held to be a distinct substance. Hlasiwetz endeavoured to prove that rutin was identical with quercitrin, and this view appears to have been generally adopted. Quercitrin having within the last few years been carefully examined by Liebermann and others, and its true composition being known, while rutin, so far as the author knows, has not recently been made the subject of investigation, it was thought that it might be of interest again to compare the two substances, and if found to be distinct, to ascertain wherein the difference consists.

The quercitrin employed by the author was obtained from quercitron bark, and was found to have the properties and composition assigned to it by Liebermann and Hamburger. The rutin was derived from buckwheat leaves, and though it had been in the author's collection for many years, had undergone no perceptible change. A comparative examination of the two substances led to the conclusion that they are indeed extremely similar, but that they differ essentially in some of their properties, and differ also in composition. Rutin yields with acids the same products of decomposition as quercitrin, viz., quercetin and isodulcite, but not in the same relative proportion; it gives less quercetin and more isodulcite. The analyses of rutin agree with the formula $C_{42}H_{50}O_{25}$, that of quercitrin being $C_{36}H_{38}O_{20}$. The process of decomposition with acids would be represented by the equation—

$$C_{12}H_{50}O_{25} + 4\ H_2O = \underset{\text{Quercetin.}}{C_{24}H_{16}O_{11}} + 3\ \underset{\text{Isodulcite.}}{C_6H_{14}O_6}.$$

Hence it would appear that rutin is derived from one molecule of quercetin and three molecules of isodulcite, whilst quercitrin is derived from one mol. of quercetin and two mols. or isodulcite.

Rutin dyes the same colours on mordanted calico as quercitrin, the alumina mordant acquiring a yellow, and the iron mordant a more or less intense olive colour, but using equal weights of both substances, the shades produced by quercitrin are perceptibly darker.—W. S.

On Benzidine-azo Dyes. E. Weingärtner. Chem. Zeit. **12**, 409.

The dyes belonging to this class dye cotton without the aid of a mordant. They are very brilliant, but most fugitive to light, and are prepared by the action of 1 mol. of tetrazodiphenyl, its homologues, the analogous stilbene and fluorene compounds, the azo-compounds of diamidobenzophenone or certain naphthylenediamines on the one hand—on 2 mol. of various α- and β-naphthylaminesulphonic acids, α- and β-naphtholmono- and disulphonic acids, their alkylised derivatives, or substitution products of benzoic acid on the other hand.

The following table shows the influence exercised by the relative positions of the NH_2 and CH_3 groups on the shade of the dye obtained:—

Tetrazo-derivates of	Naphthionic Acid $a_1 - a_2$.		α-Naphthol-α-sulphonic Acid $a_1 - a_2$.		β Naphtholdisulphonic Acid R.	
	Shade.	Affinity for Cotton.	Shade.	Affinity for Cotton.	Shade.	Affinity for Cotton.
Benzidine	Yellow-red	(Congo)	Blue-violet	..	Blue-violet	..
o-Tolidine	Red, w. tinge of blue.	(Benzopurpurin.)	Blue-violet	(Azo-blue)	..	..
m-Tolidine	Yellow-red	Small	Claret-red	Great	Red, with blue tinge.	Fairly great.
p-Tolidine	Yellow-red	Small	Blue-red	Small	Blue-red	Very small.
Xyldine, $CH_3 : NH_2 : CH_3 = 1:2:3$	Orange-red	Fairly great	Blue-red	Great	Blue-red	Small.
Xylidine, $CH_3 : NH_2 : CH_3 = 1:3:6$	Yellow-red	Slight	Blue-red	Slight	Blue-red	Very slight.
Xylidine, $CH_3 : NH_2 : CH_3 = 1:2:6$	Yellow-red	Very slight	Yellow-red	Fairly great	Yellow-red	Fairly great.
Xylidine, $CH_3 : NH_2 : CH_3 = 2:3:6$	Yellow-red	Slight	Orange-red	Fairly great	Red	Slight.
Xylidine, $NH_2 : CH_3 : CH_3 = 1:3:5$	Yellow-red	Fairly great	Yellow-red	Fairly great	Red	Slight.
Xylidine, $NH_2 : CH_3 : CH_3 = 1:2:5$	Red, w. strong tinge of blue.	Very slight	Violet	Slight	Violet	Slight.
Diamidostilbene	..	..	Violet-blue	Great	..	..
Dimethyldiamidostilbene	..	..	Violet-blue	Great	..	..

From this table it will be seen—

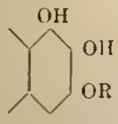
(1.) That the methyl group only exerts an appreciable influence as regards the shade of the dye when it is in the ortho position to the amido-group;

(2.) In the case of the xylidine-derivatives the further the second methyl-group in each benzene nucleus is removed from the amido-group, the bluer is the shade of the resulting dye.—A. R.

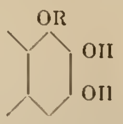
On the Ethers of the Hydroxyanthraquinones. C. Liebermann and G. Jellineck. Ber. 21, 1164—71.

According to the theory of Liebermann and Kostanecki only those hydroxyanthraquinones colour mordanted goods which have two free hydroxyl groups in the ortho- [alizarin] position. According to this the ethers of the mono- and dihydroxyanthraquinones ought not to be capable of colouring mordanted goods. In case of the trihydroxyanthraquinones there will be no colouring power left, when two or three hydroxyl groups are replaced. If there is, however, a mono-alkylether formed, the colouring power will depend on the position of the two hydroxyl groups. If they are in the ortho- position, coloured lakes can be formed; if not, the body will not possess any dyeing power. The experimental results are in agreement with this theory.

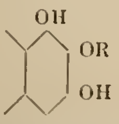
The neutral ethers of anthrapurpurin, flavopurpurin, and anthragallol could not be prepared, but mono- and di-alkylethers of these trihydroxyanthraquinones were obtained. None of the di-alkylethers were capable of dyeing mordants. None of the mono-ethers, with one exception, coloured mordants. From the anthragallol two isomeric mono-ethers were prepared, one which coloured mordants and one which did not.



or

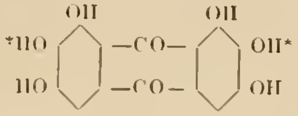


represents the constitution of the dyeing compound, and



expresses the constitution of the non-dyeing body.

The triethylether of the rufigallic acid did not dye, though there were three hydroxyl groups left. This is easily explained by the supposition that the two marked hydroxyl groups are replaced by ethyl groups.



Two methods were used for the preparation of the different ethers.

No. 1, by heating the body with an excess of dilute *aqueous* potash and ethyl iodide in a flask connected with a reversed condenser. The experiment had generally to be continued for some days, and as the mixture became neutral more caustic potash and ethyl iodide added.

No. 2, by heating the lead salts of the anthraquinones with a solution of ethyl iodide in benzene for 16 hours at 220° C. All the materials must be dry. The lead salts were prepared by precipitating the alcoholic solutions of the hydroxyanthraquinones with lead acetate.

The separation of the mono- and dialkylethers from the hydroxyanthraquinones and from each other was easy. Lead acetate precipitates the free hydroxyanthraquinones. Ammonia dissolves only the mono-ethylethers, but not the di-ethylethers.

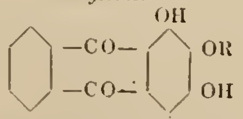
The following substances were prepared:—

Monohydroxyanthraquinone ethylether, yellowish-white needles.

Quinizarin mono-ethylether, $C_{14}H_6O_2(OH)(OC_2H_5)$, carmine-red needles. Melting point 150°—151° C. Its alkaline solution is red, dissolves in concentrated sulphuric acid with a pink colour and fluorescence.

Quinizarindiethylether, yellow needles. Melting point, 176°—177°.

Anthragallol-β-mono-ethylether—



small red needles. Melting point, 175° C. Does not colour mordants.

Anthragalloldiethylether, $C_{14}H_5O_2(OH)(OC_2H_5)_2$, brown needles, melting at 134° C. Prepared according to method 1.

Anthragallol mono-ethylether, red neeedles, melting at 245° C. This ether produces colours on mordants similar to those of alizarin. Was prepared according to method 2.

Anthragallol di-ethylether, yellow needles, melting at 198° C. Was prepared according to method 2.

Anthrapurpurin mono-ethylether, $C_{14}H_5O_2(OH)_2(OC_2H_5)$, orange-red needles, melting at 265°, prepared according to the first method.

Anthrapurpurin di-ethylether, yellow needles, melting at 162° C., when prepared according to the first method.

Light yellow needles, melting at 170° C., when prepared according to method No. 2.

Flavopurpurin mono-ethylether was only obtained in very small quantity.

Flavopurpurin di-ethylether. Reddish-yellow needles, melting point, 209° C.

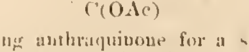
Triethylether of Rufigallic acid, $C_{14}H_2O_2(OH)_3(OC_2H_5)_3$, orange-red needles. Melting point, 195° C.—A. L.

On the Leuco-compounds of Anthraquinone Derivatives.

C. Liebermann. Ber. **21.** 1172—74.

The author describes anthraquinone derivatives obtained by simultaneous treatment with glacial acetic acid, zinc dust, and sodium acetate.

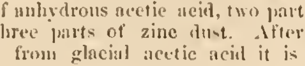
Diacetyloxanthranol—



$$C_6H_4\left\langle\begin{matrix}C(OAc)\\|\\C(OAc)\end{matrix}\right\rangle C_6H_4$$

is formed by boiling anthraquinone for a short time with 12—15 parts of anhydrous acetic acid, two parts of sodium acetate, and three parts of zinc dust. After several recrystallisations from glacial acetic acid it is obtained in colourless needles, decomposing at the melting point (260° C.).

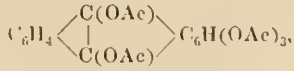
Diacetoxymethylanthranol—



$$C_6H_4\left\langle\begin{matrix}C(OAc)\\|\\C(OAc)\end{matrix}\right\rangle C_6H_3(CH_3),$$

obtained from methylanthraquinone, melts at 217° C.

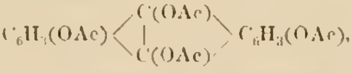
Pentacetoxanthranol—



$$C_6H_4\left\langle\begin{matrix}C(OAc)\\|\\C(OAc)\end{matrix}\right\rangle C_6H(OAc)_3,$$

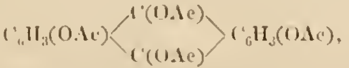
derivative of anthragallol, melts at 203° C.

Tetracetoxanthranol—



$$C_6H_3(OAc)\left\langle\begin{matrix}C(OAc)\\|\\C(OAc)\end{matrix}\right\rangle C_6H_3(OAc),$$

derivative of Anthraflavinic acid. Needles melting at 274° C.



$$C_6H_3(OAc)\left\langle\begin{matrix}C(OAc)\\ \\C(OAc)\end{matrix}\right\rangle C_6H_3(OAc),$$

Derivative of Isoanthraflavinic acid. Needles melting at 235°—240° C.—A. L.

On Methylhydroxanthranol. C. Liebermann. Ber. **21.** 1175.

The methylhydroxanthranol, which the author has previously described, differed from the other colourless alkylhydroxanthranols by its yellow colour, so that it represents probably an isomeric body.

By keeping a mixture of hydroxanthranol, caustic soda, and methyliodide for a week in a closed vessel, and then heating it for a day to 70° C., the author prepared a new colourless methylhydroxanthranol melting at 98° C., which is doubtless the true methylhydroxanthranol.—A. L.

On the Theory of the formation of Colouring Matters by the Oxidation of Aromatic Amines.

J. Barsilowski. J. d. russ. phys. chem. Ges. **19** (1), 132.

The authors' views are founded on a study of the oxidation of *p*-toluidine. In addition to the normal product, *p*-azotoluene, an isomeric body, "azotolyl," is formed. This was also identified as the main product of the oxidation of tolidine free from toluidine. Azotolyl is reduced by ammonium sulphide to hydrazotolyl, which is converted by alcoholic hydrochloric acid into the isomeric base, a body resembling leucaniline, and oxidised to the coloured hydroxy-base "*p-rosotoluidine*" $(C_7H_6N)_3O$.

These reactions attend the oxidation of *p*-toluidine, and throw light on the resulting formation of the colour bases, at the same time that they tend to disprove the hypothesis of E. and O. Fischer of the formation of amidobenzaldehyde as a first stage of the reaction and its condensation with the amine to form the products in question.—C. F. C.

Investigations on the Reactions of Quinoline.

H. Weidel and M. Bamberger. Monatsh. Chem. **9**, 99—114.

Weidel has shown in a previous paper (Monatsh. Chem. **8**, 120) that when a mixture of aniline hydrochloride and quinoline is treated with oxygen, condensation takes place with elimination of hydrogen and paramido-α-phenyl quinoline results. If a current of oxygen be passed into a mixture of ortho-toluidine hydrochloride and quinoline, to which some platinised asbestos has been added, the whole being heated at first to 180°—190° and afterwards to 200°—205°, a similar reaction takes place, the main product being paramido-metamethyl-α-phenylquinoline. This substance is called *pseudo-flavaniline*, being isomeric with the flavaniline prepared by O. Fischer (this Journal 1883, 241); it forms almost colourless crystals, difficultly soluble in boiling water, but readily soluble in alcohol, ether, &c. It melts at 112°, and distils undecomposed under diminished pressure. Analyses of the base, as well as of its hydrochloride, and also of its platinum double salt, agree with the formula $C_{16}H_{14}N_2$.

Pseudo-flavenol, $C_{16}H_{13}NO$, is formed by diazotising the above base and then heating the solution to boiling, at the same time a nitro-product and a hydroxy-pseudo-flavenol result. On oxidation with chromic acid, pseudo-flavenol yields quinaldinic acid (α-pyridine-carboxylic acid); and when distilled with zinc dust, a base *pseudo-flavoline* $(C_{16}H_{13}N)$ is obtained, together with 1:2 cresol and quinoline. On reduction with tin and hydrochloric acid, pseudo-flavenol yields a tetrahydride, and this when fused with alkali gives hydroxyisophthalic acid (1 : 2 : 4) para-hydroxybenzoic acid and a little salicylic acid.

The condensation product of 1:2 toluidine and quinoline is exactly analogous in its reactions to that obtained from aniline and quinoline; the products of oxidation of pseudo-flavenol and of its tetrahydride show that the original base, pseudo-flavaniline, is 1:4 hydroxy, 1:3 methyl α-phenyl quinoline.

Meta-toluidine reacts similarly to ortho-toluidine with quinoline; the products of the reaction have not yet been fully examined. Para-toluidine, on the other hand, does not condense in this way; these facts support the above constitution of pseudo-flavaniline.—C. A. K.

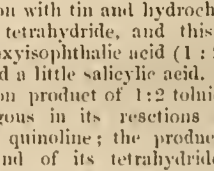
On Benzenetriphenazine.

R. Nietzki and A. W. Schmidt. Ber. **21**, 1227—1230.

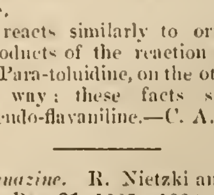
If one molecule of orthophenylenediamine sulphate acts on a solution of one molecule of sodium rhodizonate in hydrochloric acid, a monazine will be formed after a short time.

$$C_6H_2O_6 + C_6H_4(NH_2)_2 = C_6H_2O_4:N_2:C_6H_4 + 2\,H_2O.$$

Dihydroxyquinonephenazine—

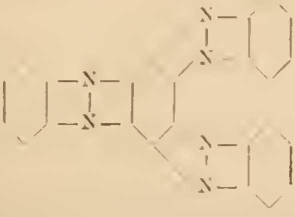


forms reddish-brown needles, soluble in caustic potash. It is converted by oxidising agents into diquinonephenazine—



a body, existing only as a hydrate, which even when dried at 100° C. retains three molecules of water. It consists of yellow needles slightly soluble in water and glacial acetic acid. Sulphurous acid reproduces the dihydroxyquinonephenazine.

By heating two molecules of orthophenylenediamine sulphate with one molecule of diquinonephenazine, benzenetriphenazine—



is formed, crystallising from hot aniline, in reddish-brown needles. This very unstable compound is decomposed even on washing with alcohol. It is a weak base, which does not melt but partially sublimes at a high temperature.

—A. L.

PATENT.

Improvements relating to the Preparation of the Methylic Ether of Gallic Acid and to the Manufacture of Purple Colouring Matters therefrom. A. Kern, Basle, Switzerland. Eng. Pat. 5953, April 23, 1887. 6*d*.

Crystallised gallic acid is dissolved in hot methyl alcohol, and dry hydrochloric acid gas is passed into the solution until it is only absorbed very slowly. The methyl alcohol is then removed by distillation, and the residue, which consists of the methyl ether, dried over a water bath; it may be purified by crystallisation from water.

The ether may also be prepared from tannin by dissolving this in methyl alcohol and treating the solution with concentrated sulphuric acid.

The purple colouring matter is made by boiling a mixture of the methyl ether of gallic acid and nitrosodimethylaniline hydrochloride for some hours with methyl alcohol, when the colouring matter separates in needle-shaped crystals, which are purified by dissolving in water, filtering and then precipitating with common salt.—E. E. B.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

On Silk. Part I. Th. Weyl. Ber. **21**, 1407—1410.

Mulder discovered that silk is soluble in fuming hydrochloric acid in the cold, and Müller (Deutsch. Industriezeit. 1873, 9.) recommended the solution thus obtained as a means of communicating a silky finish to cotton fibres. The object of the present research was to examine the hydrochloric acid solution in order to find if unaltered silk was present. It was discovered that by suitable treatment of the solution a body of constant composition could be isolated with the character of a simple chemical compound, and very nearly allied to silk, like the latter belonging to the Albuminoïds (Proteïds). It contains 1 per cent. less nitrogen than Fibroïn, and the author proposes for it the name *Sericoïn*. White ungummed silk was first purified by Staedeler's process, by digesting with cold 5 per cent. caustic soda lye, pressing, washing with 5 per cent. hydrochloric acid, and finally with water. The silk was then dried at 100° and then treated with so much fuming hydrochloric acid of 1·2 sp. gr., with continual agitation, that it dissolved in a few minutes. The solution was filtered through glass wool, and the filtrate, after standing a short time, was poured into an excess of 90 per cent. alcohol with stirring, the vessel of alcohol being well cooled. Proportion about 400 cc. alcohol for every 5 grms. of silk. After standing 24 hours the jelly-like precipitate was thrown on the filter and washed with alcohol till free from chlorine. It was then removed, still moist, from the filter, distributed in much alcohol, at length completely dehydrated in absolute alcohol, treated with absolute ether and dried in vacuo over sulphuric acid in thin layers. Thus, the substance fell to a white powder, consisting of Sericoïn.

A freshly prepared and very concentrated solution of sericoïn in fuming hydrochloric acid was proved in the 1 decimetre tube to be optically inactive. Pepsin and hydrochloric acid at 40° were equally inactive towards fibroïn or sericoïn. By long boiling of either fibroïn or sericoïn with dilute sulphuric acid (1 : 5) a substance is obtained which shows the so-called *Biuret reaction.* The reaction is thus obtained. The bodies in question are warmed for some minutes with dilute copper sulphate solution. The latter is allowed to drain off and the substances are introduced into dilute caustic soda. After a short time the caustic soda becomes coloured red, and to begin with only in the neighbourhood of the fibroïn or sericoïn. Gradually, especially on shaking, the whole liquid assumes the tint characteristic of Biuret. In a closed flask the coloration may be preserved several months unchanged. An excess of copper in presence of caustic soda causes a blue coloration. Reduction of the alkaline copper solution does not ensue even after boiling.

The solution of the silk in fuming hydrochloric acid first becomes coloured violet, then dirty brown.

On boiling with Millon's reagent fibroïn and sericoïn become coloured red. *Schweizer's reagent* (ammoniacal solution of copper oxide) dissolves fibroïn somewhat more easily than sericoïn. C. Liebermann has found that sericoïn has little or no affinity for picric acid and magenta. It is possible that this difference is occasioned less by chemical than by physical conditions. The colour evidently adheres more easily to the fibroïn *fibres* than to the sericoïn *flakes*. It is also conceivable that the presence of a special cuticular substance favours the retention of the colouring matter. Such a structure is only, of course, peculiar to fibroïn. Fibroïn as hitherto prepared offers no guarantees of chemical purity. It is neither more nor less than a residue, remaining behind when silk is extracted by means of the solvents, water, dilute acids and alkalis, alcohol and ether. It is also not yet possible to decide if sericoïn or amorphous silk, as obtained from fibroïn, be a chemically purer body than fibroïn, or if it be merely a decomposition product of that body.—W. S.

PATENT.

Improvements in Machinery or Apparatus for Separating Textile Fibres from the Stalks or Stems of Plants. E. Edwards, London. From F. J. Maizier and F. J. W. Reitz, Brussels, Belgium. Eng. Pat. 8865, June 20, 1887. 1*s*. 3*d*.

"In the improved machine the fibrous stalks or stems which are to be treated are held by means of elastic clips in a moveable frame arranged on both sides of the machine, and are fed in the direction of their width through the machine in such manner that the frame which carries them has an up and down motion for passing them through the different sets of rollers by which they are treated, and a horizontal motion for passing them from one such set of rollers to the next at intervals, whilst automatic apparatus receives and carries away the refuse." The specification is accompanied by a number of drawings.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Fluorchrome and its use in the Printing and Dyeing of Woollen Goods. G. Stein. Chem. Zeit. Rep. **12**, 94.

This product which is now brought into the market for the above purposes is a fine crystalline green powder, very soluble in water and thickening and free from either iron or sulphuric acid. Its formula is $CrF_3 + 4\ H_2O$. In most cases it may be used in the place of acetate or nitrate of chrome for printing. Alizarin dyes, coerulein, gallein, &c., and logwood extracts, are fixed as perfectly as with acetate of chrome. One advantage in using it is that it is solid. For wool, fluorchrome is a very good mordant, since the fibre combines with the chromic oxide. Thus alizarin dyes and logwood dye wool mordanted with it very well.

—A. R.

Dyeing and Calico Printing in 1887. P. Julius. Chem. Ind. **11**, 105.

There has been a further production of new azo-colours, dyeing cottons directly, on the lines of the well-known methods described in D.R.P. 28,753 (1884) and 38,802 (1885) obtained by substituting for benzidine, tolidine, dianisidine, &c. other aromatic bases, or on the other hand varying the phenol or amine constituent.

The Farbenfabrik vorm. F. Bayer and Co. have introduced the following: *Rosazurin* G, prepared from *o*-tolidine (1 mol.), methyl β-naphthylamine-δ-sulphonic acid (1 mol.), and β-naphthylamine δ-sulphonic acid (1 mol.); *Rosazurin* B from *o*-tolidine (1 mol.), and methyl-β-naphthylamine δ-sulphonic acid, as described in D.R.P. 41,761 (1886); and *Heliotrope* from dianisidine (1 mol.), and the methylnaphthylamine-sulphonic acid (2 mols.).

These colours are only slightly affected by acids.

The Actien Gesellschaft für Anilinfabrikation have patented *Brilliant Congo G* and *R* (D.R.P. 41,095, 1887), also comparatively resistant to acids, obtained from β-naphthylamine di- and monosulphonic acids—1 mol. of each—and tetrazodiphenyl (G) or tetrazoditolyl (R). Owing to the presence of 3 SO_3H-groups, the dyeing with these colours requires attention to the special details, which are given. *Benzopurpurin*, 6 B., introduced by the same firm, is obtained from tetrazoditolyl and Laurent's α-naphthylamine sulphonic acid.

L. Casella and Co.'s *Diamine Red*, 3 B (Centralb. f. d. Textilind, 1887, 1147), is obtained from tetrazoditolyl and β-naphthylamine sulphonic acid F.

The Badische Anilin u. Soda Fabrik have introduced a new Violet-Black (D.R.P. 42,011, 1887) obtained by the following process: Acet-*p*-phenylenediamine is diazotised, and the product combined with α-naphthol sulphonic acid; the acetyl group is then eliminated and the resulting base again diazotised and combined with α-naphthylamine. The colour behaves like *Congo*; it is changed by acids to a blue-black; it acts as a mordant for other colours, and will be found useful in dyeing dark drab shades in cottons.

A. Leonhardt and Co., by ethylating *Brilliant Yellow* (D.R.P. 38,735, 1886), have produced a colour, *Chrysophenin*, superior to the latter, in not being reddened by alkalis, and which can therefore be dyed directly in a bath of soap (2 per cent.) and potash (10 per cent. K_2CO_3). The *Hessian Violet* of the same firm is one of the so-called mixed azo-colours from diamidostilbene disulphonic acid (1 mol.), α-naphthylamine (1 mol.), and β-naphthol (1 mol.). The *Hessian Purples*, B, D, N and P, are prepared from diamidostilbene disulphonic acid, naphthylamine and naphthylamine sulphonic acid (Chem. Ind. **10**, 33—34). A further series of cotton colours from diamidostilbene and also diamidofluorene are manufactured bythe Actien Ges. f. Anilinfab. under D.R.P. 39,786, 1886, produced by diazotising the bases and subsequent combination with phenols, amines, &c. This firm have also issued instructions for printing in *Congo*, *Congo* 4 R, *Congo-corinth*, *Azo-blue*, and *Benzo-azurin*, according to the following recipe: 300 grms. of *Congo*, 100 grms. of caustic soda (36 B.), and 4,500 grms. of water, mixed with 300 grms. of soap previously dissolved and thickened with tragacanth. After steaming, the goods are cleared with bran. For finishing, alkaline mixtures are recommended. For a yellow and blue discharge, *Berry liquor* and *Methylene blue* respectively, are printed with tin salt; recipes are given for these.

The author then gives an ample notice of Brook, Simpson, and Spiller's "*Primuline*" and derivative colours, already described by their inventor, A. G. Green, in this Journal, 1888, 179. In regard to the constitution of Primuline, he observes that on distillation with lime it yields a body having the properties of thio-*p*-toluidine. (G. Schultz.)

The substantive cotton colours can be used for dyeing wool and silk: the addition of Glauber's salt (10 per cent.), and long boiling (1 hour) are necessary. These colours are fast to soap. (Actien Ges. f. Anilinfab.)

The Badische Anilin u. Soda Fabrik have introduced a new colour *Rhodamine*, which has been studied by E. Weingärtner (Chem. Zeit. 1887, 1620), who pronounces it the first of a new group of basic colours. It dyes tannin-mordanted cotton bright shades of pink. The same firm has introduced as *Alizarin black*, the bisulphite compound of the long-known dihydroxynaphthoquinone (D. R. P. 41,518). Woollen goods are chrome-mordanted and dyed in a neutral or slightly acid (acetic) bath of the colour.

(Färb. Muster Zeit. 1888, 23.) These blacks are faster to light than logwood blacks.

J. R. Geigy has introduced two new colouring matters of the "natural" class, *Xanthaurin* and *Anthracin* (Tex. Color. 1887, 204). They are fixed with chromium, aluminium, and tin mordants, yielding all shades, from bright yellow to the deepest "old gold."

E. Alvarez has published an important research on *the Formation of Indigo from the Plant* (Compt. Rend. **105**, 288). He has isolated the particular bacillus by which the fermentation is induced. The aqueous extract of the plant, when sterilised, remained unchanged for months; the addition of the bacillus brought about, in a few hours, the formation of indigo. The organism resembles the *Pneumonia bacillus*, and the latter was found to be also an "indigogen."

The practice of adulterating indigo with coal tar colours appears to have increased considerably in the Madras district (Färb. Muster Zeit. 1887, 195), and consumers are warned against its consequences.

G. Zetter has published (Ber. d. Oesterr. Chem. Ges. 1887, 89) an extension of Witt's (Chem. Ind. 1886, 1), and Weingärtner's (Ibid. 1887, 108), tables for the qualitative investigation of organic colouring matters. He gives a large number of individually characteristic reactions.

P. Martinon (Ind. Text. **130**, 180) has published a scheme for the identification of dyes on silks. The reagents employed are caustic soda, hydrochloric, nitric, and nitrous acids, potassium cyanide and sodium carbonate. The results are given, in the original, in the form of tables.

As a new method of dyeing piece goods, H. Danger, A. Simian, and de Marcieu publish a process (Zeits. f. d. Chem. Ind. 1887, (2) 76), which consists in applying the dye solution in the form of spray, and simultaneously fixing the colour by steaming.

For dyeing unspun cotton, G. Jagenburg describes a process (Romen's Jour. 1887, 255), which permits the gradual addition of the colour to the dye-bath without removing the fibre. The distribution of the colour is effected by introducing it into the stream of liquid, which is kept in circulation by means of a pump drawing it from the bottom of the dye-bath and returning to the top.—C. F. C.

VII.—ACIDS, ALKALIS, AND SALTS.

On the Preparation of Anhydrous Magnesium Chloride.
W. Hempel. Ber. **21**, 897.

If crystallised magnesium chloride be heated in a current of hydrochloric acid, its water of crystallisation can be driven off without the formation of a basic salt. For the preparation of small quantities, the crystallised salt is heated in a Rose crucible, through the lid of which hydrochloric acid is passed. On the large scale magnesium chloride can be anhydrated at small expense by inserting an evaporating furnace for the magnesium chloride between the sodium sulphate furnace and the condenser for hydrochloric acid.—S. H.

Condensation of the Steam emitted in the Manufacture of Sulphate of Ammonia. M. Popel. Jour. f. Gasbeleuchtung, **31**, 39–40.

In order to condense the greater part of the aqueous vapour given off during the manufacture of sulphate of ammonia, a flat sheet-iron chamber has been used in the Dresden Works of the dimensions 4 m. (13 ft.) high by 2 m. long and 0·8 m. wide, with a sheet-iron partition between the broader sides. It has also two upright perforated plates passing from top to bottom. By passing the steam and other gases through this, between 1,200 and 1,300 kilos. of water were condensed in 24 hours, which was nearly the whole of that originally passing away up the chimney, viz., 1,330 kilos., leaving but a very small amount to pass away with the exit gases. The temperature of the condenser was between 55°—85° C. By means of a second condenser, the amount of aqueous vapour passing away was kept regularly down to a minimum, the irregularities in the working of the distilling apparatus making the work for one such condenser too great at times. The condensed water is neutral and smells strongly of phenol, and contains but a trace of ammonium sulphocyanide. The amount of hydrogen sulphide in the chimney gases varied between 2 litres and 5 litres per cub. metre.—J. W. L.

On the Manufacture of Ammonium Chloride and Carbonate in Lump. W. Hempel. Ber. **21**, 897.

A large amount of ammonium chloride and carbonate is sold in lumps, obtained by sublimation. The author has found that the same end can be attained with less expense by submitting the said substances to great compression in a hydraulic press at a temperature between 50° and 100° C.—S. H.

PATENTS.

Improvements in the Manufacture of Caustic or Carbonated Soda and Caustic Potash. A. Delhaye, Brussels, Belgium. Eng. Pat. 4371, March 23, 1887. 6*d*.

This process is based on the precipitation of sodium phosphate by milk of lime. For this purpose calcium phosphate is decomposed by dilute hydrochloric acid, this being a solution of mono-calcium phosphate and calcium chloride. This solution is treated with sulphuric acid, in sufficient quantity to precipitate all the lime, while the filtrate contains "hydrochloric-phosphoric acid." This acid liquid is made to serve for several operations in place of hydrochloric acid, until the liquid contains about 17 per cent. of phosphoric acid. It is then allowed to act on sodium chloride and the temperature is gradually raised to 200° C. Hydrochloric acid is given off, and the mass, when dried, consists of mono-sodium phosphate. It is dissolved in water and mixed with milk of lime in such proportion as to combine with the whole of the phosphoric acid present. At the same time a current of steam is blown through the mass, which is also kept thoroughly agitated. After two or three hours the reaction is complete, the precipitate formed being tri-calcium phosphate, whereas the filtrate therefrom is a solution of sodium hydrate. Another method of obtaining mono-sodium phosphate is to decompose calcium phosphate with sulphuric acid and to add sodium sulphate sufficient to precipitate all the lime of the mono-calcium phosphate, formed in the first instance, thus:—

$$(PO_4)_2Ca_3 + 2\,SO_4H_2 = (PO_4)_2CaH_4 + 2\,SO_4Ca$$
$$(PO_4)_2CaH_4 + SO_4Na_2 = SO_4Ca + 2\,[PO_4NaH_2].$$

The mass is lixiviated with hot water and the solution treated with milk of lime in the same manner as described. If potassium chloride and sulphate be employed, potassium hydrate is obtained as the final product.—S. H.

Improvements in the Manufacture of Carbonate of Soda or Soda Ash and in Apparatus employed therefor. T. T. Mathieson and J. Hawliczek, Liverpool. Eng. Pat. 5753, April 20, 1887. 11*d*.

The object of this invention is the production of soda ash of a great density by the ammonia-soda process. The moist sodium bicarbonate, which is formed in the carbonating towers, is introduced into a horizontal vessel of cylindrical form, heated from below. The vessel is provided with blades, which have the combined effect of stirring the material and feeding it from one end to the other. The length of this vessel is such that the bicarbonate will be converted into monocarbonate by the time it has been fed along a portion of its length, say about one half. At this point, water in a finely divided state, or steam, is injected into the cylinder and, becoming incorporated with the mass, causes it to become granular and of greater density. When the charge has reached the end of the vessel, it is delivered through a shoot into the hopper of a suitable pulverising machine.—S. H.

The Utilisation of By-products resulting from the Manufacture or Production of certain Phosphorus Compounds. P. G. W. Typke, New Malden. Eng. Pat. 7504, May 23, 1887. 6*d*.

The object of this invention is to utilise the phosphoretted hydrogen given off in the manufacture of hypophosphites by converting it into a compound, which can ultimately again be changed into a hypophosphite. The vapours containing the phosphoretted hydrogen are first cooled so as to deprive them of the greater portion of the steam present, and the remaining gases are then conducted through a tube, which is heated in a furnace. This tube is filled with calcium oxide, whereby the phosphoretted hydrogen is decomposed with the formation of calcium phosphide. The latter is converted by the action of water into hypophosphite and phosphoretted hydrogen, which is again treated in the same manner as described.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Colouration of Porcelain at high Temperatures. Knapp. Chem. Zeit. **12**, 426.

The reason why porcelain is often coloured yellow by firing is almost exclusively due to the fire, *i.e.*, when the latter is not burning brightly. Under these circumstances the sulphides formed from the sulphates in the firing materials bring about the yellow colour. Ferric oxide colours porcelain grey.—A. R.

Colouration of Porcelain at high Temperatures. H. Seger. Chem. Zeit. **12**, 563.

This is a reply to Knapp's article (*see* previous abstract). The yellow colour of the porcelain is not due to the use of a dark fire. It is often caused by the prolonged action of air at high temperatures, and for this reason the Royal Porcelain Manufacturing Company (Berlin) open the doors, &c. of the furnace as soon as the porcelain is in proper condition, and a rapid cooling of the glazing is thus effected. Also a very dark fire is used, until the glazing begins to melt, *i.e.*, about the melting point of felspar. Then only, when owing to the sintering of the mass, air can no longer penetrate into it, a bright fire is employed, in fact, the highest obtainable temperature. Porcelain is always coloured yellow if, previous to the sintering of the mass, an oxidising fire has acted on it for some time, whereas it is perfectly white if up to this point the reducing fire gases are allowed to play on the mass. As regards Knapp's assertion that ferric oxide colours porcelain black, this is apparently true, judging from the exterior appearance. But the colouration is actually only caused by reduction; with an oxidising fire the colour is yellow. Chinese porcelain often contains 2·5 per cent. of ferric oxide, but in the reducing fire it turns bluish green. If now 0·1 per cent. of ferric oxide be added the colour becomes grey. In the former case, *i.e.*, previous to the addition of the ferric oxide, the latter is present as the silicate, which accounts for the different behaviour. In the oxidising fire the same porcelain will often assume an intense yellowish-brown colour, due to the conversion of ferrous into ferric silicate.

In conclusion the author refers to the colouring of glass by iron. When both the glass and the ferric oxide are free from sulphates, the oxide dissolves and forms a yellow to reddish-brown glass in the oxidising flame, and a green to black glass in the reducing flame. If, however, any of the materials employed contains sulphates, the ferric oxide dissolves to a yellow glass in the oxidising flame; in the reducing flame to a green glass with evolution of sulphurous acid.—A. R.

PATENT.

A Novel Vitrio-Metallic Material suitable for Glazing and for other Purposes, in place of Glass. L. C. A. Marguerie, Paris, France. Eng. Pat. 6616, May 5, 1887. 4*d.*

Wire gauze or metallic cloth in a heated state is immersed in a thin paste or liquor formed of soluble glass, gelatin, or isinglass, and glycerin or glucose, the proportions of which vary according to result desired. The sheets are then suspended in a drying-room, and when nearly dry are dipped in a concentrated solution of chrome-alum or bichromate of potash, and thoroughly dried. It is proposed to use these sheets for window-panes and other like purposes. Coloured panes are obtained by mixing the colour with the gelatin, and transparent mosaics can be produced by applying coloured pastes with a brush.—A. W.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENT.

A New Process for the Preservation of Woods. James Stevenson, London. From Jean Salvat, Mont de Marsan, France. Eng. Pat. 8024, June 3, 1887. 6*d.*

The wood is injected with a composition consisting of 10 parts of wood tar (Stockholm tar) and 90 parts of oil of resin. In order to give the composition more consistency, a little colophony may be added, and the quantity of oil of resin proportionately decreased. If the wood is previously slightly heated, the injection is facilitated. Wood for pavements thus treated is not slippery and is not affected by frost. The ingredients may be employed alone or mixed. By varying the quantity of liquid ingredients injected, different-coloured woods are obtained.—F. W. T. K.

X.—METALLURGY, MINING, Etc.

Corrosion of Iron and Steel Wire. Bädecker. Zeits. d. Ver. d. Ing. **32**, 186.

Experiments were undertaken with a view of testing the accuracy of the general assumption that puddled-iron is less readily corroded than ingot-iron, the latter less readily than steel, this, again, being corroded the more the harder it is. Stone vessels containing sulphuric acid (12° B.) or hydrochloric acid (8° B.) were employed, and the wires half immersed for periods ranging from 1—24 hours. Immediately after removing from the bath the wires were washed, dried and examined. The changes effected were tested by fixing the wires and bending them at right angles alternately backwards and forwards. Puddled-iron and ingot-iron were found to have been equally attacked, but less so than hard steel. A very short immersion will lower the elasticity or strength of flexure of the latter. It appears that by applying a gentle heat for a short time the original quality of the wire may be restored after corrosion, particularly in the case of hard steel.—A. R.

On the Combination of Carbon and Iron at High Pressures. W. Hempel. Ber. **21**, 903.

If a steel rod is subjected to tensile strain in order to test its strength, it is found that it slightly contracts shortly before breaking, and just at the point where it afterwards gives way. The point of fracture is, of course, the point which underwent the greatest strain. On examining the fracture, a grey core is seen, surrounded by metal of much lighter colour, whereas the same steel rod, if simply broken in two, will present a perfectly homogeneous fracture. This is due to the fact that a high tensile strain causes a portion of the carbon to chemically combine with the iron. The same phenomenon takes place if iron is drawn out to wire.
—S. H.

PATENTS.

A New or Improved Process for the Extraction and Recovery of Metals, and especially for the Recovery of Tin from Tinned Iron Plate. C. B. Schultze, Trotha, Prussia. Eng. Pat. 3669, March 10, 1887. 6*d.*

The substance is digested with cold dilute sulphuric acid, to remove all zinc, with some iron, cobalt, tin, cadmium, nickel and copper; the solution is then neutralised by the addition of zinc ashes or other waste zinc oxide, and filtered through metallic zinc, which precipitates the four metals last enumerated; it is then allowed to drop gently upon scrap zinc, when by the action of the air the iron and cobalt become separated as basic sesquioxide salts, and zinc sulphate crystallises out, which may be freed from the iron and cobalt by recrystallisation. The scraps of metal, after the sulphuric acid treatment, are now digested at 100 C. with sulphuric acid of sp. gr. 1·5 to 1·84 by which any lac varnish is entirely flaked off; they are then attacked by an acid solution of a ferric salt, or by acid containing suspended ferric oxide. Tin, copper, bismuth, nickel, and cobalt thus tend to dissolve, whilst the ferric salt is reduced to the ferrous state. By filtering over metallic iron, bismuth and copper are precipitated from the solution, which is now treated with metallic tin and ferric hydroxide, in order to obtain a solution of neutral protoxides. This neutral solution, on filtration over iron, yields first the metallic tin, and finally the nickel; the cobalt is not thus precipitated, and its recovery at this stage is accomplished with difficulty. The ferrous sulphate may be obtained from the final solution in crystalline form by allowing it to trickle slowly over sheet-iron. Substances containing stannic oxide, after treatment with sulphuric acid alone, are mixed with thin iron or tin plate and dilute sulphuric acid, by which, after some weeks, the tin will have become reduced to a soluble stannous salt. All or any of the above operations may be required, according to the nature of the substance to be treated.—W. G. M.

Improvements in the Manufacture or Production of Zinc and other Sulphides, in the Utilisation of Residual or Waste Products therein, and in Apparatus therefor. H. Grimshaw and H. Kenyon, Manchester. Eng. Pat. 6718, May 7, 1887. 6*d.*

The zinc is extracted from zinc residues or ores by hydrochloric or other acid or alkali; the solution is freed from iron, and zinc sulphide is produced by vapours of ammonium sulphide, obtained from any waste products containing sulphur. Waste ammoniacal liquors and Le Blanc soda waste, or similar sulphur compounds, are forced into a Coffy's still, and the products of volatilisation are suitably treated to prevent excess of ammonia, by passing them through alkali waste. The solution of zinc is preferably concentrated before precipitation, and the resulting sulphide washed and dried in the usual way. The process is claimed for the manufacture of sulphides of the metals which combine chemically with sulphur, of the sulphides of the earths and of the alkalis.—A. W.

Improved Manufacture of Metallic Alloys. A. P. Vivian, Port Talbot. Eng. Pat. 7047, May 13, 1887. 6*d.*

Metallic copper (100 parts) is melted in a reverberatory furnace with from 5 to 15 parts of wrought iron or steel, and when thoroughly alloyed is run into moulds. The ferriferous copper is remelted, and to it is then added, in the reverberatory furnace, zinc, in "the proportion of from 60 to 45 of the former,to from 40 to 55 of the latter." About one-twentieth part of the zinc is first introduced, the resulting slag is skimmed off, and a layer of small stone coal mixed with salt is then added, and finally the remainder of the zinc. Or the zinc may be added to the copper-iron alloy immediately, without ingoting and re-melting. A mixture of 55 of the prepared copper with 45 of zinc gives a metal suitable for rolling or forging (hot) and casting.—W. G. M.

Improvements in Treating Ores to obtain Gold, Silver, Lead, Zinc, Copper, and other Metals or useful Compounds thereof. J. S. MacArthur, Pollokshields, and R. W. and W. Forrest, Glasgow. Eng. Pat. 7278, May 19, 1887. 6*d*.

The finely-divided ore is treated with a hot solution of a persalt (perchloride) of iron. Copper, zinc, lead, and silver are dissolved. The chlorides of the two latter are separated by settling in tanks, metallic copper is precipitated by iron, and the zinc is thrown down by sodium sulphide. Gold is extracted from the residues, after further cleaning, if necessary, by a solution of potash, by chlorine, or by excess of a perchloride with heat and pressure, and is precipitated in the usual manner. The persalt of iron can be regenerated and used repeatedly.—A. W.

Improvements in Disintegrating Copper Pyrites by means of "Nitric Iron Salts" for extracting Copper. J. Perino, Berlin, Germany. Eng. Pat. 2019, February 10, 1888. 4*d*.

Copper pyrites, with or without previous roasting, is heated to 100°—200° C. with "nitric iron salts," by which the copper is perfectly sulphatised, and rendered soluble. The "nitric iron salts" may be prepared by mixing solutions of ferrous sulphate and calcium nitrate, and filtering from the resulting calcium sulphate. The calcium nitrate itself may be prepared by passing the gases from the sulphating chamber into milk of lime.—W. G. M.

Process for extracting Aluminium from Substances bearing Alumina and combining the Aluminium with other Metals directly from such Substances. W. A. Baldwin, Chicago, U.S.A. Eng. Pat. 2584, February 21, 1888. 4*d*.

Four parts of dry pulverised clay with 12 parts of sodium chloride and one of charcoal powder are fused together, and, when fluid, the metal to be alloyed is introduced and allowed to remain, with occasional stirring, until the alloying is complete, after which it is run into ingots. Except in the case of metals having low fusing points, the added metal may be melted with the charge, if preferred. When a more highly aluminous material is used, the proportions of charcoal and sodium chloride must be increased proportionately.—W. G. M.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

On Aluminium Bronze. O. Schmidt. Chem. Zeit. **12**, 457.

Referring to Hampe's statement (this Journal, 1888, 325), that he was unable to obtain aluminium by electrolysing fused cryolite with sodium and potassium chlorides, the author quotes an opposite experience. Cryolite and sodium chloride in the proportions indicated by the equation—

$$Al_2F_6.6\,NaF + 6\,NaCl = Al_2Cl_6 + 12\,NaF$$

were fused in a well-brasqued iron crucible. At a clear red heat the bath became perfectly fluid and transparent, and an anode of gas carbon and a cathode of sheet copper were introduced. The copper did not melt, but became covered with a film of deposited aluminium, which in part penetrated the electrode, and in part adhered to the surface as a rich alloy, which ultimately fused slowly off and sank to the bottom of the crucible. With a plate of 1 to 1·5 mm. in thickness, 10 per cent. of its weight of aluminium could thus be deposited, with one of 3 mm. about 5 per cent., and the metal could be made perfectly homogeneous by fusion in a carbon crucible. On thermochemical grounds sodium would not here be reduced, because whilst the molecule of NaCl requires 97·3 calories for its dissociation, that of $\frac{Al_2Cl_6}{2}$ needs only 80·4, and the current first attacks that most readily decomposed.

Moreover, the calculated difference of potential for Al_2Cl_6 of $\frac{80\cdot4}{23} = 3\cdot5$ volts was actually observed, and it must have increased to about 4·5 volts to bring about the electrolysis of the NaCl.—W. G. M.

PATENTS.

Improvements in Galvanic Batteries. W. H. Quarterman, Southwark. Eng Pat. 5140, April 6, 1887. 8*d*.

This invention is an improvement on the author's patent, No. 8733 of 1885. The tubular zinc electrodes have a lug which passes through the lid, is bent over and slotted to fit under the nut of a binding screw attached to the case. The zinc may be rapidly released by loosening this nut and slightly turning the zinc. The lid may be made in several pieces jointed together, the carbon terminal projecting through it in the line of one of the joints; or the lid may have conical holes which, passing over the terminals, are closed by rings of india-rubber round the bases of the terminals, the edges of the cell being also fitted with india-rubber seatings to form an air-tight joint.—E. T.

Improvements in Secondary Electric Batteries. J. Kynoch and W. Habgood, London. Eng. Pat. 7317, May 19, 1887. 4*d*.

The inventors intermix with one or more of the oxides of lead some such materials as potassium permanganate and sulphuric acid, which are able, singly or together, to peroxidise them and cause the whole to set. The mass soon becomes plastic; perforated platinum strips are inserted and the whole subjected to great pressure. A little plumbago may be added to improve the conductivity, and the plates may, if desired, be perforated.—E. T.

Improvements in Secondary Batteries or Electrical Accumulators. R. E. B. Crompton, Chelmsford, and J. C. Howell, Llanelly. Eng. Pat. 6681, May 6, 1887. 8*d*.

To separate the plates the inventors employ rods of insulating material inserted in holes or grooves of a framework or grid at the bottom of the cell. This may either be of lead in contact with one set of plates, the others being suspended by rods from the top, or it may be of insulating material. At the bottom of the cell there may be transverse ribs to support the plates, and these may be hollow and perforated that air may be blown through. Another form of separator is made like a hair-pin supported either at the bend by transverse bars at the top of the cell or in holes in the bottom. The lower ends of adjacent separators may be made continuous, or a corrugated sheet of celluloid or vulcanite perforated with holes used. This is flexible, and can yield to the growth of the plates. The connecting wires are of lead, or a lead antimony alloy, attached at several points along the top and one side of each plate. The ends are turned up vertically and inserted in conical holes punched in a lead connecting bar, and the tip of each, as it projects through, is slightly riveted over and burnt on to the burr left by the punch. The plates may be rapidly disconnected by removing this burred portion with a sharp chisel. Connexion may be made, however, by means of a screwed copper wire cast into the connecting wires and protected by dipping in "Ajax" metal. The covers of the cells are preferably of thin lead, the whole being made air-tight, if required, by a packing of india-rubber or cotton saturated with a plastic mixture of paraffin wax and oil.

—E. T.

Improvements relating to the Separation and Refining of Metals and to Apparatus therefor. H. H. Lake, London. From E. S. Hayden, Waterbury, Conn., U.S.A. Eng. Pat 2071, February 11, 1888. 8*d.*

The metal to be refined is obtained in the form of thin plates, preferably by rolling; these plates are then supported by insulating grooves, in series, in a tank containing a suitable electrolyte. They are so placed as to extend completely across the tank, but yet to leave a clear space beneath each; they should be arranged as close to one another as convenient, but without electrical connexion, except through the electrolyte. The end plates are attached to the opposite poles respectively of a dynamo, the current from which thus traverses the solution between each pair of plates, transferring the metal from the one to the other, depositing the insoluble impurities and precious metals on the bottom of the trough. In this way each plate acts as both anode and cathode, losing metal by solution on the one side in favour of the plate lying next on the side nearer to the final cathode plate, and receiving a deposit of purified metal from that adjacent to it on the other side, until the original plates have been completely dissolved and pure deposited metal has been substituted. The solution should be maintained in very gentle flow, the heavier liquid being drawn off from beneath by a siphon, and returned into the top of the tank at the opposite end. Two or more tanks may be arranged in series, and two or more series may also be arranged parallel. Rolled plates being more homogeneous than cast plates, are to be preferred; they may be obtained thinner, and therefore lighter. They do not tend to crumble under the action of the current, and their greater homogeneity tends to prevent the formation of spurs or knobs, whilst a greater number may be treated in each tank and in a shorter space of time.—W. G. M.

An Improvement in holding the Plates of Secondary Voltaic Batteries. B. M. Drake and J. M. Gorham, Westminster. Eng. Pat. 3097, February 29, 1888. 6*d.*

The plates of the battery are enclosed in two or more frames of insulating material pierced with holes at suitable intervals. The plates are cast with lugs, which, entering the holes of the frames, support the plates and separate them from each other. The spongy lead plates may have pins and holes instead of lugs.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Comparative Investigation on Stearin, Paraffin, and Composite Candles. A. Bunte and Scheithauer. Jour. f. Gasbeleuchtung **31**, 400—404.

The results of these experiments are given in the following tables, and do not require much explanation. As regards the melting and solidifying temperature, they may only be looked upon as comparative, the various methods in use for this purpose giving different results. The "firsts" stearin candles were with one exception pure white, the "seconds" and "thirds" were yellowish; those of paraffin were of the usual opal white colour. The composite candles were almost as pure white as the stearin candles; they appeared, however, a little fatty. The height of the flame was determined according to the method of Krüss, a reading being taken every half minute for a quarter of an hour. The light intensity was estimated with a Bunsen's photometer, the unit of light being a Hefner-Alteneck amyl acetate lamp, which corresponds to the average intensity of an English sperm candle.

General Properties.

Sort of Candle.	Size and Weight.			Wick.			Melting Point.	Solidifying Point.	Material Burnt in 1 Hour.	Height of Flame.				Light Intensity* A. N. K. (Amylacetate Lamp).			Material Burnt per Hour in A. N. K.	1,000 grms. Material Produce A. N. K. Hours.
	Length.	Diameter.	Average Weight.	No. of Threads.	No. of Fibres.	Weight of 1 m. of Wick.				Largest.	Smallest.	Medium.	Most General.	Maximum.	Minimum.	Average.		
A.—Stearin Candles.	cm.	cm.				gr.	C.	° C.		mm.	mm.	mm.	mm.					
Molard & Co., Berlin:—																		
1. "Firsts"	28·6	2·0	79·1	5	25	0·908	54—55	56—55	8·5766	50	47	48·6	48	1·18	1·01	1·09	7·868	127·0
2. "Seconds"	27·5	2·0	77·5	5	25	0·868	46—47	50	8·5510	48	45	46·9	47	1·16	1·04	1·11	7·704	129·8
3. "Thirds"	24·9	1·7	51·1	5	25	0·875	46—48	50—46	8·7187	45	40	42·0	44	1·08	0·82	0·91	9·584	104·4
Overbeck & Son, Dortmund:—																		
4. "Firsts"	25·7	2·0	74·9	3	36	1·293	50—51	51·5—50·5	9·6368	51	48	49·6	50	1·28	1·20	1·23	7·835	127·6
5. "Seconds"	26·4	2·0	75·9	3	36	1·362	47—49	48—47	9·4560	54	48	51·3	50	1·38	1·22	1·28	7·387	135·4
Siegert & Son, Neuweid a. R.:—																		
6. "Firsts"	19·0	2·4	77·86	5	60	2·155	55—56	58—57	10·8989	73	57	65·8	67	2·10	1·60	1·79	6·088	164·2
Hachl & Co., Ruprechtsau, Strasburg:—																		
7. "Crown"	22·6	2·2	79·2	5	55	2·063	56—57	58—57	10·5260	65	59	62·0	62	1·46	1·22	1·30	8·097	123·4
8. "Firsts"	25·6	2·1	78·6	5	45	1·58	54—55	56—55	9·8436	60	53	56·3	57	1·20	1·08	1·13	8·711	114·8
Stettin Candle and Soap Works:—																		
9. "Firsts"	28·0	2·0	78·1	3	34	1·24	50—51	53·5	9·5753	57	52	54·1	55	1·33	1·13	1·24	7·722	129·5
Munzing & Co., Heilbronn:—																		
10. "Firsts"	29·6	2·1	86·1	5	50	1·68	51·5—53	58—56	10·3594	63	57	59·3	60	1·40	1·13	1·32	7·848	127·4
B.—Paraffin Candles.																		
11. Rubecksche Montan-Werke, Ld.	24·0	2·0	70·3	3	42	1·135	56	54	8·4684	64	55	60·1	60	1·50	1·23	1·35	6·273	159·4
C.—Composite Candles.																		
12. Rubecksche Montan-Werke, Ld.	29·5	2·1	92·9	3	45	1·78	47—48	44	8·5356	58	53	55·8	56	1·32	1·11	1·23	6·939	144·1

* "A. N. K." = Amyl acetate normal candle.

From the tabulated results it is apparent that the paraffin and composite candles emit a much larger amount of light for a given quantity of material than the stearin candles. A simple calculation also shows that in the composite candles the amount of light emitted is the same as though the two ingredients, stearin and paraffin, were separately burned.—J. W. L.

Occurrence of Oleic Acid in Earth-Nut Oil. L. Schon. Ber. **21**, 878.

The author examined the acid prepared from earth-nut oil by Gössmann and Scheen's process (Ann. **94**, 230), and by Schröder's method (*ibid* **143**, 22), and found that, contrary to the statement of these investigators, earth-nut oil contained no hypogœic acid, the only acid of the $C_nH_{2n-2}O_2$ series present was oleic acid.—S. H.

On the Occurrence of Lignoceric and Arachidic Acid in Earth-Nut Oil. P. Kneiling. Ber. **21**, 880.

The oil was saponified with hot sodium hydrate solution and the soap decomposed with dilute hydrochloric acid. The mixture of acids thus obtained was dissolved in hot 95 per cent. alcohol, and on cooling flaky crystals were deposited, which after purification were found to be identical with lignoceric acid $C_{24}H_{48}O_2$, discovered by Hall and Hermanns in beech-wood tar. The different mother liquors were collected, and after distilling off the alcohol, the residue was again saponified and the soap ultimately decomposed with hydrochloric acid. By means of fractional crystallisation from alcohol, all the lignoceric acid, which is only slightly soluble in alcohol, was removed, and the last mother liquor boiled down to crystallisation, yielded on cooling an acid, which proved to be arachidic acid, $C_{20}H_{40}O_2$.
—S. H.

The Ethereal Oil from Asarum europæum L. A. S. F. Petersen. Ber. **21**, 1057—1064.

The liquid portions of the oil obtained from *Asarum europæum* consist of a thick dark-brown liquid with a sweet aromatic smell and neutral reaction. It dissolves readily in the ordinary solvents of ethereal oils and at a low temperature deposits a considerable quantity of *asarone*. By distillation with steam and subsequent fractionation it can be separated into two principal portions, one boiling below 170° and the other at 235°—260°. From the former a turpentine, which proved to be identical with pinene, was isolated. The latter, on further fractionation, yields a slightly yellow oil which boils at 247°—253°, and has the composition $C_{11}H_{14}O_2$. The halogens act on this compound very energetically, and when heated with hydriodic acid methyl iodide is evolved. When treated with nitrous acid a yellow crystalline compound, $C_{11}H_{14}N_2O_5$, melting at 118°, is obtained. Nitric acid oxidises the oil, with evolution of carbonic anhydride and hydrocyanic acid, a resinous product, oxalic acid and a small quantity of an acid, melting at 178°, being also obtained. On careful oxidation with potassium permanganate, acetic, oxalic and veratric acids are produced, carbonic anhydride being evolved. These experiments show that the chief constituent of *asarum* oil is a compound of the formula—

$$C_6H_3.C_3H_5.OCH_3.OCH_3\ [C_3H_5:OCH_3:OCH_6=1:3:4].$$

The oil of *Asarum canadense L* also contains a turpentine identical with pinene, and the portion of this oil boiling at 250° is identical with the similar fraction obtained from *Asarum europæum*. In fractionating the oil from *Asarum canadense* considerable quantities of acetic acid are evolved.
—F. S. K.

On Minjak Tengkawang—a Vegetable Fat from Borneo. A. C. Geitel. J. Prakt. Chem. **36**, 515.

This substance, known in commerce as Borneo tallow, appears to be particularly suitable for the manufacture of soap and candles. It is obtained from the fruit of a number of plants belonging to the family of Dipterocarpes. Its original colour is light green, which changes to yellow, then white on prolonged exposure to the air. In consistency at ordinary temperatures, and in its taste, it resembles cocoa butter. It has a crystalline granular structure and is covered with numerous fine white needles of stearic acid. It melts at 35°—42°. The quantity of free fatty acids present in this substance calculated as stearic acid amounts to 9·5—10 per cent. A closer examination of the nature of these acids proved that they consist almost entirely of oleic and stearic acids in the proportion of 31 per cent. of the former to 64 per cent. of the latter. The fat is saponified very readily.—A. R.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Shellac. R. Benedikt and E. Ehrlich. Zeits. ang. Chem. 1888, 237—240.

Shellac can be freed from wax by boiling it with a dilute solution of sodium carbonate; the wax separates and can be filtered off, whilst the shellac, which may be separated from the filtrate by the addition of acid, has, when melted together, the hardness of the original shellac and like it is softened but not melted, by boiling with water. If this solution of shellac in sodium carbonate, after the removal of the wax, be boiled with caustic soda solution and then precipitated with acid a thick viscous mass results, which does not harden. This dissolves in ether, and after distilling off the latter, 70 per cent. of the original product is obtained in the form of liquid shellac, which may be further purified by boiling it in a flask with six parts of 70 per cent. alcohol and an excess of ignited magnesia. The whole is then treated with hot water, the alcohol distilled off by steam, and the resulting liquid filtered, when the liquid shellac which is contained in the filtrate as a magnesium salt is separated by the addition of dilute sulphuric acid, and extracted with ether. Liquid shellac thus purified is a thick viscous mass very slightly soluble in boiling water, readily soluble in alcohol and ether, and precipitated by water from its alcoholic solution. When heated it gives off water and forms a hard mass resembling ordinary shellac. Elementary analyses of ordinary and of liquid shellac show that the two are approximately identical in their ultimate composition, but the acid value of the latter is slightly more than three times that of the former (204:66). From this acid value the authors assign the molecular weight 825 to liquid shellac, and from the elementary analysis the formula $C_{16}H_{72}O_{12}$; further, they consider that it contains three carboxyl groups for each one contained in ordinary shellac. Liquid shellac forms salts with magnesia and with baryta, which are readily soluble in water; solutions of these salts when concentrated yield a transparent residue which becomes opaque on standing. Lead, silver and zinc salts form white precipitates when added to a solution of the magnesium salt. A sodium carbonate solution of shellac when oxidised by an alkaline solution of potassium permanganate yields azaleïc acid together with soluble shellac; 20 per cent. of the former on the weight of shellac taken, is obtained, and the latter, by further oxidation, also yields azaleïc acid. Fatty acids also appear to be formed.

The wax separated from shellac in the manner above indicated contains both ceryl and myricyl alcohols, and these seem to be combined in the fat, not only with fatty acids but also with resinous acids.—C. A. K.

PATENTS.

Improved Method of Preparing a Gummy Varnish, Coloured or otherwise, for General Use or Decorative Purposes. J. A. Bigsby, Deptford. Eng. Pat. 3987, March 16, 1887. 4*d*.

Two to eight ozs. of aniline dye, mineral, animal or vegetable colouring matter, proved by previous experiments to be capable of withstanding a high temperature and exposure to strong light, are added per gallon of varnish and intimately mixed by trituration or solution by heat or any such process. Insoluble matter is removed by filtration. Any oil or spirit varnish of commerce may be used, or a varnish composed of 1 lb. of resin or any gum resin, 2 lb. of linseed or other equivalent oil, and 2 lb. of spirits of oil of turpentine combined with a small quantity of any siccative matter.—F. W. T. K.

An Improved Paint or Coating. P. Molyneaux, London. Eng. Pat. 6582, May 4, 1887. 4*d.*

THIS composition is more especially intended for the coating of metal, wood or concrete tanks in which petroleum or other mineral oil is to be stored or carried. It consists of a solution of shellac, or other resin insoluble in petroleum oil or turpentine, with a small percentage of gum arabic and glycerine, combined with powdered iron, forge scale, Portland cement, litharge, or other suitable material for giving body and durability to the composition.—F. W. T. K.

Improvement in the Enamelling of Metallic and other Surfaces, and in the Materials employed therefor. J. D. Watson, Glasgow. Eng. Pat. 7279, May 19, 1887. 6*d.*

THE metallic surface is coated with a thin layer of platinum by painting with a varnish containing oxide of platinum, sulphate of lime, and ground pumice, then heated at 500° F. for about 12 hours. Three coats of barium sulphate with varnish are then painted on, the material being dried and subjected to a temperature of 380° F. for about 12 hours after each coat. It is then treated and ignited in the same way with two coats of a varnish containing ground barilla, oxide of zinc, baryta, and rock salt. Finally, the anti-corrosive enamel is obtained by coating with a mixture of india-rubber, oxide of zinc and wood naphtha, and heating at 240° F. for six hours.—A. W.

Improvements in Lacquers and Varnishes. F. Crane, Short Hills, U.S.A. For J. Hale, Cranford, U.S.A. Eng. Pat. 7376, May 20, 1887. 6*d.*

BY the addition of amyl acetate, amyl alcohol or fusel oil to varnishes prepared by dissolving various gum resins (either alone or combined) in methyl alcohol, "benzine," petroleum, &c., varnishes are obtained which dry slowly, and as they do not absorb moisture from the air, can be applied to cold metals.—F. W. T. K.

Improvements in Varnishes. F Crane, Short Hills, U.S.A. For J. Hale, Cranford, U.S.A. Eng. Pat. 7377, May 20, 1887. 6*d.*

A SIMILAR varnish, which dries slowly, is obtained by the use of amyl acetate (boiling point 136° C.) as a solvent either alone or mixed with other suitable menstrua (*e.g.* ethyl, methyl, or amyl alcohol) in varying proportions. Any gum resins soluble in the menstruum may be used, the quantity varying from half a pound to five pounds per gallon. The amyl acetate leaves no residue to injure the varnish, it is non-hygroscopic, and by its use in proper proportions the hygroscopic nature of ethyl or methyl alcohol is rendered innocuous.—F. W. T. K.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Some New South Wales Tan-Substances. J. H. Maiden, Curator of the Technological Museum, Sydney. Parts III. and IV.

IN Part III. the author gives the results of his investigations upon 21 species of trees and plants containing notable proportions of tannin. In Part IV. his observations are extended to the leaves of 24 species of Acacia and Eucalyptus. In both parts copious qualitative tests are given for identification. (*This Journal* 1888, 38.) The great value of the Australian leather and tanning materials may be gathered from the favourable opinion expressed by the expert appointed by the Society of Arts to report upon this class of exhibits at the late Indian and Colonial Exhibition. To counteract the more or less reddish colour always produced by the acacia or mimosa bark, he suggests the admixture of other materials such as bright myrabolans.

Below is a list of the species examined, giving scientific and vernacular names, with yield of tannin.

Elæocarpus Grandis (*Blue Fig or Brisbane Quandong*), 10·28 per cent. of tannic acid in bark.

Rhus Rhodanthema (*Deep Yellow Wood*), 23·15 per cent. of tannic acid in bark, 16·91 per cent. in leaves.

Acacia Homalophylla (*Narrow-leaved Yarran*), 9·06 per cent. of catechu-tannic acid in bark.

Acacia Oswaldi (*Miljee*), 9·72 per cent. of catechu-tannic acid in bark.

Acacia Longifolia. Two specimens from different parts of the country contained 15·34 and 15·99 per cent. of catechu-tannic acid in the bark. The bark of this tree is used by the Sydney fishermen for tanning their sails and nets, which remain soft and pliable after the operation.

Eucalyptus Stellulata (*Sally or Black Gum*), 62·96 per cent. of kino-tannic acid in the kino, 16·62 per cent. in leaves.

Eucalyptus Amygdalina (*Peppermint*), 58·41 per cent. of kino-tannic acid in kino, 8·75 per cent. in leaves.

Eucalyptus Piperita (*Messmate, Narrow or Almond-leaved Stringybark*), 62·12 per cent. of kino-tannic acid in kino, 12·59 per cent. in leaves.

Eucalyptus Siderophloia (*Ironbark*), 6·70 per cent. of kino-tannic acid in bark, 5·95 per cent. in leaves.

Eucalyptus Viminalis (*Ribbony Gum or Manna Gum*), 7·50 per cent. of kino-tannic acid in bark, 4·00 per cent. in leaves.

Eucalyptus Stuartiana (*Appletree*), 5·25 per cent. of kino-tannic acid in bark, 10·16 per cent. in leaves.

Eucalyptus Corymbosa (*Bloodwood*), 5·85 per cent. of kino-tannic acid in the bark, 18·37 per cent. in leaves.

Eucalyptus Maculata (*Spotted Gum*), 9·74 per cent. of kino-tannic acid in bark, 44·55 per cent. in kino, 5·26 per cent. in leaves.

Eremophila Longifolia (*Emu Bush*), 5·10 per cent. of tannic acid in bark, 9·70 per cent. in leaves. The aborigines use these leaves for tanning purposes.

Polygonum Plebejum. The whole plant contained 11·19 per cent. of tannic acid. An American species of this genus, *P. Amphibium*, is largely used in the Chicago tanneries, and gives a leather said to be tougher, more durable, of finer texture, and capable of higher polish than that tanned with oak bark.

Grevillea Striata (*Beefwood*), 17·84 per cent. of tannic acid in bark.

Hakea Leucoptera (*Needle or Pin Bush*), 10·99 per cent. of tannic acid in bark.

Banksia Integrifolia (*Coast Honeysuckle*), 10·82 per cent. of tannic acid in bark.

Banksia Serrata (*Beefwood, Honeysuckle*), 23·25 per cent. of tannic acid in bark.

Casuarina Glauca (*Belar, Belah, Billa, or Bull Oak*), 11·58 per cent. of tannic acid in bark.

Exocarpus Cupressiformis (*Native Cherry*), 15·75 per cent. of tannic acid in bark.

The percentages of tannin given below refer to the leaves only, being calculated (as in the above instances) on the weight of substance dried at 100° C.

Acacia Vestita, 15·18 per cent. of catechu-tannic acid.

Acacia Melanoxylon (*Blackwood, Lightwood*), 3·38 per cent. of catechu-tannic acid.

Acacia Longifolia (*Golden Wattle*), 1·93 per cent. of catechu-tannic acid.

Acacia Glaucescens (*Myall*), 2·87 per cent. of catechu-tannic acid.

Eucalyptus Sirberiana (*Cabbage Gum*), 2·39 per cent. of kino-tannic acid.

Eucalyptus Amygdalina (*Ribbon Gum*), 1·81 per cent. of kino-tannic acid. This is a different variety of *E. Amygdalina* from that mentioned above.

Eucalyptus Obliqua (*Stringybark*), 17·2 per cent. of kino-tannic acid.

Eucalyptus Macrorrhynca (*Stringybark*), 10·13 per cent. of kino-tannic acid.

Eucalyptus Melliodora (*Yellow Box*), 7·89 per cent. of kino-tannic acid.

Eucalyptus Hæmastoma (*Rough or Small-leaved Stringybark*), 11·27 per cent. of kino-tannic acid.

Eucalyptus Polyanthemos (*Box*), 1·88 per cent. of kino-tannic acid.

Eucalyptus Odorata (*White Box*), 6·77 per cent. of kino-tannic acid.

Eucalyptus Robusta (*Mahogany*), 12·07 per cent. of kino-tannic acid.

Eucalyptus Rostrata (*Red Gum*), 6·62 per cent. of kino tannic acid.

Eucalyptus Gunnii (*Red Gum*), 16·50 per cent. of kino-tannic acid.

Eucalyptus Gunnii (another variety — *Bustard Gum, Hooded Gum*), 8·28 per cent. of kino-tannic acid.

—A. R. D.

XV.—AGRICULTURE, MANURES, Etc.

The Physiological Importance of the Exhalation of Oxygen by certain thick-leaved Plants. A. Mayer. Landw. Versuchsstat, **34**, 127—143.

The author drew attention in former researches to the fact that the green parts of many Crassulaceæ exhale oxygen in the absence of carbonic anhydride; moreover, he pointed out that this exhalation in presence of sunlight was more vigorous, the greater the quantity of free malic or similar acid in the leaves; but that no such changes are observed in dead leaves or in leaves containing other acids, such, *e.g.*, as oxalic. Warburg showed that other plants having thick cuticles and few stomata, with consequent small power of transpiration, behave in a similar manner. Kraus, too, suggests that the malic acid or calcium malate in these plants acts as a kind of reserve material in place of carbohydrates. In the author's opinion these observations indicate that plants which have only a small capacity for converting carbonic anhydride into carbohydrates, exhale oxygen during insolation for the same physiological reasons as ordinary plants, but instead of utilising carbonic anhydride alone they reduce and convert into carbohydrates malic (or some such) acid as well. Moreover, in these thick-leaved plants the malic acid is a product of respiration, inasmuch as the organic material taking part in their respiration in the dark is not wholly dissipated as carbonic anhydride, but is, at least in part, converted into an organic acid and stored up in the plant ready for reconversion into carbohydrates during the day.—D. A. L.

The Action of Nitrogen in Soil. R. Müller. Sächs. Landw. Ztschr. **34**, 122.

The ammonia produced by the decomposition of vegetable and animal matter in soil is gradually converted into nitric acid, which change is effected without the aid of micro-organisms, but is greatly favoured by the presence of lime. As regards their absorption of nitrogen, plants act very differently, some taking up a large portion of their supply in a short time, others more slowly. Vegetables take up nitrogen continuously, particularly at high temperatures and when much nitric acid is being formed. The application of lime is therefore advisable to soil in which vegetables are grown.—A. R.

Chemical condition of Potassium in Plants, Humus and Field-soil. Berthelot and André. Compt. Rend. 1887, 833—840, 911—914.

The field-soil employed contained when dry 2·35 per cent. of organic carbon, 0·166 per cent. of nitrogen and 0·892 per cent. of total potash estimated by means of ammonium fluoride. When 50 kilos. of this soil were treated by percolation with 50 kilos. of water, $\frac{9}{10}$ of the water was recovered and contained potash (K_2O), amounting to 0·00029 grm. per cent. of the dry soil. By suspension in water a larger quantity of potash was extracted, but even then a total of only 0·0143 grm. of potash per cent. of dry soil was dissolved by digesting 100 grms. of the soil with three successive litres of water for periods of 1½ hours, 24 hours and 3 days respectively. The quantity of potash dissolved by digestion was not altered by the addition of 2 per cent. of ammonia or ethyl acetate to the water, but it was somewhat increased by the presence of a similar quantity of the following substances: — sugar, acetamide, or acetic, hydrochloric, or nitric acid; or by using water saturated with carbonic anhydride, or by digesting with cold hydrochloric or nitric acid, even under the most favourable of these conditions, that of digestion with very dilute hydrochloric acid, the quantity of potash dissolved only reached 0·0404 grm. per cent. of the dry soil. A much larger amount was removed by boiling with hydrochloric or nitric acid, for after 16 hours' boiling with the latter acid 0·1026 grm. of potash per cent. of dry soil was obtained in solution. Igniting the soil did not increase the amount of potash dissolved by water, but the quantity of potash dissolved by dilute hydrochloric acid was, however, greatly augmented, owing to the decomposition of silicates during ignition.

For the investigation of the potassium in plants *Mercurialis annua* was selected. The plant dried at 100°, lost 78·26 per cent., and the dry matter contained 1·935 per cent. of total nitrogen, 12·50 of ash, consisting principally of potash and lime compounds. By digesting 50 grms. of the dry plant with 500 grms. of cold water, 1·892 per cent. of potash were dissolved, whilst 500 grms. of 3 per cent. hydrochloric acid removed 2·458 per cent. of potash. Potassium, therefore, exists in plants in three conditions:—1. Soluble in water. 2. Soluble in acids. 3. Insoluble in these solvents.

The humus mould taken for experiment contained at first 32·4 per cent. of water, but lost 45·9 per cent. by air drying. The dry substance contained 9·58 per cent. of organic carbon, 1·45 of carbonic anhydride as carbonate, 0·86 of nitrogen, and 1·165 of potash (by ammonium fluoride). By digesting the dry humus with 10 times its weight of water for 24 hours, 0·296 grm. of potash dissolved, or quarter of the potash present, and 40 times as much as the field-soil yielded under similar treatment. Whilst 0·584 per cent. of potash was dissolved during 24 hours by digesting 200 grms. of dry humus with 1,000 grms. of 2 per cent. hydrochloric acid, and as in the case of field-soil, incineration increased the quantity of potash dissolved by dilute acid, even then 0·296 of the potash remained undissolved. The results show that the mould does not retain all the potash derived from plants, a small amount being lost by rain. But taking into consideration the large percentage of nitrogen along with other good qualities, humus may be regarded as a quick acting compound manure, intermediate in character between organic and inorganic manures.—D. A. L.

Precautions for the Purchase of Clover Seeds. J. König. Landw. Zeit. f. Westfalen u. Lippe, 1888, 44.

The author calls attention to the fact that several samples of seed were found to contain about 30 per cent. of clover silk. And other samples more than a year old proved deficient in germinating power to the extent of 30 to 40 per cent.—D. A. L.

Absence of certain Plants in very Limey Soils. W. R. Lazenby. Agric. Science, 1, 218.

The American chestnut tree is found generally throughout Ohio, but never flourishing in limestone districts where the water is hard. Moreover, the numerous representatives of the Ericaceæ never grow on limestone soils.—D. A. L.

Addition of Wood-ashes to Superphosphate. V. T. Magerstein. Oesterr. landw. Wochenblatt, 1887, 355—356.

Experiments on a diluvial sand-soil with barley, oats, white mustard, potatoes, &c. indicate that when wood-ashes are added in quantities under 25 per cent. the action of the superphosphate is not diminished, but in some cases even increased.—D. A. L.

Results of Experiments on Barley in Schleswig-Holstein in 1887. A. Emmerling. Landw. Woch. f. Schleswig-Holstein, 1888, 85—86.

The following conclusions, drawn from the results of experimental cultivation of five varieties of barley on medium clay soils in Schleswig-Holstein, confirm the experience of Märcker in Saxony.

Glassy appearance indicates high percentage of albuminoids, but the best quality barleys for brewing have a low percentage of albuminoids, and should not contain many glassy grains. High percentage of flour is frequently associated with bad colour, and the grain is then regarded as a low class brewing barley in spite of the large amount of starch. The colour appears to be influenced by moisture, inasmuch as the percentage of moisture in the grain increases as the quality decreases. Complete and uniform ripening and dry storage are important for the production of a good brewing barley; and all influences interfering with these conditions are detrimental and should be avoided, such as cultivation on rolling country or on moor land and exposure to rain during harvest. Freshly sown nitrogenous manures or soils rich in nitrogen are undesirable for the production of barley with a high percentage of flour. Mangold-wurzel, sugar-beet, or rye are good crops to precede barley.

The following were the yields in kilos. per hectare, the weight per hectolitre, and the percentage of albuminoids in the dry grain in the five varieties of barley:—

——	Field.	Weight per Hectolitre.	Albuminoids.
Fehrmarn's six-row barley ..	2334	66·9	9·92
Propsteier two-row barley...	2544	69·5	9·84
Scotch (peerless white) barley	2520	69·2	9·08
Danish two-row barley	2489	63·4	9·42
v. Trotha's (Gansefurther) two-row barley	2290	68·5	9·72

—D. A. L.

Experimental Cultivation of Maize, Sorghum Vulgare, and S. Saccharatum for Fodder. Schleh and J. König. Landw. Zeit. f. Westphalen u. Lippe, 1888, 25—26.

In these experiments, conducted at Herford, the seeds were sown in May in rows 40 cm. apart; the plants were singled out on the 14th June and harvested in September 22. Details of the number, length, and weight of the stocks, haulms, and leaves are given in the paper; the yield in kilos. per hectare was as follows:—

Maize	74103
S. vulgare	43893
S. saccharatum	49408

And the composition of the plants in 1887:—

——	Horse-tooth Maize.	S. Vulgare.	S. Saccharatum.
	Per Cent.	Per Cent.	Per Cent.
Water	82·57	76·19	75·62
Dry matter:			
Crude albuminoids	7·37	7·77	7·06
= pure albuminoids	5·95	5·51	5·45
Fat	1·90	1·95	1·99
Sugar	23·29	9·55	15·11
Other non-nitrogenous extract	29·08	33·85	32·99
Woody fibre	31·32	39·71	37·03
Ash	7·04	7·17	5·82

—D. A. L.

Comparative Experiments with Ammonium Sulphate and Sodium Nitrate as Manures for Potatoes. Kiepert. Hannov. land- u. forstw. Zeit. 1888, 109.

The following results were obtained per morgen, from the experiments:—

Manuring.	Potatoes.	Starch.	
	Ctrs.	Per Cent.	Ctrs.
Unmanured	60	22·2	13·32
2½ centners ammonium superphosphate	80	21·4	16·96
1 ctr. ammonium superphosphate 50 lbs. (German) superphosphate, 60 lbs. Chili saltpetre	80	20·7	16·56
1 ctr. superphosphate, 120 lbs. Chili saltpetre	96	20·5	19·68

—D. A. L.

On the Supposed Occurrence of Hydrogen Peroxide in Vegetable and Animal Juices. Th. Bokorny. Ber. 21, 1100—1102.

C. Wurster (Ber. 19, 3195) concludes that hydrogen peroxide occurs widely distributed in vegetable and animal juices, from the fact that white tetramethylparaphenylenediamine paper is turned blue on being brought into contact with freshly cut muscles, saliva, potato slices, &c. Bokorny maintains that this conclusion is based on perfectly insufficient evidence. Wurster himself has shown that a number of other substances give the same reaction as hydrogen peroxide. Amongst others the following occur widely distributed in animal and vegetable juices: alcohols, salt, aldehydes, ethereal oils, and sugar. Even the oxygen dissolved in water attacks these test papers, though certainly more slowly than slices of apples or potatoes.

The only legitimate conclusion seems to be that *possibly* traces of hydrogen peroxide are present in the juices. Bokorny concludes, from his own investigations (Pringsh. Jahrb. f. wiss. Bot. XVII. 2), that living protoplasm (*spirogyra*) does not give off hydrogen peroxide. Spirogyræ do not cause Wurster's papers to turn more blue than water alone does. Comparative experiments by Bokorny have shown that the old reagents, iodide starch papers, ferrous sulphate and tannic acid give distinct reaction with one part H_2O_2 to 100,000 parts of water; whereas one part of H_2O_2 to 20,000 parts of water is necessary to give a distinct reaction with Wurster's papers. It is true that iodide of starch paper is slower than Wurster's paper, but it is not affected by the oxygen in the water. The old reagents are therefore stated to be more trustworthy than Wurster's paper in testing for the minute traces of hydrogen peroxide, which are only likely to occur in plants and animals.

—F. W. T. K.

XVI.—SUGAR, STARCH, GUM, Etc.

Analysis of Sugar-beet in 1885, 1886, *and* 1887. P. Wagner. Zeits. d. landw. Vereins d. Grossh. Hessen, 1888, 46.

In 1885, 47; in 1886, 79; in 1887, 50 samples were examined and showed a mean percentage of sugar amounting to 12·32 in 1885, to 12·41 in 1886, to 13·59 in 1887. Eighty per cent. of the samples in 1885 contained from 10½ to 12 per cent. of sugar, in 1886, 93 per cent. of the samples ran from 11 to 14 per cent., whilst in 1887, 92 per cent. of the samples had from 12 to 16 per cent. of sugar, and there were none lower than 11 per cent. in that year.—D. A. L.

Controlling the Waste Water from Beet-Sugar Works. Kozietulski. Przegl. techn. **13**, 257.

After describing a plant for the above purpose, the author states that a large quantity of organic bodies are lost in the evaporating pan, being mechanically carried away. The quantity may be considerably reduced (in one case from 0·405 to 0·075 grms. per 1 litre) by a careful control of the waste water and by employing larger still-heads.—A. R.

U. S. Department of Agriculture. Division of Chemistry. Bulletin, No. 17.

This is an interesting "Record of Experiments conducted by the Commissioner of Agriculture in the manufacture of sugar from Sorghum and Sugar Canes at Fort Scott, Kansas; Rio Grande, New Jersey; and Lawrence, Louisiana, 1887—1888."

The greater part of the pamphlet is devoted to the results of manufacturing sugar from sorghum, while an account is also given of experiments made with the diffusion process and with sugar canes at Lawrence, La. Previous attempts and failures to make sugar profitably from sorghum are described, and the present state of the industry is summarised thus: "The experiments in making sugar from sorghum which have been in progress for several years at private expense, assisted by the U. S. Department of Agriculture, have this year reached results sufficiently favourable to place the manufacture of sorghum on a profitable basis."

Congress voted 50,000 dollars to assist in experiments at the above-named places, and the State of Kansas, which is considered the locality most adapted to the production of sorghum, passed a Bill in 1887, providing for a bounty of 2 cents per pound to be paid upon all sugar manufactured in the State for five years, the maximum amount to be paid in one year being limited to 15,000 dollars.

The reports of the various officials connected with the experiments are very full.

At Fort Scott the total amount of cleaned cane worked for sugar was 2,610 tons, total amount of first sugar 235,476 lbs., polarising, on an average, 96 per cent., and total molasses, 51,000 gallons. The average yield of first sugar per ton of cane was fully 100 lbs., polarising 97, and 12 gallons of molasses.

This factory can work about 170 tons of field canes, equal to 135 tons of chips or cleaned canes, per day of 22 hours, and on this scale the total cost of working one ton of cleaned cane is calculated to be two dollars. The cost of the cane is two dollars per ton. The average yield of cane per acre was 9½ tons.

The total value of the products of the season's working, including the bounty of 2 cents per lb., was 34,976·50 dollars, and the cost of production 21,746·93 dollars, leaving a balance of 13,229·57 dollars; but as the Department of Agriculture has paid 6,534·75 dollars, the actual profit to the company at Fort Scott is 19,764·32 dollars for the season.

The processes of making sugar from sorghum are as follows:—

1st. The topped cane is delivered at the factory by the farmers who grow it.

2nd. The cane is cut by a machine into pieces about 1¼ ins. long.

3rd. The leaves and sheaths are separated from the cut cane by fanning mills.

4th. The cleaned cane is cut into fine bits called chips.

5th. The chips are placed in iron tanks, and the sugar "diffused"—soaked out with hot water.

6th. The juice obtained by diffusion has its acids nearly, or quite, neutralised with milk of lime, and is heated and skimmed.

7th. The defecated or clarified juice is boiled to a semi-syrup in vacuum pans.

8th. The semi-syrup is boiled "to grain" in a high vacuum in the "strike" pan.

9th. The mixture of sugar and molasses from the strike pan is passed through a mixing machine into centrifugal machines, which throw out the molasses and retain the sugar.

It is essential that the cane be quickly worked after being cut to avoid inversion, and the rule is laid down that while the weather is warm "all cane cut in the forenoon should be worked the same day, and that cut in the afternoon should be worked by noon the next day." When the weather is cooler it is not necessary to be quite so prompt.

At first much difficulty was experienced owing to inversion taking place in the diffusion battery, but this was entirely prevented by placing 10 lbs. of precipitated carbonate of lime in each cell containing about 2,000 lbs. of chips.

The amount of glucose in sorghum is large, as the following mean figures from a table show:—

—	Means.	
	Sorghum.	Louisiana Cane.
	Lbs.	Lbs.
Cane sugar	193·10	230·00
Grape sugar	53·55	14·89
Total sugars	246·65	244·89
Not sugar	49·97	43·16
Total soluble solids in 1 ton of cane	296·62	288·05

The grape sugar, however, imparts a very agreeable taste to the syrup, and on this account is considered one of the most valuable contents of the sorghum cane.

Another feature of the sorghum industry is the seed, of which there is produced about two bushels per ton, and which is estimated to be worth about 70 cents a bushel.

It is proposed to use the exhaust chips either in the manufacture of paper pulp, or, after expressing a large portion of the water, for fuel.

Experiments on the storing of sorghum canes in silos were also made, and from these it is "fully established that some varieties of sorghum cane can be preserved in an inexpensive way without impairment of the sugar until the end of January."

A long account is also given of air-evaporating apparatus in manufacturing syrup, both with air at the ordinary temperature and when heated to 140°. The apparatus consisted of a liquid carrier which had 273 sq. ft. of surface enclosed in a box 3 ft. by 2 ft. and 6 ft. high, standing on a tank; the liquid carrier passed continuously through the syrup or juice in the tank, and its surfaces were kept uniformly wet with syrup in thin films. Hot air passed over these surfaces and evaporated 1 lb. of water per hour from each square foot of surface. By this means juice can be evaporated to heavy syrup.

The mean analyses of juices of fresh chips, diffusion juices and exhausted chips, are as follows:—

——	Fresh Chips.	Diffusion Juices.	Exhausted Chips.
	Per Cent.	Per Cent.	Per Cent.
Sucrose	9·54	6·68	1·03
Glucose	3·40	2·20	

By using the diffusion process it was found that 92·04 per cent. of all the sugars contained in the cane, was obtained.

Diffusion experiments were also conducted with sugar cane at Lawrence, La., at a factory where the most successful results had been obtained by crushing the canes, and the testimony of the owner of the factory is that 35 lbs. more sugar were obtained from the diffusion process than from the crushing.

The quantity of coal required to make 1 lb. of sugar by the diffusion method was estimated at 2 lbs., but the evaporating appliances were not economical, and it is calculated that with better apparatus only 1—1½ lbs. of coal per pound of sugar would be required.

It is pointed out that diffusion can only be made a success economically when the best machinery and most economical methods are employed.

An extensive series of experiments were made on the use of brown coal and wood char in the filtration through filter presses of cane juices and syrups. The decolourising power of the brown coal was great, but it was a complete failure from the point of view of quantity and purity of liquor filtered, whereas wood char gave much better results, as the following comparison shows:—

——	Matrix required on Weight of Sucrose.	Improvement of Purity Coefficient.	Decolourisation Sulphured.
	Per Cent.		Per Cent.
Brown coal	30 to 45	0·30 to 1·90	60 to 80
Wood char......	4 to 12	1·50 to 1·30	6 to 12

The ton referred to weighs only 2,000 lbs.—W. M.

On the Compounds of Phenylhydrazine with Sugars.

E. Fischer. Ber. **21**, 988—991.

The conversion into the osazones, which are difficultly soluble and crystallise well, is the best method for identifying sugars. This method has been applied in the examination of certain sugars the constitution of which was doubtful.

Phlorose.—Experiments prove that this is identical with dextrose.

Crocose.—The colouring matter and the bitter principle of saffron yields on heating with acids a sugar, which was called crocose by Kayser. On treatment with phenylhydrazine phenylglucose-azone was formed. It consists, therefore, in part, of dextrose. Whether another sugar is present is not yet decided.

Formose.—The product obtained from formaldehyde and calcium hydroxide by Butlerow is, according to Loew, a uniform body of the composition $C_6H_{12}O_6$, which he calls formose. The phenylformose-azone analysed by Loew is, however, a mixture of at least two, but probably of three or four osazones. The author describes the means of separating the osazones. Phenylformose-azone has the formula $C_{18}H_{22}N_4O_4$, and melts between 130° and 144° C. Another product melts at about 200° C., and the figures obtained from analysis are between those calculated for $C_{17}H_{20}N_4O_3$ and $C_{18}H_{22}N_4O_4$. There has been a third osazone observed, melting above 204° C., which was not, however, obtained perfectly pure.—A. L.

XVII.—BREWING, WINES, SPIRITS, Etc.

On the Effect of the Water on the Quality of the Beer.

O. Windisch. Wochenschr. f. Brauer. **5**, 237.

The author enumerates a few instances showing that a variation in the character of the water affects the beer, and enjoins brewers to frequently analyse the water they employ, as the latter is continuously liable to change its composition. In one case an unexpected turbidity of the beer was traced to the presence of a large number of bacteria in the water.
—A. R.

Denaturation of Alcohol. Chem. Zeit. **12**, 523.

The denaturation of alcohol by means of pyridine and methyl alcohol is the best means of rendering the product unfit for consumption. The added ingredients cannot be removed by distillation or by dilution, and then filtering through charcoal; the pyridine is held back by distilling after the addition of acid, but the wood spirit remains with the distillate. Further, it is not possible to render alcohol thus treated fit for consumption by the addition of acids, or of aromatic essences. A mixture of two volumes of wood spirit to one volume of pyridine was originally recommended by the German commission on this subject, three litres of this mixture being added to 100 litres of 100 per cent. alcohol. It appeared, however, that the proportion of pyridine was too great, and at the close of last year the following proportions were adopted:—1 volume of pyridine to 4 volumes of wood spirit, and 2½ litres of this mixture to 100 litres of 100 per cent. alcohol. The complaints regarding the denaturation of alcohol by this means are to be traced to two causes; on the one hand the proportions at first adopted contained too much pyridine, and there is no doubt a considerable amount of this over-denaturated alcohol still in the market, whilst on the other hand the objectionable properties of denaturated spirit is often due to the spirit itself, and not to the ingredients added.
—C. A. K.

Recent Progress in the Manufacture of Spirit. Dingl. Polyt. J. **268**, 126—136.

In a report to the Society of Technical Chemistry in Bavaria on the estimation of fusel oil in brandy, Mayrhofer selects from various methods those of Röse and Traube as being the only ones likely to meet the difficulties of the fusel oil question, and gives a decided preference to Röse's method, which depends on the alteration in volume of a layer of chloroform. (This Journal, 1886, 498.) The author has examined the influence exerted by ethereal oils which cannot be completely separated from the alcohol by distillation with caustic potash, and finds that the presence of nitrobenzene, oil of peppermint, oil of fennel, acetate of amyl, oils of orange and carraway, hardly affect Röse's method, but exert a large influence in the case of Traube's method, which has the further disadvantage of being largely affected by accidental conditions, such as slight turbidity of the fluid, or mere traces of moisture in the capillary tubes. R. Fresenius recommends great caution in the use of either method, as they have in some cases given high results with cognac of known purity. A proposal of Mayrhofer to estimate fusel oil in liqueurs and brandies by Röse's method as modified by Stutzer and Reitmair was adopted by the meeting, the method of Traube being discarded.

Officially selected methods for testing denaturation agents are published with detailed instructions (Zeitschrift für Spiritusindustrie **10**, 344). The instructions concerning wood spirit are:—(1.) The colour must not be darker than the lighter Rhine wines. (2.) The specific gravity must be taken with instruments officially verified. (3.) For the boiling point determination 100 cc. are to be placed in a metal flask which has a bulb tube for carrying a delicate thermometer, and for connexion with a Liebig's condenser. The distillation must proceed slowly enough to deliver the distillate in separate drops, and at least 90 cc. must come over below 75° C. (4.) 20 cc. of the wood spirit when mixed with 40 cc. water must give no separation of oily drops on standing. (5.) As to the proportion of acetone, 20 cc. wood spirit shaken with 40 cc. caustic soda of 1·3 sp. gr. must cause a separation of at least 4 cc. on standing. (6.) As to bromine absorption a specified solution of potassium bromate and bromide is acidified with sulphuric acid, by which 0·703 grm. bromine is set free, and to this the wood spirit is added in drops until the colour disappears; not more than 10 cc. and not less than 7·5 cc. of the wood spirit must be required. Equal parts of the wood spirit and water are to be poured into a stoppered flask filled with small pieces of freshly-burnt charcoal, and after standing 12 hours, at least 30 cc. of the filtered liquid must be required to decolourise the above-mentioned bromine solution. The bromine tests must be made by daylight. Pyridine bases must fulfil the following conditions:—(1.) Since the mixture of pyridine bases is liable to deepen in colour on long standing, the tint of Madeira wine is the limit of colour allowable. (2.) 20 cc. of a solution of 1 cc. of pyridine bases in 250 cc. water when mixed with a 5 per cent. aqueous solution of cadmium chloride must give a perceptible cloudiness after a few moments. (3.) The boiling point determination is to be made as for wood spirit, and at least 90 cc. of distillate must come over below 140° C. (4.) 20 cc. pyridine mixed with 40 cc. water must give no oily drops on standing. (5.) As to the proportion of water, agitation of 20 cc. of the bases with 20 cc. caustic soda of 1·4 sp. gr. must result in the separation of at least 18 cc. of the bases after standing some time. (6.) Four drops of the pyridine heated on platinum foil over a Bunsen flame must burn away and leave no residue.

An article in the *Gazeta* on the testing and denaturation of foreign spirits in Spain recommends testing with sulphuric acid and with caustic potash only, and a denaturation with petroleum, and that, in order to minimise the possibility of admixture of the spirit with extractive matters from the wood, the casks should be well gelatined.

R. Diez publishes (Zeitschrift für physiologische Chemie **11**, 472) a new method for the quantitative estimation of glycerol. The solution should contain not more than 0·2 grm. glycerol in 10 or 20 cc., and this is shaken with 5 cc. benzoyl chloride and 35 cc. caustic soda of 10 per cent. strength, on which the glycerol is separated as tribenzoate.

Will recommends (Archiv. für Pharmacie, 812) for the estimation of grape sugar, the precipitation as barium saccharate in presence of alcohol.

F. Mylius publishes (Zeitschrift für physiologische Chemie **11**, 306) researches on the blue iodide of starch, which is shown to bear a striking analogy to iodocholic acid. The evidence is strongly in favour of its being a chemical compound rather than a mechanical mixture. Without the presence of hydriodic acid, no blue compound is formed. Metallic salts of the blue compound are obtainable, and $(C_{21}H_{40}O_{20}I)_4\ IBa_3$ is given as the probable formula of the barium compound.

Researches on diastase. C. J. Lintner publishes (Journal für prakt. Chemie, 1887, 481) a continuation of his work on this subject, and examines the properties of diastase from other grain than barley. He finds that wheat contains fully as much diastase as barley, and of identical character. He confirms the previously noted fact that diastase withstands the deteriorating effect of higher temperatures better in presence of starch than when heated alone, and also that diastase parts with none of its inverting power by its action on starch at the ordinary temperature (17·5°); the maximum effect from a given weight of diastase is obtained at 50° C.—G. H. B.

PATENTS.

Improvements in the Manufacture of Alcoholic Liquids. Jokichi Takamine, Tokio, Japan. Eng. Pat. 7277, May 19, 1887. 4*d*.

This invention has for its object the increased economy in the manufacture of alcoholic liquids, the Sake ferment being used either alone or combined with yeast for promoting alcoholic fermentation in saccharine liquids, whereby a much greater percentage of alcohol is obtained, since a larger quantity of glucose or other saccharine substance can be employed than in the ordinary process.—J. H.

The Manufacture of Wine from Barley and other Grain. G. E. Jacquemin, Nancy, France. Eng. Pat. 9363, July 1, 1887. 6*d*.

Advantage is taken in this process of the fact that when saccharomyces ellipsoideus is employed alone in the fermentation of malt wort, to which an appreciable quantity of invert sugar is added, a true barley wine is produced. Sweet malt wort (*i.e.* wort to which no hops have been added) is taken, of such specific gravity as to give an extract of 26 to 30 grms. of solid matter per 1,000 cc.; to this is added a suitable quantity of bitartrate of potash, for the production of an acidity similar to that of the grape, a certain proportion of invert sugar is next added, whereby the elliptical fermentation is set up, and after following the usual course of fermenting grape-must, a white wine is produced possessing the same taste and odour as that ordinarily obtained from grapes. A portion of the germinated grain may be replaced by an equivalent quantity of cereal flour, rice or maize, in the preparation of the wort, and instead of cane sugar the juice of sacchariferous plants, beetroot, sorghum, &c. or commercial glucose may be used. —J. H.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

On Cocoa. C. G. Bernard. Chem. Zeit. **12**, 445.

Cocoa berries contain from 4·05—4·73 p.c. of water. When roasted they contain only 2·48—3·17 p.c., and are very hygroscopic. It is not advisable to judge of the excellence of a cocoa preparation by its ash, as the quantity of the latter will be greater, the less fat it contains. Thus Sprüngli's saccharine-cocoa has 6·45 p.c. of ash, and contains 28·78 p.c. of fat, whereas one of the most soluble and best known Dutch cocoas has 7·9 p.c. of ash and 36·8 p.c. of fat, the latter being of course preferable, notwithstanding the higher percentage of ash.—A. R.

Kola Nuts. J. v. Jobst and O. Hesse. Gewerbl. a. Würtenburg, **40**, 94.

As these nuts contain 1·83 p.c. of caffeine they may be regarded as a strong stimulant. When roasted like coffee, ground and extracted with hot water, the infusion has an unpleasant taste resembling acorn-coffee. To make chocolate from kola nuts, they are roasted and ground, and cocoa-butter added as the nuts do not contain sufficient fat. This chocolate is of superior appearance and smell, but the flavour resembles acorn-chocolate. However, kola nuts are likely to be used as an admixture of cocoa in the preparation of chocolate.—A. R.

(*B*)—SANITARY CHEMISTRY.

Composition of the New Water Supply from Naunhof for Leipzig. F. Hofman. Jour. f. Gasbeleuchtung, **31**, 156—158.

The composition of this water is as follows; that of the old supply, the Connewitz water, being given for comparison. The sample of the Naunhof water was taken as it enters the reservoir.

One litre contains :—

	Naunhof Water.	Connewitz Water.
	Mgrms.	Mgrms.
K_2O	1·9	9·4
Na_2O	14·2	13·6
NH_3	0	0
CaO	18·3	63·5
MgO	5·1	18·3
Fe_2O_3	0·5	1·7
SO_3	25·9	38·7
SiO_2	20·9	25·0
N_2O_5	4·4	7·0
Cl	5·9	12·7
$NaCl$	9·6	21·0
Oxygen of $K_2Mn_2O_8$ required to oxidise the organic substance	0·7	0·7
Total solids dried at 100° C.	138·5	230·3

A determination of the iron in the water at Naunhof showed 1·09 mgrm. Fe_2O_3, the quantity of this constituent apparently decreasing during transit. The methods used for analysis were the ordinary ones. In the case of the ammonia, 300 cc. were treated with sodium carbonate, and after the precipitate had settled 20 cc. were Nesslerised.
—J. W. L.

PATENTS.

New or Improved Compositions for Disinfectant, Preservative, or Remedial Purposes. J. W. Hamilton, Liverpool. Eng. Pat. 6571, May 4, 1887. 6*d.*

The leading feature of this invention is the combination of a strongly oxidising compound with an antiseptic. For ordinary purposes it is proposed to proceed as follows. To 14 ozs. of potassium chlorate and 16 ozs. of black oxide of manganese (both pulverised and well mixed together) is added a solution of 20 ozs. of caustic potash in 16 ozs. of distilled water. The whole is evaporated to dryness and heated in a covered crucible to semifusion. After boiling several times with water the extract is saturated with carbonic acid and allowed to crystallise. The crystals obtained by re-solution and a second crystallisation are dried over sulphuric acid, and 5 ozs. dissolved in a gallon of cold distilled water already containing 7 ozs. of borax in solution.

It is claimed that the resulting liquid has valuable curative properties, especially for skin and throat diseases, is an excellent dentifrice, and a good preservative of food. Diluted with 200 times its volume of water it forms a powerful disinfectant. Other oxidisers and antiseptics may be substituted for those prescribed above.—A. R. D.

Improvements in Apparatus for Purifying and Filtering Water. O. H. Jewell, Chicago, U.S.A. Eng. Pat. 1836, February 7, 1888. 11*d.*

The water is forced through a sand filter in a closed cylindrical tank, the outlet pipe rising from below the filter-bed to above the top of the tank. A branch from the feed-pipe goes directly underneath the filter-bed, and communicates with a series of distributors by a number of lateral branches. When the filter-bed requires cleansing, water is admitted below it by this branch pipe, and, rising upward, it cleans the bed, and escapes by a suitable outlet. If it is desired to introduce gaseous or liquid reagents to precipitate any matters dissolved in the water, the inlet for such reagents is connected with the suction pipe of the pump. An important feature in the improvements is the use, if desired, of electrolysis as a purifying or precipitating agent. Two suitably chosen electrodes are contained in a dome surmounting the filtering cylinder, and are so placed as to be just below the water inlet. Any solid matters therefore precipitated by the electric current in the upper part of the tank are separated as the water passes downwards through the filter-bed.—A. R. D.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

Improvements in Apparatus for Straining Pulp used in the Manufacture of Paper. G. Hibbert, Gateshead-on-Tyne. Eng. Pat. 6897, May 11, 1887. 8*d.*

The apparatus is shown in section in Fig. 1. The frame A, carrying the strainer plates *a*, is pivoted at H′ on to the vat B, and at the other end is connected with the rod E, by means of which and the cam R a shaking motion is produced. The frame A is made smaller than the vat B, and the two are connected by means of a flexible diaphragm C′, Fig. 2. The shaking motion produced by the rod E creates a partial vacuum under the plates *a*, and assists the passage of the pulp. This is further assisted by means of the motion of the diaphragm D. Fig. 1, and by the knocking caused by the contact of the brackets H, Fig. 2, fixed on the frame A with the vat B. The pulp is run into the box A′, and flows over the strainer-plates, which are placed

Fig. 1.

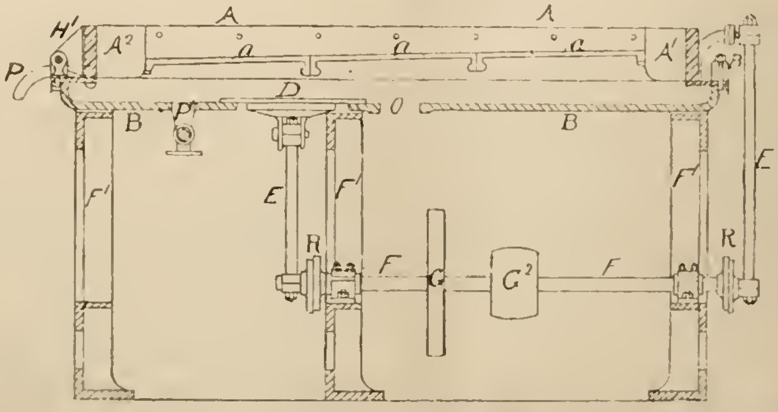
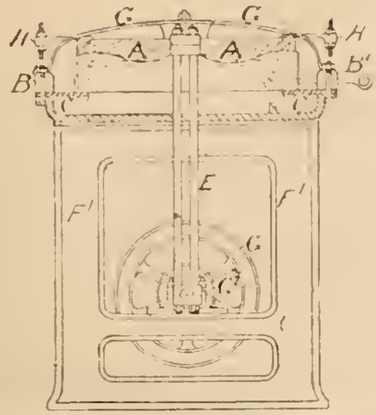


Fig. 2.



at an angle so that the portion retained by the strainer may flow away to be discharged by the pipe P. The frame A is carried by means of the springs G, Fig. 2.—E. J. B.

Improvements in Preparing Safety Paper for Cheques or other Documents. R. C. Menzies, Musselburgh, and C. M. King, London. Eng. Pat. 7226, May 18, 1887. 6*d.*

This invention consists in adding to the pulp, phosphate of copper, ferrocyanide of zinc and phosphate of manganese. When acid is added to paper so prepared, a stain of ferrocyanide of copper is produced which is exceedingly difficult to remove. When an alkali is added, a stain of ferrocyanide of copper and manganese oxide is formed.

—E. J. B.

Improvements in Treating Rhea or China Grass and like Plants, and Apparatus therefor. E. Casper, Bayswater. Eng. Pat. 14,034, October 15, 1887. 8*d.*

The improved apparatus consists of a tank divided into three compartments connected with each other at the bottom. The material to be treated is placed in a series of perforated trays. The centre compartment is furnished with an air-tight piston, moving up and down by means of a connecting rod and crank or eccentric. By the downward motion of the piston the liquid in the tank is forced down through the material contained in the central division and up through that in the outer ones, the opposite being the case when the piston is moved upward. In this way every particle of the material is brought in contact with the liquid, which may be heated by means of a steam coil in the bottom of the tank.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Two New Salicylates. B. Fischer. Pharm. Zeit. **33**, 146.

(1.) *Hydrargyrum salicylicum,* a white tasteless and odourless powder of neutral reaction, with difficulty soluble in water or alcohol. It is decomposed by CO_2 but not by acetic, tartaric, or lactic acid, and dissolves readily in caustic soda.

(2.) *Magnesium salicylicum* is prepared by saturating hot aqueous solutions of salicylic acid with $MgCO_3$. It crystallises in long colourless needles readily soluble in water or alcohol, and has a slightly bitter taste.—A. R.

Sparteïne. F. B. Ahrens. Ber. **21**, 825—832.

Sparteïne yields a base $C_{14}H_{24}N_2$, and methyl iodide when heated with hydriodic acid, and the base thus obtained forms a nitroso derivative. When sparteïne sulphate is distilled with lime, ethylene and propylene are evolved, and a mixture of bases is obtained, in which the presence of γ-picoline was proved. By passing sparteïne through a tube heated to dull redness, pyridine, γ-picoline, small quantities of a reduced base, ethylene, propylene, non-aromatic hydrocarbons, ammonia, and hydrocyanic acid are produced.

From the above results it follows that sparteïne is a pyridine derivative; since only very simple pyridine derivatives and no aromatic compounds are obtained by the above decompositions, it is probable that the molecule is composed of two pyridine rings, which are perhaps linked in a similar manner as in nicotine. The fact that pyridine carboxylic acids cannot be obtained by the oxidation of sparteïne (this Journal 1887, 736), and also that it can only take up two atoms of hydrogen, shows the presence of reduced rings. One methyl group is combined with nitrogen and one is situated in the γ position in one of the pyridine rings. A side chain, consisting of three carbon atoms, is probably present.—F. S. K.

Apiol. G. Ciamician and P. Silber. Ber. **21**, 913—914.

Apiol is found in the distillation-product obtained in the preparation of "oil of parsley," when parsley seeds are distilled with water. Besides a terpene, a crystallisable body has been long identified, the latter gradually separating out in fine needles. This is the so-called "*parsley camphor*" or apiol, and has the formula $C_{12}H_{14}O_4$. It dissolves with gentle warming in concentrated sulphuric acid, producing an intense red colouration, a reaction characteristic of it (Ber. **19**, 1477). Apiol boils under ordinary pressure at 294°, under 34 mm. pressure at 179°. It can be distilled with steam, and dissolves readily in ordinary solvents. It does not combine either with acids or bases, and yields no compound with hydroxylamine or phenylhydrazine. When oxidised with chromic acid a neutral compound (probably $C_{10}H_{10}O_5$) is obtained, which is sparingly soluble in water and petroleum ether, but dissolves readily in alcohol and ether. It crystallises from benzene and alcohol in long, shining needles, melting at 102°, and dissolves in concentrated sulphuric acid with an intensely yellow colour, which changes to olive green on warming. Brown flocks are precipitated from this solution by the addition of water.

When apiol is oxidised with potassium permanganate an acid, and a neutral substance melting at 122°, are obtained.—F. S. K.

Apiol. J. Ginsberg. Ber. **21**, 1192—1194.

The only product obtained by boiling apiol (Ber. **19**, 1478) with alcoholic potash, seems to be an isomer, which, on oxidation with chromic acid, yields a compound which crystallises in colourless needles, melting at 102° and boiling at 315°.

The nitro-compound of apiol (loc. cit.) gives with stannous chloride and alcoholic hydrochloric acid a reduction product, which crystallises from boiling water in long, yellowish needles, melting at 118°, and soluble in mineral acids with a red colour. This base forms a *picrate, hydrochloride* and an *acetyl* derivative; the latter crystallises from water in colourless leaflets, which melt at 260°.

—F. S. K.

On *Narceïne.* Ad. Claus and Al. Meixner. J. Prakt. Chem. **37**, 1—9.

The substance which has hitherto been regarded as pure narceïne is found to contain certain impurities, which are removed by a limited oxidation with potassium permanganate. In this case, impurities are first oxidised, but at the same time a considerable quantity of narceïne is also decomposed. The pure product, $C_{23}H_{29}NO_9$, melts at 162°. On further oxidation with permanganate ($4\frac{1}{2}$ mol. of the latter to 1 mol. of narceïne) at 20°—23°, an acid is obtained called by the authors *Narceïc acid,* $C_{15}H_{15}NO_8 + 3\,H_2O$. It is a tribasic acid. Narceïc acid melts at 184°, when it is decomposed into CO_2, dimethylamine and a new acid of the formula $C_{12}H_8O_6$, called *Dihydroxy-naphthalic acid.* This change is best effected by passing a current of air through narceïc acid heated to 180°—200°. The new acid is obtained pure from the residue by sublimation. It then melts at 162°. On crystallising from hot water no change in the composition is observed, whence it may be inferred that an anhydride is not formed by sublimation. The acid is dibasic. By reducing with phosphorus and conc. HI for several days, a new *Naphthalic acid,* $C_{12}H_8O_4$, is formed, melting at 250°—253°, which, on distilling with lime, gives naphthalene. This naphthalic acid closely resembles the so-called γ-naphthalenedicarbonic acid of Wichelhaus and Darmstädter, but absolute identity was not established. The new body certainly differs from naphthalic acid from acenaphthene.

Though it cannot be assumed that narceïne is a derivative of naphthalene, there is no doubt that it contains a group of carbon atoms, which under certain circumstances combine to form a naphthalene nucleus. In conclusion, one of the authors contradicts a statement in one of his previous papers, that hemipinic acid can be obtained by oxidation of pure narceïne with ferric chloride.—A. R.

Erythroxylon Coca grown in India. C. J. H. Warden. Jour. Soc. Agric. and Horticult. of India, **8.**

The author has examined some coca leaves grown in India. The dry pulverised leaves, moistened with alcohol acidified with sulphuric acid, were then extracted with alcohol, the alcoholic extract mixed with acidified water, exhausted with ether, and finally made alkaline with sodium carbonate and again exhausted with ether. This final extract, containing the cocaïne, was washed twice with water, dried and weighed, the result being the amount of "crude alkaloid." The dry leaves yielded :—

District where Grown.	Ash.	Crude Alkaloid.
	Per Cent.	Per Cent.
Ranchi, young leaves	6·71	1·139
„ mature leaves	8·99	0·883
Arcuttipore, Cachar, 1st sample	7·39	1·369
„ „ 2nd sample	6·36	1·671
Darjeeling	7·58	1·115
Alipore, Calcutta	10·23	0·358
Matelli	12·18	1·022
Chulsa, Dooars	7·62	0·610
Jaunpore	12·64	0·571

The "crude alkaloid" was very faintly yellow in colour, and was in no instance obtained crystalline, although many experiments were made to get a crystalline alkaloid, both by changing the mode of preparing the leaves and by modifying the mode of extraction by the use of different acids and solvents and varying temperatures. Even Williams' method of purification (Pharm. J. Trans. 1887) failed to yield crystals. The only instance of crystallisation was the deposition of star-shaped crystals on one occasion from the ethereal solution of the alkaloid obtained from the decomposition of the soluble platino-salt. This extract of Indian coca leaves yields a soluble and insoluble platino-salt, both yielding bases producing a marked anæsthetic effect on the tongue. Howard states that in the leaves he examined, only the soluble platino-salt yielded a base producing anæsthesia, the insoluble salt giving some other base. The author found from 18·71 to 19·3 per cent. of platinum in his soluble platino-salt, and 18·88 per cent. in his insoluble platino-salt ; he attributes discrepancies from the theoretical to varying amounts of cocamine in the Indian leaves.

The author observed the largest amount of coca-tannic acid was associated with the largest amount of alkaloid, and suggests that possibly the alkaloid exists in the leaves as coca-tannate. With regard to hygrine, no volatile base has been found in the Indian leaves.

Judging from the available data, which however are obtained from leaves and plants of various ages, the percentage of alkaloid in Indian leaves is not much affected by either altitude or rainfall. The plants may require both nitrogenous and potash manures. The best mode of preparing the leaves is to dry them as rapidly and thoroughly as possible at the lowest possible temperature, and directly they are cold to pack them in air tight boxes, to avoid absorption of moisture, as the dry leaves are very hygroscopic. The leaves grown in India contain more alkaloid than the South American leaves, and the non-crystalline character of the alkaloid does not appear to detract from its physiological activity.—D. A. L.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Klic's Method of Heliogravure. Phot. Archiv. **29,** 107.

A smooth copper plate is first covered with a fine powder, consisting of Assyrian asphalt and colophonium powder in three successive stages, and then the plate is heated so as to melt the adhering dust. Pigment paper sensitised by potassium bichromate in the usual way is pressed on to the prepared copper plate, then developed with hot water, and finally etched with ferric chloride, which is employed in four baths of different strengths. When the etching is finished the plate is placed in dilute alkali in order to remove the gelatin; the asphalt is dissolved off with turpentine, and the plate polished with chalk and water.
—C. A. K.

Modification of the Pigment Process. Dr. Stolze. D. Photogr. Kalender, 1888, 160.

A silver chloride gelatin paper is exposed until dark brown, then allowed to swim on a solution of bichromate, dried in the dark, and exposed under a negative. The length of exposure is measured—as with the ordinary pigment paper—with a photometer. The undeveloped picture is now fixed on to glass or paper and developed in warm water. The light shades dissolve and the image remains, being retained on the plate by the chromo-gelatin, which has become insoluble. The image is then best toned in a gold sulphocyanate bath.—A. R.

PATENTS.

Improvements in the Production of Photographs in Colours. W. Trenemen, London. Eng. Pat. 4915, April 2, 1887. 6*d.*

A carbon print is first produced on a gelatin film on a collodionised glass plate. A coloured paper backing is made as follows :—A glass transparency is produced by any wet or dry plate process and varnished with hard waterproof varnish (a mixture of commercial white hard varnish and methylated spirit), or a carbon print may be produced from the original negative, transferred, after development, to glass coated with albumen or gelatin, and finally varnished as above. After the varnish is dry a piece of "Rice" paper is damped and stretched over the film side of the transparency, and, by transmitted light, the proper colours are evenly "washed" over the paper to coincide with the lights and shades of the photograph. After the colouring is sufficiently dry, the paper is floated in a warm 20 per cent. gelatin solution ; the carbon print first described is also coated with the solution and squeezed upon the coloured paper so that the colours are in their proper places under the print. After the gelatin is set, it is immersed in a 15 per cent. alum solution for five minutes, or the prints may be left to dry upon the glass, and, after being cut round and stripped, immersed in the alum solution for the same period before mounting. For further details, the specification must be consulted.—O. H.

Improved Photographic Plate to be Developed in Water. A. J. Boult, London. From L. Baekelandt, Ghent, Belgium. Eng. Pat. 1201, January 26, 1888. *4d.*

The object of this invention is to permit photographic plates to be developed in water instead of in a specially-prepared bath. The plates, covered with emulsion and dried, are coated on the back with the following developing mixture :—

Heated gallic acid, or other suitable reducing substance	10 grms.
Salicylic acid	1 grm.
Gum arabic, dextrin, gelatin, &c.	10 grms.
Alcohol	5 cc.
Water	20 cc.

and dried at "an ordinary temperature." The above proportions may be varied according to the quality of the emulsion.—O. H.

XXII.—EXPLOSIVES, MATCHES, Etc.

Recent additions to the List of Licensed Explosives. Twelfth Ann. Rep. of H.M. Inspectors of Explosives, and Ann. Rep. for 1887.

Roburite.—This consists of a mixture of nitrate of ammonium and well purified chlorinated dinitrobenzene. It is provided, however, that such chlorinated dinitrobenzene shall not contain more than four parts by weight of chlorine to every 100 parts by weight of the chlorinated dinitrobenzene. It passed all the tests in a satisfactory manner.

Amide Powder.—This explosive is a mixture of nitrate of potassium, nitrate of ammonium, and charcoal.

Fortis Explosive.—Two qualities of this explosive were submitted to the Crown authorities. They consist of a nitrate mixture containing varying proportions of crystallised ferrous sulphate (copperas). It was found that on exposure to moist air, owing to the oxidation of the ferrous sulphate, nitric acid became liberated. This nitric acid, though not seriously affecting the stability of the explosive itself, might have seriously imperilled the safety of any explosive of the nitro-compound class stored with it. The license was hence made subject to the condition that this explosive only be made in the form of compressed cartridges thoroughly air and moisture proof.

Borland's Powder.—A powder of the nature of Schultze[*] or E. C. powder, but containing dinitrocellulose only.

Carbo-dynamite.—Nitroglycerol absorbed in a special kind of highly absorbent charcoal. The nitroglycerol, notwithstanding the high proportion present (upwards of 90 per cent.), was perfectly retained under all conditions to which the explosive was submitted.—W. S.

PATENT.

Improvements in the Manufacture of Explosives. H. H. Lake. From Wohanka and Co., Vienna, Austria. Eng. Pat. 7608, May 25, 1887. *4d.*

Cellulose is added to the liquid explosives made by dissolving in concentrated nitric acid the nitro-derivatives of the hydrocarbons of the aromatic phenol series. The cellulose becomes nitrated and swells up, forming with the explosives a plastic mass-like gelatin.—E. E. B.

XXIII.—ANALYTICAL CHEMISTRY.

The Precipitation of Barium Sulphate in solutions containing Bromine. G. Tauber, Chem. Zeit. **12**, 477.

The author's experience in estimating sulphites, by converting them into sulphates by bromine and weighing as barium sulphate, enables him to confirm the statement by Lucion (Chem. Zeit. **12**, 427) that the presence of free bromine is not detrimental to the estimation as barium sulphate. He finds that, in dealing with easily dissociable sulphites, bromine water is preferable to pure bromine, for a large excess of that element may thus be at once employed without the necessity for awaiting its solution. Oxidation with nitric acid never yielded equally satisfactory results.—W. G. M.

On the Application of Sodium Pyrophosphate to the Estimation and Separation of Metals. G. Vortmann. Ber. **21**, 1103—1106.

By the addition of sodium pyrophosphate solution to solutions of copper, cadmium, manganese, zinc, cobalt, nickel, ferrous, ferric, aluminium, uranous, and chromic salts, precipitates are obtained which are easily soluble in an excess of the reagent, except in the case of chromium where the precipitate dissolves with difficulty even on boiling. The solutions of cadmium, manganese, zinc, cobalt, nickel, ferrous, and aluminium salts thus obtained are *completely* precipitated on the addition of acetic acid (in some cases only on boiling or evaporating to dryness and digesting with water). Precipitation does not take place with acetic acid in the case of ferric, uranous, and chromic salts (a turbidity is obtained with the latter on boiling, but even this is prevented by the addition of sodium tartrate). If sodium sulphite be added with the acetic acid to the ferric salt and the whole boiled, the iron will be completely precipitated. If sodium tartrate be added before the acetic acid no precipitate will be obtained in the case of copper and nickel salts, and the residue obtained on evaporating to dryness is perfectly soluble in water. Sodium tartrate also prevents the precipitation of aluminium salts by acetic acid. Sodium thiosulphate behaves like the tartrate towards copper and cadmium salts. Ammonia may be substituted for acetic acid in the case of cobalt and nickel, and the mixture thus obtained boiled down; the cobalt is, however, not completely precipitated. By this method it is possible to separate copper from cadmium, cobalt from nickel, manganese and zinc from iron (ferric salts), manganese from aluminium and uranium, ferrous salts from aluminium and uranium (possibly from chromic and ferric salts). Cadmium, manganese, zinc, cobalt, nickel, and possibly also iron and aluminium, can be estimated as pyrophosphates. The author has not yet completed his investigations of the exact composition of all the above pyrophosphates, but the reactions are available for qualitative purposes.—F. W. T. K.

Quantitative Analysis by Electrolysis. A. Classen. Ber. **21**, 359.

Apparatus for Reduction of Intensity of Current.—Owing to the inconvenience of introducing into the circuit a rheostat for each separate electrolytic determination, the author has devised a simple form of apparatus by means of which a number of such analyses can be conducted simultaneously. This apparatus (*see* Fig. 1, half natural size), consists of a series of bands of fine-mesh nickel gauze; the current enters at *a*, passes through the apparatus, returning to the battery by *b*. For conducting the electrolysis the platinum vessel serving as the negative electrode is connected with the screws 1—20, while the positive electrode is similarly connected with the screws marked +. By this apparatus eight analyses can be performed simultaneously. In the paper a number of such determinations are given.

Voltameter.—With the ordinary forms of voltameter the volume of electrolytic gas, serving to measure the current intensity, cannot conveniently be read off. Neumann has

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[*] *Schultze Gunpowder* consists of purified nitrolignin mixed or impregnated with a nitrate or nitrates, other than nitrate of lead, and with or without starch or collodion (the collodion to consist of carefully purified nitrolignin dissolved in com. pure ether and alcohol) or pure solid paraffin, provided the paraffin shall be free from mineral acid.

E. C. Powder.—Rifle- and gun-cotton with the addition of aurin or picric acid free from mineral acid, and dissolved in a solvent composed of ether, alcohol, and benzoline, or with that of beeswax, paraffin, shellac, or certain gums or resins similarly dissolved.

Fig. 1.

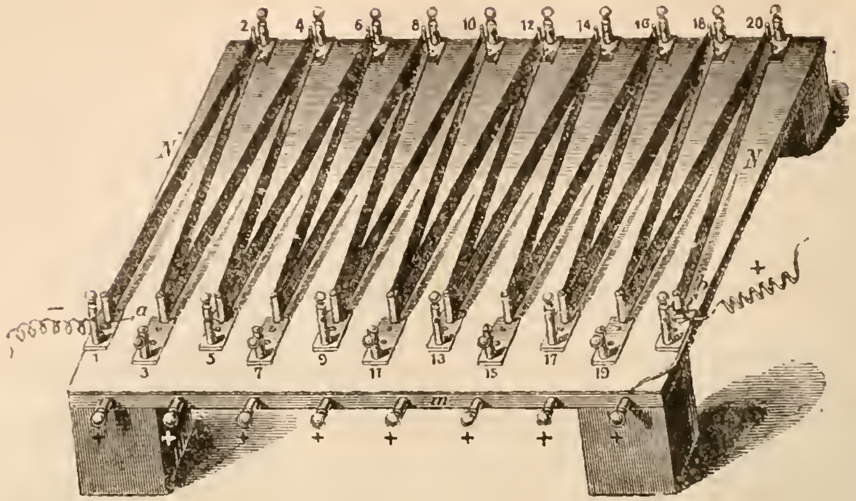


Fig. 2.

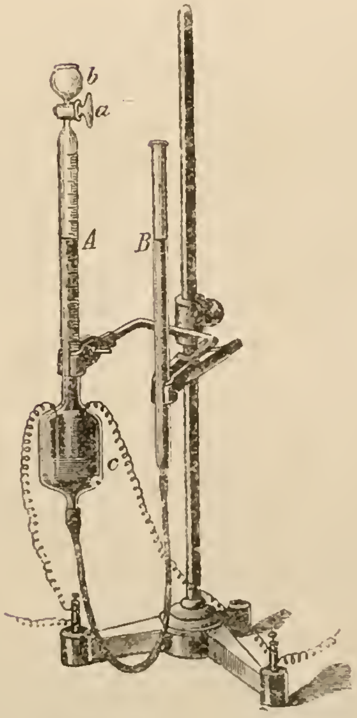
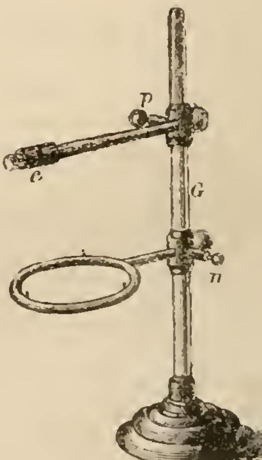


Fig. 3.



recently modified the voltameter devised by Walters as follows: the apparatus (Fig. 2), consists of a tube A of 40 cc. capacity, graduated into $\frac{1}{10}$ cc., the graduations starting below the stop-cock *a*; below the graduations the tube is enlarged to hold conveniently the platinum electrodes. The lower end of the bulb is contracted and connected by means of flexible tubing with the level tube B. The tube is filled with dilute sulphuric acid (sp. gr. = 1·22), and the level of the acid set at the zero mark. The volume of electrolytic gas given off on connecting with the battery is directly read off by readjusting the level tube B.

Stand for Electrolytic Analyses.—This consists of a glass stand G (Fig. 3), to which are fixed a glass arm, bearing the positive electrode at *c*, and a glass ring for holding the platinum dish, connected with the negative electrode at *n*. This apparatus possesses the advantages over other forms proposed in not being attacked by acid fumes.

It is well known that electrolytic determinations of copper containing arsenic give too high results; this error cannot be entirely corrected by roasting the deposited metal to volatilise the arsenic, redissolving the copper oxide in acid, and repeating the electrolytic process. The arsenic can, however, be conveniently volatilised as bromide by treatment of the deposit with a hydrochloric acid solution of bromine and evaporating on a water bath. The residue of copper bromide is heated with sulphuric acid, the solution diluted, the necessary quantity of nitric acid added, and the solution again electrolysed. Satisfactory test analyses are given. The arsenic can be removed at once from pyrites by repeated warming with a few cc. of bromine; this method is not available for roasted ores.

In order to determine simultaneously lead and copper, the former deposited as the peroxide on the positive pole, the latter as the metal, certain precautions are necessary. To a solution of both metals in about 120 cc., 30—40 cc. of nitric acid (sp. gr. = 1·2) are added. The electrolysis must be commenced with a current of sufficient intensity to liberate ·1 cc. electrolytic gas per minute, which must be increased to 3 cc. per minute as soon as a fairly thick deposit of lead peroxide has been formed on the platinum dish, serving as the positive electrode. When this deposit is no longer formed, 10 cc. of water are added, and the passage of the current continued for an hour longer. The nitric acid is washed out by water without interrupting the current, and the determination finished in the usual manner. Satisfactory test analyses are quoted.—V. H. V.

Determination of the Carbonates of the Alkaline Earths in presence of Hydrates of the same. M. Kretzschmar. Chem. Zeit. **12**, 511.

The author does not consider any of the methods for the determination of the carbonates of the alkaline earths in presence of their hydrates, depending on the use of indicators, to be accurate. The old method is recommended in which the mixture of free and combined alkaline earth is decomposed with an excess of titrated sulphuric acid, the carbon dioxide boiled off and the excess of acid titrated back with baryta or lime solution, whilst the amount of carbonate is found by a carbonic acid determination. The latter is effected by heating with a mixture of equal parts of potassium chromate and bichromate previously melted together and then powdered. A short combustion tube drawn out and closed at one end is fitted at this end with an asbestos plug; this is followed by a short layer of the chromate mixture, then comes the substance mixed with eight times its weight of chromate, and finally, a long layer of chromate kept in position by a second plug of asbestos. A calcium chloride tube and a weighed Geissler's caustic potash apparatus are attached to the end of the tube. The combustion is completed in 10 minutes, and is carried out exactly on the lines of Will and Varrentrap's method for the determination of nitrogen, a current of air being aspirated through the tube at the close of the operation. The substance itself must be dry; if it is not, or if it contains much hydrate, it should be mixed with gypsum.

The method of indirect determination may be employed to advantage in the determination of the alkaline earths in mixtures of their carbonates and hydrates. Two equal quantities of the substance are weighed out, in one of which the total carbonate is precipitated and weighed, whilst in the other the total alkaline earth (free and combined) is titrated with sulphuric acid.

If G be the weight of total carbonate found, and G_1 the weight of the heavier carbonate ($BaCO_3$, $SrCO_3$, or $CaCO_3$), equivalent to the weight of sulphuric acid neutralised, the calculation of the result is readily effected by the following equations:—

(1.) For a mixture of calcium and strontium salts:—

$$CaO = (G_1 - G)\ 1{\cdot}17895.$$

$$SrO = \left(G - \frac{G_1 - G}{0{\cdot}475}\right) 0{\cdot}7017.$$

(2.) For calcium and barium compounds:—

$$CaO = (G_1 - G)\ 0{\cdot}57734.$$

$$BaO = \left(G - \frac{G_1 - G}{0{\cdot}97}\right) 0{\cdot}7767.$$

(3.) For strontium and barium compounds:—

$$SrO = (G_1 - G)\ 2{\cdot}091.$$

$$BaO = \left(G - \frac{G_1 - G}{0{\cdot}3356}\right) 0{\cdot}7767.$$

For mixtures of carbonates only, G is of course equal to the weight of substance taken.—C. A. K.

Quantitative Determination of the Noble Metals in Potassium Cyanide Solutions. L. Opificius. Chem. Zeit. **12**, 525.

The solution of the metals in potassium cyanide as used for electro-plating purposes, &c., is measured or weighed off and warmed with an excess of hydrochloric acid and then a little sulphuric acid added. The addition of the latter renders the complete reduction of silver chloride by means of zinc possible. This reduction is started after the addition of the sulphuric acid, and it can readily be seen when the precipitation of the noble metals is complete. The precipitate is then filtered, washed, dried, and cupelled; if both silver and gold are present they are parted by nitric acid in the usual way. The solutions after being employed for electro-plating always contain copper, which, like gold and silver, is also reduced by the zinc, but not until the noble metals are completely precipitated, so that this serves as a guide in determining the point of complete precipitation of the gold and silver. The method is both rapid and accurate.—C. A. K.

Apparatus for rapidly estimating Ammonia in Water colorimetrically. M. Müller. Zeits. Ang. Chem. 1888, 245—246.

In order to estimate the ammonia in water by means of Nessler's reagent, the tint obtained is compared with that given by a series of circular glasses of 1½ mm. diameter, coloured yellow—preferably by a mixture of ferric oxide and manganese dioxide. 100 cc. of the water is treated with 1 cc. of a concentrated solution of sodium hydrate or carbonate, if calcium salts are present, and then filtered. By using a large excess of alkali the tint obtained is independent of the quantity of alkali added, and this also serves to prevent inaccurate results in presence of carbon dioxide in the water. 0·5 cc. of Nessler's reagent is added to the water after the filtration and the liquid is then placed in a suitable glass tube holding 10 cc. (a polarimeter tube answers the purpose well), round which black paper is put to prevent the access of light. This tube and a metal cylinder into which the coloured glasses fit, are both attached to a stand which is fitted with two prisms and an eye-piece so arranged that on looking down the latter two fields are seen and the tints thus readily compared. The values of the glasses are fixed once for all by comparison with an ammonium salt solution of known strength and range from 0·02 for one glass to 0·2 mgrms. for six glasses, of ammonia in 100 cc. of water. If the water contains more than 0·2 mgrms. of ammonia in 100 cc. it must be diluted before Nesslerising.—C. A. K.

Separation and Determination of Antimony and Tin. Loviton. J. Pharm. Chim. **17**, 361.

Antimony is completely precipitated by sulphuretted hydrogen from a solution containing equal volumes of water and of hydrochloric acid of 22° Baumé, whilst tin only begins to be precipitated when the solution contains three volumes of water to one of acid of the above strength. A solution of the two metals can therefore be readily prepared in which only the antimony is precipitated, and the method can be used to advantage in the quantitative separation of the metals, and also to detect small quantities of antimony in tin. For the former purpose the alloy is dissolved in hydrochloric acid, a little nitric acid or potassium chlorate being added, and the solution then diluted with so much water that only the antimony is precipitated on treating with sulphuretted hydrogen. The acid liquid is filtered through glass wool, the precipitate washed with a mixture of 1 vol. of hydrochloric acid (22° B.) and 1½ vols. of water, saturated with sulphuretted hydrogen, and the tin precipitated in the filtrate after diluting with the requisite amount of water. The quantity of metal in the precipitates is determined electrolytically, by dissolving the sulphides in sodium sulphide and electrolysing with two Bunsen cells, when an adherent deposit of the metal is obtained on the negative electrode.—C. A. K.

On the Absorption of Carbonic Oxide by Cuprous Chloride. W. Hempel. Ber. **21**, 898.

Drehschmidt lately recommended (Ber. **20**, 2752) the use of fresh solutions of cuprous chloride for each carbonic oxide test, since solutions used several times over gave off carbonic oxide. The author cannot confirm this statement, but finds that cuprous chloride absorbs physically all gases to a very considerable extent. If, for instance, a solution of cuprous chloride be brought into contact with a mixture of carbonic oxide and nitrogen and afterwards with hydrogen, the latter is physically absorbed, whereas nitrogen is liberated. If this solution be now again treated with nitrogen, hydrogen is set free. All liquids have this property, and cuprous chloride solution is specially distinguished for it. It is therefore inadmissible to use the same solution at first for illuminating gas and afterwards for another kind of gas. The fault is easily avoided by making two analyses of the latter gas, and disregarding the first test, the object of which is to saturate the reagents with the right kind of gas.—S. H.

Quantitative Estimation of Active Oxygen by Means of Tetramethylparaphenylenediamine. C. Wurster. Ber. 21, 924.

In a previous publication (*this Journal*, 1887, 304) the author described a method for the detection of active oxygen. The process is based on the oxidation of tetramethylparaphenylenediamine by active oxygen, whereby a blue dyestuff is produced. This oxidation proceeds quantitatively, and the test is so sensitive as to allow of the estimation of active oxygen in one drop of the juice of plants, saliva, pus, &c. Schuchardt of Goerlitz has undertaken the manufacture of a colour-scale, containing eight tints. The scale is obtained by the action of one or two drops of a standard iodine solution on paper saturated with tetramethylparaphenylenediamine ("tetra-paper").

The test is carried out as follows:—One or two drops of the liquid to be examined are allowed to drop on uncoloured tetra-paper, folded twice. The paper is again folded, slightly pressed between the fingers, and compared after a few minutes with the standard papers of the colour-scale. The table gives directly the amount of active oxygen present. If the liquor to be tested is alkaline, the tetra-paper must be moistened with glacial acetic acid. The oxidising power of air, *i.e.* the amount of ozone in the air, can also be conveniently determined by tetra-paper. A piece of tetra-paper, slightly moistened with dilute glycerol, is placed over the opening of a glass tube of 0·6 cm. bore, and fastened with a little india-rubber tubing. The other end of the tube is connected with a "finger-pump," and a certain amount of the air to be tested (from 5 to 20 liters) is aspirated through the tetra-paper. If ozone be present, the paper will be coloured, and by comparing the tint with the standard papers of the scale, the amount of ozone can be estimated.

—S.H.

Standard Iodine solution	$\frac{1}{250}$	$\frac{1}{500}$	$\frac{1}{1,000}$	$\frac{1}{2,500}$	$\frac{1}{5,000}$	$\frac{1}{10,000}$	$\frac{1}{33,000}$	$\frac{1}{100,000}$
Corresponding No. of colour-scale	1	2	3	4	5	6	7	8
Contains milligrms. of active oxygen per liter	32	16	8	3·2	1·6	0·8	0·24	0·08
Or counting 16,000 drops to 1 liter.								
Contains milligrms. of active oxygen per drop	0·002	0·001	0·0005	0·0002	0·0001	0·00005	0·000015	0·000005

Differences of Reaction between Quercetin and Rutin in the pure state. E. Schunck. J. Chem. Soc. 1888, 264.

Quercetin:—(1.) Soluble in 280 parts of boiling water. (2.) Soluble in 125 parts of ordinary ether. (3.) Easily decomposed when the aqueous solution to which sulphuric acid has been added, is boiled. (4.) When a dilute alcoholic solution containing silver nitrate is shaken up with three times its volume of ether, the latter acquires a crimson colour; the colour soon fades, metallic silver being deposited. (5.) An aqueous solution gives with stannous chloride a light red precipitate. (6.) By the action of bromine crystallised tetrabromoquercitrin is obtained.

Rutin:—(1.) Soluble in 170 parts of boiling water. (2.) Soluble in 335 parts of ordinary ether. (3.) Very slowly decomposed by the action of boiling dilute sulphuric acid. (4.) A dilute alcoholic solution containing silver nitrate, shaken up with ether, imparts only a light yellow colour to the latter. (5.) An aqueous solution gives, with stannous chloride, a bright yellow precipitate. (6.) By the action of bromine, only amorphous products are obtained. (*See also this Journal*, 1888, p. 382.)—W. S.

Reaction of Cotton-Seed Oil. M. Labiche. Archiv. de Pharm. 1888, 57.

A small quantity of the oil is mixed with an equal quantity of a saturated solution of normal lead acetate, ammonia is then added and the whole shaken. Under these circumstances cotton-seed oil assumes a reddish orange colour, whilst butter, olive, castor, almond, and other oils give a red colour.—D. A. L.

On the Hydrazones. E. Fischer. Ber. 21, 984—988.

The author proposes to call the combinations of the hydrazines with aldehydes and ketones, hydrazones. Double hydrazones, containing the hydrazone groups in the position 1, 2, are called osazones. Other double hydrazones, dihydrazones.

For instance:—

$COH-CH=N_2H.C_6H_5$ glyoxalphenylhydrazone, and

$C_6H_5HN_2=CH.CH=N_2HC_6H_5$ glyoxalphenylosazone, &c.

Theoretical considerations induce the author to express the constitution of the hydrazone by the formula,—

$$(C_6H_5.NH.N:C)''$$

but he has not yet quite succeeded in proving this formula experimentally.

The melting points of the hydrazones are now frequently used as a means of identifying ketones and aldehydes. Some of them, however, decompose when melted, and it is essential to heat up quickly when taking a melting point.

—A. L.

Detection of Methyl Alcohol in Spirits of Wine and in Brandy. J. Habermann. Chem. Zeit. Rep. 12, 101.

The author considers the method of Cazeneuve and Cotton the best for the above purpose, but it is necessary to remove sugar and all substances which reduce permanganate of potassium before applying the test. The ethereal oils, &c. added to brandy and liqueurs contain bodies which distil over with alcohol, and which reduce permanganate. These are best removed by shaking 30—40 cc. of the brandy with 20 cc. of pure olive oil twice, and then filtering the alcohol through a wetted filter paper. If the sample is free from sugar the test can be made at once with the clear filtrate; if not, the filtrate must be distilled and 50—60 cc. of brandy and the corresponding amount of olive oil should be taken.

—C. A. K.

Testing Iodoform. A. Kremel. Pharm. Post. **21**, 213.

One part of iodoform shaken up with 10 parts of water should give a colourless filtrate (absence of picric acid), which should not be immediately affected by the addition of either silver nitrate or of barium nitrate.—C. A. K.

Examination of Spiritus Aetheris Nitrosi. E. Utescher. Apoth.-Ztg. **3**, 86.

Ethylnitrite is best detected by dissolving 1—2 grms. ferrous sulphate, which has been precipitated by alcohol, in a little hydrochloric acid, and then adding a few cc. of the spr. eth. nitr. under examination. The solution should be immediately coloured a deep brownish black.—A. R.

Examination of Ricinus Communis. A. L. Beck. Am. Jour. Pharm. **60**, 93.

The leaves of *Ricinus communis* were extracted with alcohol, the residue from the latter dissolved in acidulated water, filtered to remove wax and tarry matter, and the aqueous solution again extracted with chloroform. The residue was purified by repeated solution in alcohol and precipitation with ether. The crystalline body thus obtained is readily soluble in water, alcohol, and chloroform. The usual reagents for alkaloids, except a solution of iodine in potassium iodide, produce no precipitate. The crystals melt at 194°. They have a very bitter taste, and are coloured green by bichromate and sulphuric acid. Heated with caustic soda, ammonia is evolved. The formula is $C_{21}H_{32}N_7O_3$.—A. R.

Determination of Emetin in Ipecacuanha. A. Kremel. Pharm. Post. **21**, 151.

Ten grms. finely-powdered ipecacuanha are well mixed with an equal weight of lime and water, dried on the water bath, ground, and extracted with chloroform. The residue from the latter is dried at 100°, and consists of almost pure emetin.—A. R.

The Quantity of Fusel-Oil contained in Spirits, and a Method for its Estimation. Prof. F. L. Ekman. Chem. Zeit. **12**, 564.

Contrary to statements made by others, the author has not found any alcohols with a boiling point between that of ethyl and amyl alcohol in potato or corn brandy, with the exception of propyl and isobutyl alcohol. Fusel-oil contains 3—12 per cent. of propyl, 15—47 per cent. of butyl, and 44—71 per cent. of amyl alcohol, besides 5—7 per cent. of oils with a high boiling point. The largest quantity of butyl alcohol is contained in fusel-oil from corn-brandy; in fact, there is more of this alcohol present than any other. A colorimetric method with sulphuric acid was employed for determining the quantity of fusel oil. The types are strong solution of known quantities of cobalt chloride for red, ferric chloride for yellow, and cupric chloride for blue. It is necessary to remove non-volatile bodies in the spirit before determining the quantity of fusel-oil, which is effected by using the distillate only. 200 cc. of the spirit and 25 cc. of water are rapidly distilled in a brass retort until 185 cc. have gone over. After diluting to 200 cc., 25 cc. of the solution are added with rapid stirring, to 15 cc. of conc. sulphuric acid in the space of about five minutes. After at least three hours the solution is compared with the types. Propyl alcohol is not coloured by sulphuric acid. The presence of aldehyde is unfavourable to the obtaining of good results in the case of amyl alcohol, as it intensifies the colour reaction which the latter gives of itself.—A. R.

New Books.

Kurzes Lehrbuch der Organischen Chemie. Von Dr. A. Bernthsen, Professor an der Universitat zu Heidelberg. Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn. 1887. London: H. Grevel and Co., 33, King Street, Covent Garden.

Octavo volume, in paper cover, with Preface, Table of Contents, and 564 pages of subject-matter.

In his preface the author states that the treatment of the theoretical matter, especially in the first half of the book, is according to the inductive method, and also that no constitutional formula is given without at least indications of the reasons for such formula, and a special feature is made of the practical discrimination of the class distinctions of organic compounds.

The work is subdivided according to the following scheme :—

Introduction.

I. Class: Methane Derivatives.—I. Hydrocarbons. II. Halogen substitution products of the Hydrocarbons. III. Monatomic Alcohols. IV. Derivatives of the Alcohols. V. Aldehydes and Ketones. VI. Monobasic Fatty Acids. VII. Acid derivatives. VIII. Polyatomic Alcohols. IX. Polyatomic Monobasic Acids. X. Dibasic Acids. XI. Tri- to Hexabasic Acids. XII. Cyanogen Compounds. XIII. Carbonic Acid derivatives. XIV. Carbohydrates. XV. Transition to the Aromatic Compounds.

II. Class: Chemistry of the Benzene Derivatives.—XVI. General Details and Theory. XVII. Benzene Hydrocarbons. XVIII. Halogen substitution products. XIX. Nitro derivatives. XX. Amido derivatives. XXI. Diazo- and Azo-Compounds; Hydrazines. XXII. Aromatic Sulphonic Acids. XXIII. Phenols. XXIV. Aromatic Alcohols, Aldehydes and Ketones. XXV. Aromatic Acids. XXVI. Indigo Group. XXVII. Diphenyl Group. XXVIII. Diphenylmethane Group. XXIX. Triphenylmethane Group. XXX. Dibenzyl Group. XXXI. Napthalene Group. XXXII. Anthracene and Phenanthrene Group.

Pyridine Derivatives, Alkaloids, and Allied Bodies.—General Reviews. XXXIII. Pyridine Group. XXXIV. Quinoline and Acridine Groups. XXXV. Terpene and Camphor. XXXVI. Resins, Glucosides, Vegetable Matters (Unknown constitution). XXXVII. Albumens; Animal Chemistry.

A Treatise on Alcohol, with Tables of Spirit-Gravities. By Thomas Stevenson, M.D. Lond., F.R.C.P., &c. (Second Edition.) London: Gurney & Jackson, 1, Paternoster Row. 1888.

Small 8vo. volume, bound in red cloth, containing Preface, an Introduction to the Tables, giving full explanations of the manner of using them, covering 24 pages, the Tables themselves filling 73 pages more.

Year-Book of the Scientific and Learned Societies of Great Britain and Ireland, comprising Lists of the Papers read during 1887 before Societies engaged in all Departments of Research, with the Names of the Authors. With an Appendix comprising a list of the leading Scientific Societies throughout the World. Compiled from Official Sources. Fifth Annual Issue. London: Charles Griffin & Company, Exeter Street, Strand. 1888.

Trade Report.

(From the Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Russia.

Classification of Articles in Customs Tariff.

Note.—Poud = 36 lbs. avoirdupois. Funt = 0·902 lbs. avoirdupois.
Gold Rouble = 2*s.* 2*d.*

The following decision affecting the classification of articles in the Russian Customs Tariff has recently been given by th Russian Government :—

Sulphuretted soda (natrum sulphurasum).—Section 140. Duty 2 roubles 40 copecks per poud.

SWEDEN.

Modifications of Duties on Spirits.

The following is a statement of some of the changes in the Customs tariff:—

No. in Tariff.	Articles.	Rates of Duty.			
				Kr.	Ore.
1	Ether and spirituous ether or Hoffmann liqueur imported by apothecaries, or, after examination of the chief trade administration, by manufacturers requiring to use it in their manufacture.	Litre	-	1	75
2	Compositions or mixtures of ether, such as ether of saltpetre, of vinegar, of fruits, oil or essence of cognac, of rum, or arrak, &c.	„	-	1	75

FRANCE.

Imposition of New Duties on Heavy Oils and Residues of Petroleum.

According to the *Moniteur Belge* for the 19th April last, a French law was passed on the 30th March embodying the resolutions of the 1888 Budget with respect to the imposition of new duties on heavy oils and residues of petroleum. A notification of these duties to the effect that they were impending appeared on p. 16 of the January number of the *Board of Trade Journal*.

Importation of Saccharine.

The following is a translation of a circular, under date of the 28th March last, addressed by the French Director-General of Customs to the heads of French Customs houses calling their attention to the importation of the new chemical product called saccharine:—

"A new chemical product, derived from coal tar, and which has received the name of saccharine, has made its appearance in the commercial world. Although not possessing the elementary composition of vegetable sugars, this substance has a sweet flavour, sensibly exceeding in intensity that of sugar properly so-called. The high price (about 130 fr. per kilog.) at which saccharine is at present sold, would appear to militate against the development of its consumption, if not for certain special uses. Be that as it may, the Administration, desiring to follow the movement of the importation of saccharine, either pure or in a mixed state, I request you to invite the service to take note of the quantities which shall henceforth be introduced. You should inform me of these introductions, and forward me particulars which you may be able to gather of the use of the product, its value, &c.

"I may add that saccharine is admissible free of duty, as coming under the category of 'chemical products derived from coal tar.'"

Appended to the above circular was a copy of a letter addressed on the 20th February last by the Director-General of Indirect Taxes to the various agents, calling their attention to the subject of the introduction of saccharine into commerce, and requesting to be informed of any facts which would lead to the supposition that saccharine has been used in the place of ordinary sugar, with a view to its taxation in the event of such an employment.

TUNIS.

Export Duties on Tanning Bark.

According to the *Moniteur Belge* of the 23rd April last, the export dues on tanning bark obtained from the cork trees of the State forests are suppressed, but only in the case of those barks which are accompanied by a certificate of origin furnished by the head of the forest *circonscription* testifying to the origin and weight of the bark.

SPAIN.

Classification of Articles in Customs Tariff.

Peseta = $9\frac{3}{10}d$.

Powder known under the name of *Blanc de Perle.*—Category 98. Duty, 1 peseta 73 cents per kilogramme.

UNITED STATES.

Customs Decisions.

So-called floral extracts, which are in fact concentrated alcoholic perfumery, are dutiable under the specific provision for such perfumery under T.I., 100, and not under the provision for "alcoholic compounds," under T.I., 103.

So-called "manganmetal," which the appraiser's report shows to be a metal containing 90 per cent. of manganese, nearly 5 per cent. of iron, 5 per cent. of undetermined substances, and valued at 1,500 dollars per ton, is not dutiable, by assimilation, at the rate applicable to ferro-manganese, or to *spiegeleisen*, but is dutiable as an unwrought metal, under T.I., 215.

Certain air-meters, used by miners in shafts and by architects in flues to measure the velocity of air currents, are not free of duty as philosophical and scientific apparatus, but are dutiable under T.I., 216, as manufactures in part of metal.

Certain so-called "charcoal," which consists of small evenly-shaped blocks, specially prepared, chiefly from carbon and partly from oxide of manganese, for use in electric batteries, and commercially known as carbon "blocks" or "plates," are dutiable, under section 2513 of the Revised Statutes, at the rate of 20 per cent. *ad valorem*.

"Coerulein," so-called, is dutiable as a coal-tar product under T.I., 82.

An article composed as follows: Silica, 26·04 per cent.; alumina, 15·85 per cent.; carb. lime, 55·50 per cent.; and magnesia, 2·10 per cent., which does not possess the principal attribute of cement, to wit, that of indurating upon being mixed with water, is dutiable as an alkaline silicate, under T.I., 76, and not as a cement, under T.I., 44.

CONGO.

Modification of Export Duties on Copal.

The *Bulletin Officiel* of the Government of the Free State of the Congo for the month of April last, contains a decree of the Governor-General of the Congo, providing that from the 1st January 1888 the export duty on red copal was to be at the rate of 8 frs. per 100 kilos., and on white copal (of inferior quality) of 2 frs. per 100 kilos.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

IMPORTS INTO THE UNITED KINGDOM FROM SPAIN.

PRINCIPAL ARTICLES.		March 1887.	March 1888.
Chemical products unenumerated	Value £	6,590	9,248
Copper ore and regulus	Tons	3,615	5,236
	Value £	70,628	157,195
Manganese ore	Tons	1,600	..
	Value £	2,400	..
Pyrites of iron or copper	Tons	48,354	57,933
	Value £	92,545	108,261
Quicksilver	Lbs.	300,000	974,475
	Value £	29,509	104,944
Rags, Esparto	Tons	5,687	7,518
	Value £	30,433	46,366

Total Value	1887.	1888.
March	£906,072	£1,172,198
April	£799,058	£799,093

EXPORTS OF BRITISH AND IRISH PRODUCE FROM THE UNITED KINGDOM TO SPAIN.

PRINCIPAL ARTICLES.		March 1887.	March 1888.
Alkali	Cwts.	30,865	29,338
	Value £	10,492	8,955
Caoutchouc, manufactures of	Value £	1,250	890
Cement	Tons	158	385
	Value £	354	707
Chemical products and preparations (including dye stuffs)	Value £	3,660	2,786
Coal, products of (including naphtha and paraffine)	Value £	1,623	1,928
Manure	Value £	10,464	25,906
Painters' colours and materials	Value £	1,840	2,441
Paper of all sorts	Cwts.	888	552
	Value £	1,939	1,379
Soap	Cwts.	281	218
	Value £	252	204

Total Value	1887.	1888.
March	£327,115	£313,680
April	£246,897	£315,654

CUSTOMS TARIFF OF CHINA.

Note.—Haikwan Tael = 10 mace = 100 candareens = 1,000 cash = 6*s.* 8*d.* (nominal value). Catty = 1⅓ lbs. avoirdupois. Chang = 141 inches.

Classification.	Rates of Duty.	
		t.m.c.c.
Agar-agar	100 catties	0.1.5.0
Alum	„	0.0.4.5
Alum, green or copperas	„	0.1.0.0
Arsenic	„	0.4.5.0
Asafœtida	„	0.6.5.0
Brimstone and sulphur (Cannot be imported except under special authority.)	„	0.2.0.0
Camphor	„	0.7.5.0
Camphor baroos, clean	Catty	1.3.0.0
Do. do. refuse	„	0.7.2.0
Charcoal	Free.	
Cinnabar	100 catties	0.7.5.0
Cubebs	„	1.5.0.0
Cutch	„	0.1.8.0
Dye, green (native, Lu-kiao)	Catty	0.8.0.0
Gambier	100 catties	0.1.5.0
Glue	„	0.1.5.0
Gum, Benjamin	„	0.6.0.0
Do. do. oil of	„	0.6.0.0
Do. dragon's blood	„	0.4.5.0
Do. myrrh	„	0.4.5.0
Do. olibanum	„	0.4.5.0
Gunpowder (cannot be imported or exported except under special authority).		
Gypsum, ground, or plaster of Paris	„	0.0.3.0
Lead, red (minium)	„	0.3.5.0
Do. white (ceruse)	„	0.3.5.0
Do. yellow (massicot)	„	0.3.5.0
Medicines, foreign Including surgical instruments, photographic chemicals and apparatus; also medicines of foreign origin made up for Chinese use.* [Excluding castor oil if arriving in quantities of more than 100 catties weight at a time.]	Free.	
Quicksilver	100 catties	2.0.0.0
Perfumery (Excluding Musk.)	Free.	
Saltpetre (cannot be imported or exported except under special authority).		
Smalt	100 catties	1.5.0.0
Soap, foreign	Free.	
Do. Chinese	5% *ad val.*	
Turmeric	100 catties	0.1.0.0
Varnish or crude lacquer	„	0.5.0.0

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* If in reasonable quantities, when declared to be for the personal use of the applicant, and not for sale.

MISCELLANEOUS TRADE NOTICES.

THE CHILIAN NITRATE OF SODA PRODUCTION.

The *Bulletin du Musée Commercial* for the 24th March last contains the following particulars of the Chilian nitrates of soda industry:—

There are in Chili about 59 manufactories of nitrates. The total production of 47 of these factories during the month of December 1887 amounted to 659,164 metric quintals, or 65,946 tons; it was 67,745 for the month of November. Assuming that these figures were maintained for the other months, there would be produced in 1887 about 800,000 tons. This is almost double the amount exported by Chili in 1886 and 1885, when syndicate of manufacturers decided to diminish the production.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

NEW SUGAR REFINERY AT PHILADELPHIA.

A report, dated the 10th April last, has been received from Capt. R. C. Clipperton, Her Majesty's Consul at Philadelphia, on a new commercial enterprise in sugar now under way at the port of Philadelphia. Capt. Clipperton says:—

" This enterprise, when completed, will add greatly to the prosperity of the port and the interests of British shipping, as well as give new life to the depressed sugar plantations of Her Majesty's possessions in the West Indies.

" Mr. Claus Spreckles, a sugar refiner of San Francisco, California, has purchased a site on the river front in the most central part of the city, and is now engaged in the preparation of designs for the erection of a sugar refinery of such proportions as to rank it as the largest in the world.

" Twenty-five architects are at present engaged on the detail plans. The buildings will cover a plot of ground 1,500 ft. by 400 ft.; the wharfage facilities will be 3,200 ft.; some of the buildings will be nine stories high, others 11 stories; the cost of construction, &c. will be between three and four million dollars, which will include the construction of the buildings and the necessary machinery. The number of men required to keep such an extensive establishment running to its full capacity will be 1,500. The consumption of coal will be 250 tons daily, and 15,000,000,000 gallons of water will be required per annum. The raw sugar, beetroot and cane, to a large extent, will be imported by Mr. Spreckles direct from the West Indies and Germany, and purchases will also be made in the open markets of this country. An ordinary steamer's cargo will be consumed every two days, averaging a daily output of 600 hogsheads, and 60 car-loads, 1,600,000 pounds, will be shipped daily from the city, which does not apply to the consumption in Philadelphia, with her million of inhabitants. Centrifugal beetroot sugar will be used, about one-third being mixed with two-thirds of cane, and the product will be cube, cut loaf, granulated, and various yellow sugars. Neither of the three first-named grades are made in this city at the present time.

" It is claimed that this gigantic enterprise will increase the direct trade of Philadelphia by at least 40,000,000 dollars, and an indirect increase of over 100,000,000 dollars."

REPORT ON RECENT CHANGES IN THE PRICES OF EXPORTS AND IMPORTS.

By R. Giffen.

See Board of Trade Journal for May, pp. 549–556.

NEW DANISH BUTTER LAW.

Id. pp. 569—573.

PATENT OFFICE INQUIRY.

Report of the Committee appointed by the Board of Trade to inquire into the duties, organisation, and arrangement of the Patent Office under the Patents, Designs, and Trade Marks Act, 1883, so far as relates to Trade Marks and Designs; together with Minutes of Evidence, Appendices, &c. (C.—5350.) Price, 2s. 6d.

Id. p. 582.

STATISTICS.

BOARD OF TRADE RETURNS.

IMPORTS.

——		April 1886.	April 1887.	April 1888.
Drugs, unenumerated..	Value £	64,595	52,629	80,948
Chemical manufactures and products, unenumerated	„	124,107	107,614	115,466
Chemicals and dye-stuffs, unenumerated	„	224,989	238,581	221,859
Oils, not enumerated...	„	71,989	82,610	66,215
Alkali	Cwt.	5,878	5,680	4,186
	Valuo £	4,082	3,519	3,328
Brimstone	Cwt.	58,899	69,220	37,956
	Value £	14,755	15,967	9,398
Nitrate of soda	Cwt.	202,613	142,800	557,441
	Value £	110,815	25,000	293,878
„ of potash......	Cwt.	26,105	30,947	22,053
	Value £	22,301	27,089	18,445
Quicksilver	Lbs.	452,700	881,400	597,000
	Value £	36,264	88,300	57,329
Cinchona bark.........	Cwt.	16,748	13,375	10,724
	Value £	95,032	69,213	40,832
Gum Arabic	Cwt.	3,871	2,394	3,816
	Value £	11,212	11,837	17,616
Lac, seed, shell, stick, and dyo	Cwt.	11,396	11,192	8,590
	Value £	34,394	28,570	22,673
Bark (for tanners' or dyers' use)..........	Cwt.	31,319	38,645	18,524
	Value £	15,149	17,191	6,615
Aniline	Value £	22,127	18,269	23,162
Alizarine	„	24,935	20,188	20,281
Other coal-tar dyes	„	360	585	1,246
Cochineal..............	Cwt.	1,031	701	366
	Valuo £	6,745	4,253	2,397
Cutch and gambier	Tons	1,486	1,661	2,342
	Value £	37,367	41,160	56,949
Indigo	Cwt.	4,831	5,101	7,210
	Value £	55,026	97,192	134,040
Madder, madder-root, &c.	Cwt.	1,417	553	815
	Value £	1,848	727	1,100
Cocoa-nut oil	Cwt.	16,822	13,745	12,025
	Value £	23,627	20,036	15,516
Olive oil	Tuns	1,487	1,855	1,383
	Value £	60,234	67,184	53,873
Palm oil	Cwt.	69,716	62,816	82,781
	Value £	69,613	60,916	80,569
Petroleum oil	Gals.	3,178,015	6,886,910	7,137,543
	Value £	83,722	190,777	193,305
Oil seed...............	Tons	1,488	977	1,888
	Value £	34,555	22,013	46,103
Turpentine	Cwt.	5,697	14,435	4,725
	Value £	7,195	15,246	6,729

EXPORTS.

——		April 1886.	April 1887.	April 1888.
British and Irish produce—				
Drugs and medicinal preparations, unenumerated	Value £	59,780	62,784	76,956
Sundry chemicals -	„	286,522	263,285	202,214
Painters' colours and materials	„	104,078	106,534	123,678
Alkali	Cwt.	518,108	526,983	588,938
	Value £	142,200	150,316	150,215
Bleaching materials .	Cwt.	130,105	122,425	132,917
	Value £	37,616	46,234	50,178
Seed oil.............	Tons	7,225	6,799	7,133
	Value £	150,907	141,477	143,635
Soap............ ...	Cwt.	38,695	35,502	38,144
	Value £	40,462	35,334	38,709
Foreign and Colonial merchandise:				
Chemicals, unenumerated	Value £	7,513	24,391	24,814
Cinchona bark	Cwt.	9,929	14,960	10,025
	Value £	46,611	58,084	29,586
Cochineal...........	Cwt.	1,069	714	315
	Value £	6,972	4,627	1,930
Cutch and gambier .	Tons	859	854	697
	Value £	21,296	22,076	19,108
Gum Arabic	Cwt.	2,852	2,801	2,214
	Value £	10,690	9,918	10,240
Indigo..............	Cwt.	5,199	7,437	6,167
	Value £	101,906	164,541	128,811
Lac, seed, shell, stick, and dye	Cwt.	7,006	5,021	4,359
	Value £	21,110	13,657	11,049
Cocoa-nut oil	Cwt.	10,670	10,060	6,976
	Value £	15,007	14,570	10,366
Olive oil	Tuns	232	312	257
	Value £	10,018	12,282	10,673
Palm oil	Cwt.	50,598	39,871	50,473
	Value £	51,033	38,350	48,543
Petroleum oil	Gals.	45,806	29,201	31,935
	Value £	2,150	1,197	1,329
Quicksilver.........	Lbs.	662,834	476,783	313,979
	Value £	50,513	43,590	33,476
Nitrate of potash ...	Cwt.	2,158	6,228	9,719
	Value £	2,202	5,101	8,678

BRITISH AND FOREIGN CONSULS' REPORTS.

From the Chemist and Druggist.

BELGIUM.

Petroleum.

There was a falling-off in the receipts of American petroleum last year, the figures being, in 1887, 852,339 barrels, as compared to 936,915 barrels in 1886. Russian petroleum, on the other hand, is on the increase, about 100,000 barrels having been imported in the year 1887, against 91,000 barrels in 1886, at prices slightly below those quoted for American oils.

CANADA.

Imports of Drugs and Chemicals.

During the year ending June 30, 1886, Canada imported from abroad 1,190,781 dollars of dutiable drugs, chemical products, medicines and dye-stuffs, and 1,233,307 dollars of duty-free chemicals. In the year 1885 the figures under these heads were respectively 1,226,867 dollars and 1,251,058 dollars.

A good opening for French Drugs.

The French Consul at Quebec states that French drugs and pharmaceutical specialities are highly esteemed in Canada, and that in this branch of trade, the prospects being so encouraging, his countrymen would still find a very good field open. During the fiscal year ending June 30, 1886, Canada's imports from France were:—Drugs, 39,949 dollars; chemicals, 68,918 dollars; perfumery, 3,987 dollars; pomades, 1,825 dollars; soap, 8,318 dollars; oils, 12,866 dollars; seeds and roots, 19,450 dollars; scientific and optical instruments, 14,469 dollars.

CHINA.

The Wenchow Drug Trade.

Among the articles imported into Wenchow during the year 1887 opium figures to the extent of 64·00 piculs; China root, 137·44 piculs; aniline dyes, value 1,365*l.*; other dye-stuffs, 238·40 piculs; medicines, 2,601*l.*; safflower, 11·38 piculs; Japan wood, 407·89 piculs; vermilion, 18 piculs; varnish, 110·43 piculs; and white wax, 138·41 piculs; most of these items showing a considerable increase over the previous year.

Opium.

In 1887 the Wenchow district yielded as large a crop of opium as it is capable of. The country, as viewed from a hill-top, was in many places one vast brilliant patch of poppy, with only sparse squares of green. The yield per acre of the best sort is 12 to 16 catties (say, 16 to 21 lbs.); of inferior sorts, 16 to 24 catties. The best drug, when the crop came in, sold at 2 dollars per catty, but rose to 4 dollars at the end of the year.

Aniline Dyes for Canton.

The important and growing trade in aniline dyes is entirely in the hands of German firms, who mostly import dyes manufactured by certain German factories who have succeeded in creating an established reputation on the China market. The large silk and paper works of Canton and Fatchan (a town about 60 miles distant from Canton) use enormous quantities of these dyes, and all the more because Chinese do not add any acids to increase the dyeing properties of the aniline. The manner in which the dyes are packed and got up greatly influences their prospects of sale on the Canton market, elegance and neatness of labels being especially looked for; while it is an additional advantage if the name by which the importing firm is known among the Chinese is added in Chinese characters. The bright white glass bottles in which the dyes are packed should not be too small in size, even although the contents do not entirely fill the vessel. The label should not encircle the bottle altogether, but a space of about 1½ inch be left open. For the retail trade 2-oz. bottles are preferable, but, as the Canton dyers above all things look to cheapness, packing in small tins, containing 8 or 20 oz., or large ones of ½ and 1 catty, is especially recommendable for this market. Lately 100-oz. tins have been in demand for old-established brands, but it is not advised to send new makes in this packing. Each tin should be packed in smooth coloured paper of the exact shade of the dye contained in it. The principal colours used are scarlet, pink, green, and blue. The two former are particularly required for the manufacture of coloured paper, as the Chinese use red-coloured visiting-cards, and contracts and other important documents are invariably written on red paper, while pink is mainly used for ruling letter-paper, books, &c. The use of red and pink in cotton and silk-dyeing is unimportant. Green, blue, and magenta are used mostly for silk, and but little for either paper or cotton. Violet, orange, and yellow also are used almost exclusively for silk-dyeing. All dyes should be easily soluble in water, as the Chinese decline to use any acids in conjunction with aniline, and only employ a liquid prepared from rice to dissolve blue and green colours. At present Canton imports about 150,000 dollars worth of aniline dyes per annum, but that quantity is pretty certain to increase in future.

The Cassia Lignea Trade.

The opposition of the cultivators of cassia lignea in the province of Kwangsi against the newly-formed cassia syndicate caused the Viceroy, in the spring of 1887, to again grant the old cassia merchants permission to trade with the producing districts. These old traders compete very strongly with the syndicate, and consequently the price of cassia fell to the lowest point ever known, viz., $5·60 per picul, at which large contracts were made. The shipments of cassia lignea and broken cassia from Canton during the year 1887 reached the abnormal figure of 110,733 piculs, against 79,434½ piculs in 1886, while in former years an export of 100,000 piculs was considered exceptionally high.

Preservation of Books from Insects.

In certain parts of China, the British Consul at Swatow observes, books are extremely liable to be attacked by insects. They first destroy the glue used in the backs of books, and gradually perforate the whole volume. Cockroaches, too, entirely disfigure the covers by eating away patches of the glazing.

The remedy for both these nuisances is easy. The late Dr. Hance who had a large library, used the following recipe:—

Corrosive sublimate	5 drachms.
Creosote	60 drops.
Rectified spirit	2 lbs.

This mixture, a violent poison, he applied with a brush in the joint of the book between every six or seven pages, and, as a preventive of the ravages of cockroaches, he varnished the cover of the book with a thin clear spirit-varnish. In binding books, it would be only necessary to add a small quantity of the above mixture to the glue used, and to give a coating of spirit-varnish to the cover, to secure complete protection from the attacks of insects of all kinds.

COLOMBIA.

Carthagena Drug Exports.

The exports from Carthagena during the year 1887 include the following articles affecting the drug trade to the principal countries trading with the port. The figures represent the weight of the exports in kilogrammes:—

—	United Kingdom.	United States.	France.	Germany.
Anise	500	..	..	..
Balsams	348	3,490	530	3,745
Brazil Wood	..	..	..	..
Cinchona	25,570	45,468	8,080	..
Fustic	6,578	23,085	..	24,070
Ipecacuanha	..	..	60	..
Musk seed	..	..	780	..
Sarsaparilla	180	1,222	..	..

ECUADOR.

Bark Exports from Guayaquil.

The port of Guayaquil exported, in 1887, 549 quintals of bark of all varieties, worth 1,647*l.* In 1886 613 quintals, worth 2,452*l.*, were shipped.

DUTCH INDIAN POSSESSIONS.

Gum Benjamin Exports.

During the year 1887 6,298 piculs gum benjamin were exported from Padang (west coast of Sumatra). Nearly the whole of this went to Java, small shipments to Holland, the Straits Settlements, and America. This quantity is one of the largest on record, but it should be observed that the shipments of gum benjamin from this port are steadily on the increase. In the thirty years from 1858 to 1887 inclusive, 140,901 piculs have been exported from Padang.

FRANCE.

The Chemical Trade at Rouen.

During the year 1887 the rise in price of chemicals continued, notwithstanding that little business was done. Ammonia salts augmented in price on account of the demand for agricultural purposes, as did nitrate and nitric acid 10 per cent. for the same reason. Colouring matters, pyroligneous acid, and soaps remain the same. The rise in volatile alkalis continues, on account of the orders from the South of France, as a preventive against the mildew in the vines. In the third quarter of the year a rise took place in sub-products of wood, and in the end of the year there was another decided improvement. The arrangement between the large manufacturers has kept up the price of bicarbonate of soda, and the increasing demand for chemical manure has caused a change for the better. There is, altogether, a very satisfactory state of affairs in chemicals, and there appears to be every prospect that this will continue during the early months of 1888.

The Marseilles Oil Trade.

The year 1887 has not been any better than the previous one for the oil manufacturers, as owing to the continued crisis many of the factories are shut up, whilst others have reduced their work. The decline in the price of oils, increasing scarcity of foreign markets for it, and the high local railway tariffs, which although reduced in 1887 are still higher than in 1884, have all tended to render the position of the Marseilles manufacturers a difficult one, and it is stated that, of 1,500 presses that exist in the town, about 450 have ceased working within the last two years, and it is feared that there is no prospect of any great amelioration in the state of affairs in the near future, although the amount of oleaginous seeds imported during the year has increased considerably, as compared with 1886.

A decrease has taken place in the quantity of olive-oil imported for table use, as compared with 1886, principally to be accounted for by the crops of olives having been below the average in Italy, Algiers, and Spain, but also by the increased use of cotton-seed oil as an article of food—up to 1886 it was used to a certain extent mixed with olive-oil, in the proportion of about 3 to 7—but, for the last year, work having become scarce at Marseilles, the labouring classes have taken to consuming it without mixture, this oil being sold by the retail dealers at a much cheaper rate.

Soap Exports.

The amount of soap exported from Marseilles during the year 1887 was somewhat less than the quantity shipped off in the previous year, and amounted to 8,915 tons. The countries supplied are principally Algeria, Roumania, West Coast of Africa, Mauritius, Cochin China, Tonquin, and Japan. There are about 100 soap manufacturers in Marseilles and the rest of the Department, and their collective production has been about 100,000 tons, of the value of 2,000,000*l*.

About 70,000 tons have been sent from Marseilles by rail, and the balance was exported by sea, or remained for home consumption.

FRENCH COLONIES.

Tahiti Drug Exports.

The exports from Tahiti during the past two years include the following articles of interest to the drug trade:—

—	1887.		1886.	
		£		£
Arrowroot	4,026 lbs.	34	36,300 lbs.	681
Bees' wax........	1,385 lbs.	192	2,959 lbs.	124
Lime juice	8,987 gals.	374	..	..
Vanilla	7,610 lbs.	3,014	8,408 lbs.	2,522

JAPAN.

Taxation on the Drug Trade.

Among the items forming a standing feature in the Japanese Imperial Budget are direct taxes affecting soy and drugs, which yield a not inconsiderable amount of revenue. Thus the tax on soy during 1887-88 is estimated to produce 212,202*l*., and that on drugs 69,203*l*., both being considerably in excess of the yield in the preceding year.

SPANISH COLONIES.

The Drug Business in Manila.

In a recent report the German Consul at Manila refers to the relative largeness of the importation of drugs, chemicals, and pharmaceutical preparations into the Philippine Islands, and points out that during the year 1886 no less than 465,251 pesos, or 87,231*l*. worth of these goods, weighing over 45 tons, arrived from abroad. In 1885 the value of the imports under this section was 469,964 pesos, and in 1884 581,436 pesos. It is stated (though probably with some exaggeration) that the bulk of the pharmaceutical articles used in Manila is of German origin, although a large proportion of them are imported by way of England. In a few important articles, however, such as chlorate of potash, citric acid, and mustard flour, England continues to dominate the market. An extremely good demand exists in the islands for patent medicines, which are known by the name of "especificos." Most of these come from France, American and English patents following in order of importance. There is also a considerable sale in Manila for brandy and liqueur essences. These are diluted in the local distilleries which have been established during the last few years. Anise liqueur is a favourite article of consumption, but most of the essential oil used in its manufacture is obtained from China, and only a small proportion is oil distilled from European (Spanish) seed. The imports of perfumery represented, in 1886, a value of 45,478 pesos (8,527*l*.). Common soap is manufactured locally, but toilet soaps have to be imported. Paints and varnishes are principally imported from the United Kingdom, English brands having acquired an established reputation which would render it difficult for German manufacturers to compete. All the same, the Consul thinks that his countrymen, by sending cheap consignments of good quality to leading houses, may ultimately succeed in obtaining a footing in this branch. Aniline dyes are not much used yet, though small lots are occasionally imported from Hong Kong through Chinese merchants. As regards business in general, the year 1886 does not appear to have been particularly distinguished either for exceptionally good or for unusually bad trade but it is pointed out that the importance of Manila as a market for European goods is frequently overrated, and that particular care should be taken not to offer a line of samples of new articles through more than one importer at the time, as the price can only be kept up if the Chinese, who in all cases act as intermediaries between the native consumer and the European merchant, find it impossible to procure suitable goods from more than one dealer. These Chinese traders are evidently a very slippery class to deal with, but as yet their services seem indispensable, and they know it, so that the European traders are pretty well at their mercy as regards credit and custom. The Chinese travellers hawk the European goods all over the islands, a task which no European could undertake owing to climatic obstacles, while the natives themselves are not sufficiently intelligent and reliable for it. It is expected that trade throughout Luzon, the principal island of the Philippine group, will derive a considerable impetus from the completion of the projected railway system, the main line of which is now in course of construction, and will bring some of the richest and most fertile districts in direct communication with the capital. Sugar, tobacco, *abaca*, or Manila hemp, and coffee remain the staple products of the islands, while among the exports of pharmaceutical interest sapan wood, logwood, indigo, and essential oil of ylang-ylang are the leading articles. The distillation of ylang-ylang is extending very rapidly throughout the island of Luzon, especially in the neighbourhood of Manila and in the province of Albay, and the European markets have unfortunately been flooded with oil, much of it of very inferior quality, although a few of the old-established distillers maintain their reputation for excellence of product. The exports of ylang-ylang were 764 kilos. in 1884, 1 613 kilos. in 1885, and 1,487 kilos. in 1886.

MISCELLANEOUS.

THE HYDROCARBONS OF CALIFORNIA.

The last report of the State mineralogist, Mr. William Irelan, jr., and the paper by Mr. W. A. Goodyear, show to what an extent the petroleum industry of California is likely to develop. The number of known occurrences is being constantly added to, and without further prospecting it is evident that California possesses important supplies of oil, which in time will be drawn upon. As is well known the California oil is mainly of the heavy variety, there being comparatively little suitable for refining into illuminating oil. Its use as a fuel has passed the purely experimental stage, though new applications and improved methods of burning it will continue to be found. For many years it has been used for generating steam and for metallurgical purposes, but not to a very large extent until lately. Now there is reason to believe that its use as a fuel may assume greater importance, in view of the sulphurous character of the California coal and the high cost of imported coals. The successful results which have followed the introduction of petroleum as a fuel in Russia have been repeated in California on a smaller scale, but enough has already been accomplished to give great promise for the future.

The boom in natural gas has also reached California, and in passing it is curious to note in how many unexpected localities gas is discovered now that its value has become generally appreciated.

Another hydrocarbon, asphaltum, is known to exist in large quantities in the State, and it has been worked to the amount of a few thousand tons annually for a number of years. At present, the local market is limited, and, of course, the product will not bear the expensive handling involved in shipping to points of large consumption; but here, too, is a reserve factor of wealth, which will make itself felt in the future development of the State.—*Engineering and Mining Journal, New York.*

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

18,641 of 1887. A. R. Pechiney, London. Apparatus for treating bodies at a high temperature. November 17, 1887. Antedated under International Convention.

5950. W. R. Rawlings and J. J. Rawlings, Manchester. Blow-pipe apparatus. April 21.

6047. O. Imray.—From P. P. Aries, France. Apparatus for heating liquids, or for maintaining them at a certain temperature. April 23.

6109. C. Wells, London. Obtaining power from waste steam. April 24.

6124. W. Smith, Durham. Machine for agitating or mixing solid and liquid substances. April 24.

6150. R. H. Heenan. Apparatus for stirring, mixing, or incorporating substances. Complete Specification. April 25.

6212. C. Tellier, London. Apparatus for producing cold by means of waste heat. Complete Specification. April 26.

6282. O. A. Berend, London. Means for filtering water or other liquids. April 27.

6302. R. S. Brownlow, Manchester. Improvements in filters. April 28.

6329. E. Sauer, London. Apparatus for evaporating saline or other solutions, especially adapted for production of fresh water from sea water. April 28.

6375. T. P. Miller and J. Bennie, Glasgow. Improvements in filters. April 30.

6442. J. Illingworth, Halifax. Improvements in pipes, gas retorts, and other hollow articles. May 1.

6487. G. F. Redfern.—From T. T. A. Hansen. Centrifugal apparatus. Complete Specification. May 1.

6559. F. Edenborough, London. Improved apparatus for stirring and mixing purposes. May 2.

6748. D. C. E. Steinbrenner, London. Improvements in anemometers. May 5.

6764. E. Tucker, Stornoway. Evaporating and concentrating liquids. May 7.

6874. F. D. Delf, Liverpool. Apparatus for use as retort stands, filtering stands, &c. May 8.

7060. I. S. McDougall, J. T. McDougall, R. K. Hartley, and T. Sugden, London. Improvements in the construction of apparatus for making bisulphites or other compounds used in the treatment of wood pulp and other fibrous materials or the like. May 11.

7061. I. S. McDougall, J. T. McDougall, R. K. Hartley, and T. Sugden. Boilers or vessels lined with lead or other acid-resisting metal or alloy. May 11.

7168. C. D. Abel.—From E. Langen, Germany. Furnace for roasting, calcining, burning, drying, or otherwise subjecting materials to heat. Complete Specification. May 14.

* COMPLETE SPECIFICATIONS ACCEPTED.

1887.

6327. W. P. V. Wallis. Means of feeding furnaces so as to economise fuel and consume smoke. May 5.

8756. J. T. Harris. Cocks, taps, valves, &c. for controlling the flow of water, steam, gas, or other fluid. April 28.

9199. A. J. Boult.—From J. Fischer, Austria. Apparatus for cooling, heating, or purifying liquids, gases, and vapours. May 12.

9250. A. M. Clark.—From T. D. Williams. Amalgamating apparatus. May 5.

9521. S. H. Johnson and C. C. Hutchinson. Construction of filter-presses. May 5.

1888.

3006. S. M. Lillie. Multiple effect evaporating apparatus. May 5.

3863. J. B. Hannay and R. P. Doxford. Apparatus for burning liquid fuel in steam-boiler furnaces. April 28.

3910. C. R. Hoopes. Apparatus for utilising liquid fuel in furnaces. April 28.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

5985. W. A. S. Benson, J. Lovegrove, and E. Haiton, London. Improvements in artificial lighting. April 21.

6019. J. Thorneloe, London. Improvements in the manufacture of fire-lighters. April 23.

6075. E. E. Ries, London. New and improved method of heating by means of electricity. Complete Specification. April 24.

6123. R. B. Helliwell, Liverpool. Improvements in fire-lighters. April 25.

6346. S. Chandler, jun., and J. Chandler, London. Improvements in or relating to apparatus used in the purification of gas. April 28.

6432. B. H. Thwaite, Liverpool. Improvements in gaseous fuel producing apparatus. May 1.

6451. E. Brook, London. Improvements in gas producers. May 1.

6496. E. J. Frost, Philadelphia. Improvements in devices for regulating the quality of carburetted vapour or gas. Complete Specification. May 1.

6514. A. Wilson, London. Improvements in gas producers. May 2.

6663. C. H. Mowll, London. Improvements in the composition of artificial or block fuel. May 4.

6827. J. M. Storror, Glasgow. An improvement in the manufacture of candles. May 8.

6920. W. A. McIntosh-Valon and Brin's Oxygen Co., Limited, London. Improvements in the purification of carburetted hydrogen or coal gas. May 9.

7040. J. Walker and G. R. Sisterson, Upton Park. Reducing the pressure of gas to that best suited for illuminating purposes. May 11.

7097. A. G. Meeze, London. Improvements in the process of and apparatus for manufacturing gas. Complete Specification. May 12.

7219. H. Williams, London. Improvements in artificial fuel. May 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,811. G. Watson. A hydraulic gas valve to be fixed between retort and gas main on retort bed. May 19.

1888.

3533. P. Dronier. Magnesium lamps. May 5.

4484. J. E. Wren. Manufacture of illuminating gas. May 5.

4953. C. Wesphal. Production of water-gas. May 12.

5689. J. Swallow and N. Proctor. Artificial fuel. May 19.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

6325. N. J. Fenner, London. Improvements in the distillation of hydrocarbon liquid or solid bodies, or like bodies of mineral or vegetable origin, and in apparatus employed therein. April 28.

6341. J. Imray.—From J. Bartsch, Germany. Improvements in the treatment of coal so as to obtain separate products therefrom, and apparatus for that purpose. April 28.

7334. F. Lennard, London. Improvements in and apparatus for the distillation of tar and the like. May 17.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

5909. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Berlin. Manufacture of blue colouring matters. April 20.

5910. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Berlin. Manufacture of azo colouring matters. April 20.

6319. J. Y. Johnson.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of dye-stuffs. April 28.

6743. H. H. Leigh.—From R. G. Williams, United States. Improvements in the manufacture of colouring matters. May 5.

6899. L. Limpach, London. Improved process or method for effecting the separation of isometric xylidines from commercial xylidine in a pure state for the production of colouring matters. May 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8437. L. Paul. Producing mono and diamidoazobenzidines, transforming them into tetrazo compounds, and combining them with amines and phenols or their sulpho-acids. April 28.

9257. J. Imray. — From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis. A. F. Poirrier, Z. Roussin, and D. A. Rosenstiehl. Manufacture of new azoic colouring matters. May 5.

9315. J. Imray. — From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and D. A. Rosenstiehl. Manufacture of yellow, orange, and red azoic colouring matters, and reduction of certain nitro-compounds for that purpose. May 19.

9414. J. Imray. — From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and D. A. Rosenstiehl. Manufacture of yellow, orange, red, and violet azo colouring matters. May 5.

9468. T. R. Shillito.—From J. R. Greigy. Production of a new red azo colour. May 5.

9887. J. Rust. Material for colouring paints, cements, &c May 19.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

6156. J. J. Jagger and A. Priestman, London. An improved manufacture of cloth. April 25.

6236. E. Martin, Halifax. A new or novel manufacture of cloth. April 27.

6316. B. Barraclough, Bradford. Improvements in textile fabrics. April 28.

6675. A. L. Bill and P. E. Taylor, Birmingham. Improvements in silk warp threads for the manufacture of silk or mixed goods. May 4.

7024. E. H. Hargraves, Manchester. Improvements in finishing cotton goods and other fabrics. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8178. E. Tremsal and A. Dicktus. Process of scouring wool, and apparatus therefor. April 28.

8815. H. J. Simpson, G. M. MacKirdy, and A. Taylor. Production of a textile material from the bark of a certain tree. April 28.

10,650. P. Cohnreich. Oiling or fatting wool, and apparatus therefor. May 19.

13,699. I. Singer and M. W. Judell. Cleansing wool, &c., and extracting oil therefrom; and apparatus therefor. May 12.

1888.

2532. I. Singer and M. W. Judell. Process and apparatus for cleansing wool and other textiles and recovering oils and fats. May 5.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

5968. T. Hill and T. Mayfield, London. Improved drying apparatus for developing aniline dyes. April 20.

6029. H. Gross, London. Improvement in the art or process of dyeing cotton. April 23.

6246. S. Walker and G. Leek, Radcliffe. Wringing sized or dyed yarns—styled "The Excelsior Machine." April 27.

6412. G. F. Landauer. *See* Class XIV.

6570. E. Brasier, London. Improvements in machinery or apparatus for treating, washing, cleansing, discharging, bleaching, drying, and softening fibrous and textile materials. May 2.

6756. J. Nelson and A. Nelson, London. Improvements in apparatus for dyeing and sizing yarns. May 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

1816. A. J. Boult.—From F. Rubay. Bleaching vegetable tissues. May 12.

5035. C. A. G. Schmidt. Apparatus for subjecting textiles to the action of fluids for washing, dyeing, bleaching, &c. May 5.

5338. C. D. Abel.—From F. E. Koethe. Apparatus for treating textiles by steam. May 12.

10,113. A. Gilliard, P. Monnet, and J. M. Cartier. Production upon fibres and fabrics of colours varying from black or brown-black to blue-black and blue. May 19.

11,477. T. A. Boyd. Producing variegated or fancy yarns. April 28.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

5953. L. G. G. Daudenart, Liverpool. New or improved method of extracting magnesia from sea-water, and apparatus applicable therefor. April 21.

6151. R. E. Chatfield, London. Manufacture of an ammonia carbonate applicable as baking power. April 25.

6152. R. E. Chatfield, London. Improvements in the manufacture of ammonia and its sesquicarbonate. April 25.

6175. E W. Parnell and J. Simpson, Liverpool. Improvements in the production of sulphur from sulphuretted hydrogen. April 26.

6248. J. Dawson and R. Hirsch, Kirkheaton. Purification of nitric acid. April 27.

6307. J. Ruffle, Plaistow. An improved utilisation of the exit gases from vitriol chambers. April 28.

6513. B. H. Thwaite, Liverpool. Improved method of treating soluble sulphides and sulphates for the purpose of converting them into carbonates. May 2.

6694. C. N. Hake and R. H. Heenan, London. Improvements in the manufacture of ammonium nitrate. May 4.

6695. C. N. Hake and R. H. Heenan. Improvements in the manufacture of ammonium nitrate. May 4.

6696. C. N. Hake and R. H. Heenan. Improvements in the manufacture of ammonium nitrate. May 4.

7046. G. Borsche and F. Brünjes, London. Process for the conversion of chloride of calcium into chloride of magnesium and carbonate of lime by means of oxychloride of magnesium and carbonic acid. May 11.

7285. P. A. Mallet and T. A. Pagniez, London. Improvements in distilling, purifying, and concentrating ammoniacal liquids. May 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

6417. J. Marx. Manufacture of alkalis and compounds thereof. May 12.

7701. C. F. Claus, H. S. Sulman, and E. E. Berry. Manufacture of soda by the ammonia soda process. May 5.

8289. W. Bramley. Obtaining chlorine or hydrochloric acid from calcium chloride. April 28.

9227. C. Wigg. Manufacture of bicarbonate of soda, and apparatus therefor. May 12.

9543. H. C. Bull and Co., Limited, and W. E. Sendey Manufacture of sulphate of ammonia; recovery and purification of bye-products; and apparatus therefor. April 28.

9873. E. W. Parnell and J. Simpson. Production of sulphuretted hydrogen in combination with the manufacture of alkali by the ammonia process. May 5.

1888.

4284. M. R. Wood. Apparatus for the manufacture of mono-carbonate and bi-carbonate of soda, &c. April 28.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

5921. F. Kreysler and J. Mohr, London. Improvements relating to the decoration or ornamentation of glass and ceramic ware. April 20.

6028. M. Malvez, London. Improvements in apparatus for polishing and grinding plate glass and analogous objects. April 23.

6087. A. J. T. Wild, London. Improvements in the manufacture of bottles and other glass hollow-ware. April 24.

6105. A. S. Chinnock, C. E. McLaren, and A. Campbell, London. Improvements in preparing and drying china clay and other substances, and in apparatus therefor. April 24.

6153. J. Armstrong, London. Improvements in machinery or apparatus for blowing and moulding glass. April 25.

6629. J. Elliott, London. Improvements in the manufacture of roofing slabs, tiles, and the like. May 3.

6639. W. Ambler, J. Rhodes, and S. Rhodes, Bradford. Improvements in the manufacture of glass bottles. May 4.

6837. H. C. Braun.—From J. Derry, Paris. A new plastic compound for modelling forms for moulding and casting. Complete Specification. May 8.

6905. J. M. Day, Dublin. Improvements in the method of manufacturing glass bottles. May 9.

6980. G. Lazenby, London. Improvements in muffle kilns for bending and firing stained glass, tiles, pottery ware, and for other suitable purposes. May 10.

7183. W. T. Turner, Tunstall. "Towing" or "scouring" ceramic productions in the clay or biscuit state of manufacture. May 15.

7309. J. T. H. Richardson, Hatton, Burton-on-Trent. An improvement in the manufacture of glass. May 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

9752. F. J. McMinn and H. Jackson. Earthenware tops fo tables. May 19.

9957. J. Trassl and H. Lindner. Manufacture of thin plates &c. of glass. May 12.

1888.

4632. H. A. Cawkwell. Manufacture of tiles. May 5.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

5881. A. McArn, Glasgow. Improvements in cement, in "cooling" or maturing the same, and in apparatus therefor. April 20.

6261. J. C. Sellars, Liverpool. Improvements in and relating to cement. April 27.

6557. W. Cussans, London. Improvements in colouring Portland cement in imitation of grained or figured marble, and for the manufacture of slabs, tiles, and other forms in plain or mixed colours, and in the appliances to be used in the said manufacture. May 2.

6724. C. Brand, London. Improvements in the manufacture of paving blocks from blast-furnace slag. May 5.

6807. P. Stuart, London. Improvements in pavements. May 7.

6896. J. T. Pullon, Leeds. Improvements in apparatus for drying materials, for gas absorption, and roasting processes; specially applicable for drying cement, slurry, and sewage, and for mixing ground cement. May 9.

6944. H. H. Lake.—From A. van Berkel, Prussia. Improvements relating to the manufacture of plates, slabs, or blocks for building and other purposes. May 9.

7087. J. H. Hughes, J. Holdsworth, and T. Hughes, London. Improvements in the manufacture of a fireproof material which can be used for all kinds of decorative building, artistic, sanitary, and other purposes. May 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

7708. N. R. Foster. Constructing kilns and drying floors for the manufacture of cements and limes. May 12.

8266. W. D. Cliff and B. E. Peto. A new brick or building block. May 12.

10,244. J. S. Rigby. Manufacture of cement. May 5.

11,274. J. S. Rigby. Treatment of lime, mud, &c. to obtain whiting and cement, and apparatus therefor. May 12.

11,937. J. Homan. Construction of fireproof floors. April 28.

1888.

326. M. H. Blanchard. Terra-cotta fireproof construction. April 28.

5333. T. H. Lodge. Manufacture of Portland cement, and apparatus therefor. April 28.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

6081. L. L. Burdon, London. Improvements in the manufacture of compound ingots and the wire produced therefrom. Complete Specification. April 24.

6082. L. L. Burdon, London. Improvements in the manufacture of compound ingots. Complete Specification. April 24.

6102. P. Jensen.—From E. H. Russell, United States. Improvements in the art of extracting metals from ores or metallurgical products. Complete Specification. April 24.

6104. J. Weirich, London. Improvements in treating auriferous and auroargentiferous ores. April 24.

6276. D. Whitehouse, London. Improvements in the manufacture of tin and terne plate, and in machinery therefor. April 27.

6326. A. G. Greenway, London. Improvements in and connected with the manufacture of iron. April 28.

6452. J. Williams, Landore. Improved machinery or apparatus for coating metal plates with tin, terne, or any other metal or alloy. May 1.

6460. H. H. Lake.—From F. J. Seymour, United States. Improvements relating to the separation or extraction of aluminium, or compounds thereof, from ores and other substances, and to fluxes, and apparatus therefor. Complete Specification. May 1.

6470. J. E. T. Woods, London. Further improvements in processes for the utilisation and recovery of refuse metals. May 1.

6495. S. Pitt.—From A. C. Bradley, United States. Improvements in the manufacture of metallic oxides, and in appparatus therefor. Complete Specification. May 1.

6725. W. L. Card, London. A machine for eliminating metals from their matrices. Complete Specification. May 5.

6812. T. K. Rose, London. Improvements relating to the recovery and regeneration of bromine, chlorine, and other chemicals employed in the extraction of gold from its ores, or for other purposes, and to apparatus therefor. May 7.

6872. W. P. Thompson.—From W. T. Wells, United States. Improved process of and apparatus for producing a rustless coating on iron and steel surfaces. Complete Specification. May 8.

6886. J. W. Bookwalter.—From G. Robert, France. Improvements in or relating to the conversion of crude or pig iron into malleable iron or steel. Complete Specification. May 9.

6951. J. W. Bookwalter, London. Improvements in apparatus for converting crude iron into malleable iron or steel. Complete Specification. May 9.

6952. J. W. Bookwalter. Improvements in apparatus for converting crude iron into malleable iron or steel. Complete Specification. May 9.

6956. A. G. Greenway, Liverpool. Improvements in the manufacture of zinc from hard spelter, zinc iron, or galvanisers' dross. May 9.

7106. T. Freeman and D. R. Jenkins, London. Improvements in means or apparatus to be employed in or connected with the coating of metal plates or surfaces with tin or terne metal or other metal or alloy. May 12.

7123. W. White, Cheshunt. Improvements in the manufacture of sodium and potassium. May 14.

7159. S. T. Dahl, London. An improved method of and apparatus for amalgamating gold and other metals. Complete Specification. May 14.

7187. J. B. Hannay, Glasgow. Improvements in treating ores for the obtainment therefrom of gold and other metals. May 15.

7245. T. Price, Loughor. Improvements in the manufacture of tin, terne, and other coated metal plates. May 16.

7257. F. Fenton, Batley, and R. J. Partridge, Grasmere.—From J. Woolford, France. Improvements in apparatus or plant for preventing loss in the smelting of ores, metals, or compounds of zinc or other oxydisable metallic substances and ores or wastes of them. May 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

7567. D. Owen. Manufacture of tin and other metal-coated plates and apparatus therefor. May 19.

8426. J. B. Thompson and W. White. Manufacture of sodium and potassium, and apparatus therefor. May 5.

8427. J. B. Thompson and W. White. Manufacture of aluminium and its alloys, and apparatus therefor. April 28.

8968. J. Toussaint. Manufacture of iron and steel. May 5.

9169. E. Patterson. Miners' safety lamps. May 5.

9316. R. A. Hadfield. Manufacture of steel. May 5.

9389. C. A. Burghardt and W. J. Twining. Production of aluminium. May 5.

9706. J. B. Clark and The Panther Lead Co., Limited. Condensing and separating lead fume and apparatus therefor. May 12.

1888.

2607. C. J. Dobbs. Annealing kilns for slag blocks. May 19.

4707. H. H. Lake.—From P. H. Adams, jun. Apparatus for generating steam by utilising the heat of slag from blast and other furnaces. April 28.

4708. H. H. Lake.—From O. B. Peck. Apparatus for generating steam by utilising the heat of slag from blast and other furnaces. April 28.

4709. H. H. Lake.—From O. B. Peck. Apparatus for generating steam by utilising the heat of slag from blast and other furnaces. April 28.

4710. H. H. Lake.—From O. B. Peck. Apparatus for generating steam by utilising the heat of slag from blast and other furnaces. April 28.

4951. G. Lindenthal. Process of refining iron. May 5.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

5870. R. Ranschke, Halifax. Improvements in electric batteries. April 20.

5937. A. Collingridge, London. Improved galvanic salts. April 21.

6191. C. A. J. H. Schroeder, London. Mode of preparing carbons for electric lighting. Complete Specification. April 26.

6237. A. Millar, Glasgow. Improvements in jars or cells for primary or secondary electric batteries. Complete Specification. April 27.

6314. J. P. Hall, Manchester. Improvements in or relating to dynamo-electric machines. April 28.

6322. P. R. de Faucheux d'Humy, London. Improvements in galvanic batteries. April 28.

6373. L. Dill, Berlin. Improvements in electric batteries. April 30.

6416. L. Hoppe and G. Hoppe, London. Improvements in galvanic batteries. Complete Specification. May 1.

6502. H. H. Lake.—From N. Tesla, United States. Improvements relating to the generation and distribution of electric currents, and to apparatus therefor. Complete Specification. May 1.

6524. C. Wilcox and H. Smith, Birmingham. Improvements in machinery or apparatus for galvanising or tinning wire netting and other flexible metallic fabrics or sheets. May 2.

6657. B. D. Williams, Bristol. Improvements in secondary batteries or electric accumulators. May 4.

6836. W. E. Ayrton, J. Perry, and D. Cook, London. An electro-dynamic relay for constant or varying currents. May 8.

6893. E. C. Walker, Darlington. Improvements in electro-magnetic and magneto-electric generators. May 9.

6907. M. Immisch, London. Improvements in storage batteries. May 9.

6961. G. A. Nussbaum, London. Improvements in automatic electric batteries. May 10.

7333. R. McKenzie.—From H. Weymersch, France. Improved electrolytes for electric batteries. May 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

1383. W. Webster, jun. *See* Class XVIII.—B.

7189. W. H. Akester. Secondary batteries. May 12.

7426. A. C. Henderson.—From P. L. T. Héroult. Preparation of aluminium, aluminium bronze, and alloys of aluminium by electrolysis. April 28.

8284. S. P. Thompson. Electro-deposition of the heavy metals. April 28.

17,047. F. King. Secondary batteries. May 5.

1888.

5235. G. Miot. Multipolar dynamo-electric machines. May 5.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

5971. H. J. Haddan.—From J. W. Evans, United States. Improvements in percolators for the extraction of oil by the naphtha process. Complete Specification. April 21.

5981. T. S. Saunders, London. An improved soap. April 21.

5985. J. Lewkowitsch, London. Improvements in obtaining fatty acids and glycerine from fats and oils. April 21.

6428. J. Taylor, Leith. Improvements in the manufacture of soft soap. May 4.

6669. A. J. Boult.—From O. Korschelt, Germany. Method of extracting or winning wool oil (lanolin) in a mechanical way. May 4.

6671. A. J. Boult.—From O. Korschelt, Germany. Method of extracting or winning wool oil (lanolin) in a mechanical way. May 4.

6930. J. Thomson, London. An improved mercurial antiseptic soap. May 9.

6949. W. A. Mitchell and O. C. Hagemann.—Partly communicated by M. von Schmidt, Austria. Improvements in the purification of oils and fats and the obtainment of useful products therefrom. May 9.

7020. W. Alber, Manchester. An improved oil cement. Complete Specification. May 11.

7095. W. P. Thompson.—From C. C. Parsons, United States. Improvements in that class of detergent compounds in which ammonia is employed as one of the ingredients. May 12.

COMPLETE SPECIFICATION ACCEPTED.

1887.

7117. J. Thomson. Composition of mercurial soaps. May 12.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

5878. The Belfast Paint and Colour Manufacturing Co., Belfast. An invention for perfuming their paint enamels, commonly known as "Woodstock" oxydised enamels, and to have the sole right of using perfumeries in enamelled paints generally. April 20.

6012. E. F. Wailes and E. J. Dove, London. Compositions for the coating and preservation of iron, steel, or metal structures from corrosion, and apparatus for the application of the same. April 23.

6336. P. Hanlon, London. An improved preservative composition or polish. April 28.

6389. S. P. Moon and J. Oswald, London. An improved composition for covering kilns, ovens, cylinders, steam-boilers, chests, and pipes or other heated chambers. April 30.

6508. J. Scaife, Birkenhead Park. Dissolving and utilising waste amber and other gums, and an improved method of making varnish therefrom, and apparatus therefor, the said apparatus being suitable for boiling oils, liquids, and other properties of a kindred and allied nature. May 2.

6972. J. B. Hannay, Glasgow. Improvements in making a white pigment of lead, and in apparatus therefor. May 10.

7033. J. B. Hannay, Glasgow. Improvements in preservative and anti-fouling coatings for ships' bottoms. May 11.

7206. C. Straub, London. Improvements in wall-covering composition. Complete Specification. May 15.

COMPLETE SPECIFICATION ACCEPTED.

1887.

6619. J. C. Martin. Imparting body or opacity to sulphate of baryta, &c., and manufacturing therefrom white and tinted or coloured pigments. May 5.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

6035. T. Woodward and W. W. Foster, London. Improvements in the method of, and process employed in, utilising scrap or waste leather in the manufacture of various articles. April 23.

6412. G. F. Landauer, London. An improved method or process of, and apparatus for, dyeing leather. April 30.

6491. H. Levick, London. Improvements in tanning. May 1.

7007. C. L. Royer, London. An improvement in the treatment of hides for belting and such like purpose. May 10.

COMPLETE SPECIFICATION ACCEPTED.

1888.

4211. V. Rivière. Rendering tanned hides and skins soft, flexible, and waterproof, and mordanting the same. May 5.

XV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

6532. A. Bodtker, Glasgow. Improvements in slag manure. May 2.

7071. A. Bodtker. Improvements in the manufacture of slag manure. May 12.

7302. A. Bodtker. Improvements in the manufacture of slag manure. May 17.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

6030. R. Harvey.—From T. S. Cornish, Demerara. Improvements in and connected with defecators or eliminators for saccharine and other liquids. April 23.

6098. G. Fletcher, London. Improvements in sugar cane mills. April 24.

6778. H. Kiel and R. Stoltenhoff, London. Improvements in the manufacture of starch. May 7.

7228. W. M. Sandison, London. Improvements in apparatus for concentrating cane juice syrup and the like in the manufacture of sugar. May 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

6875. A. M. Wood. Treatment of india-rubber, caoutchouc, gutta-percha, and analogous gums. May 5.

8357. H. Rimmer. Manufacture of material for purifying and filtering water, saccharine, alcoholic, and other fluids. April 28.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

5972. T. J. Rayner, London. Improvements in steam generation for distilling purposes. April 21.

6026. W. Hucks, London. Improvement in the treatment of brewers' or distillers' worts. April 23.

7181. T. Bolland, London. Improvements in or relating to distilling apparatus for spirits. May 15.

7259. J. Death, Cheshunt. Improvements in distilling spirits and in distillery plant. May 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8357. H. Rimmer. *See* Class XVI.

8986. W. W. Davenport. Apparatus for automatically regulating the temperature of fermenting liquids. April 28.

9425. E. J. Taylor. Manufacture of spirits. May 5.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

6616. R. Chodat and P. Chuitt, London. Process of manufacturing an alimentary substance for use as a substitute for coffee, cocoa, or the like, or for mixing with other alimentary substances. May 3.

B.—Sanitary Chemistry.

6051. S. Welsh, Walsall. Ventilating sewers, and destroying or rendering innocuous the sewer gas. April 24.

6070. G. A. J. Schott.—From C. Lortzing, Germany. Improvements in the method or process of, and apparatus for, purifying sewage and other impure waters or liquids. April 24.

6405. F. R. Lipscombe, Greenhithe. An apparatus for precipitating inorganic and organic matter held in solution or suspension in liquids, and for purifying and clarifying the liquid afterwards. April 30.

6478. W. P. Thompson.—From S. Moro, Italy. New or improved method of preventing the decomposition of organic substances. Complete Specification. May 1.

7307. A. Fawcett, Halifax. Improvements in apparatus employed in the clarification of sewage. May 17.

C.—Disinfectants.

6407. H. H. Lake.—From C. H. Shaw, United States. Improvements relating to disinfectants. April 30.

6738. J. W. Knights and W. D. Gall, London. Improvements in or relating to the automatic distribution of disinfecting or antiseptic fluids or the deodorising or perfuming of the atmosphere. May 5.

7177. W. P. Thompson.—From G. C. W. Belcher, United States. Improvements in antiseptic or disinfecting compounds. Complete Specification. May 15.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1887.

9247. J. F. V. Steenberg. Process for preserving meat, fish, &c. May 5.

9419. Prince John Tarchan-Mauranoff (called Tarchanoff). Treatment of eggs or the albuminous portions thereof for preservation, transport, or use as food. May 5.

B.—Sanitary Chemistry.

1887.

1333. W. Webster, jun. Oxydising and decomposing by electrical action organic matter and inorganic salts in sewage, water, and other liquids. April 28.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

5958. H. Parker, Glasgow. Improvements in and connected with the manufacture of paper, and in the appliances or mechanism therefor. April 21.

6154. G. Schenkenwald and G. W. Osborn, London. Improvements in the manufacture of paper for paper-hangings and other purposes. April 25.

6155. W. H. Howarth, London. Improvements in cheques, for preventing fraud and tampering therewith. April 25.

7112. Thorburn, Bain, and Co., London. An improved method of making into blocks a paper for sanitary and other purposes. May 14.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

6634. M. J. Schreiter, London. Improvements relating to the refining of camphor. May 3.

6869. J. Y. Johnson.—From La Société Française de Alcools purs of Paris. An improved process for purifying alcohol, and obtaining aldehydes and acetones. May 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8816. H. J. Simpson, G. M. MacKirdy, and A. Taylor. Manufacture of tannins, gallates, kinos, and other vegetable extracts from a certain tree bark and wood. May 5.

1888.

3049. P. M. Justice.—From L. B. Weld. Manufacture of hydrochlorate of quinine. April 28.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

5869. J. Harmer, Littlehampton. Improvements in photographic cameras. April 20.

5974. E. Edwards.—From J. W. C. C. Schirm, Germany. Improvements in magnesium lighting apparatus for taking photographic pictures. April 21.

6793. A. F. Herzog, London. Improvements in photographic apparatus. May 7.

6814. S. M. Clark, London. Improvoments in and relating to photographic apparatus. May 8.

6950. A. J. Boult.—From G. Eastman, United States. Improvements in or relating to cameras. May 9.

7039. J. F. Fetter, London. An apparatus for enlarging photographic negatives. May 11.

7044. R. Norris, London. Improvements in the production of collodion photographic films on surfaces of exalted sensitiveness. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8744. T. R. Dallmeyer and F. Beauchamp. Apparatus for regulating exposures. May 19.

1888.

5545. F. Hurter and V. C. Driffield. Instruments for calculating photographic exposures. May 19.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

5949. A. Kuhnt and R. Deissler, Berlin. Improvements in explosive compounds. Complete Specification. April 21.

6280. L. Bonneville, London. Improvements in explosive compounds. April 27.

6498. J. W. Graydon, London. Improvements in high explosive shells, and method of preparing the charge therefor. Complete Specification. May 1.

6560. A. V. Newton.—From A. Nobel, France. Improvements in explosive compounds. May 2.

6805. G. J. Mayer, London. Improvements in the manufacture of quick match and other fireworks, and in apparatus for covering the same. May 7.

6875. A. Favier, London. Improvements in cartridges and in detonators for exploding the same. Complete Specification. May 8.

7213. P. A. Oliver, Washington, U.S.A. Improvements in gunpowder mills. Complete Specification. May 15.

COMPLETE SPECIFICATION ACCEPTED.

1887.

6817. J. H. Burke and A. Leather. Centrifugal percussion fuse. May 19.

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THE JOURNAL

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. Ludwig Mond has been nominated to the office of President; and Prof. Jas. Dewar, F.R.S., has been nominated Vice-President under Rule 11.

Sir I. Lowthian Bell, F.R.S., Mr. R. Forbes Carpenter, and Dr. John Evans, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. B. E. R. Newlands and Mr. Alexander M. Chance have been nominated Ordinary Members of Council under Rule 17 in the place of Mr. R. Forbes Carpenter and Dr. John Evans, F.R.S., nominated Vice-Presidents.

The Treasurer has been nominated for re-election, and Dr. F. Hurter has been nominated Foreign Secretary in the place of Mr. Ludwig Mond.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18:—"No such nomination shall be valid, unless it be signed by at least ten members of the Society, who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's office, at least

one month before the date of the commencement of the Annual General Meeting, and the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

Change of Date of Annual General Meeting.

Members are requested to take special notice that the Annual General Meeting in Glasgow will be held on Wednesday, Thursday, and Friday, the 4th, 5th, and 6th July next, instead of the 18th, 19th, and 20th, as notified in the April issue. This change is due to the fact that the Glasgow Fair holidays, during which many works are closed for repairs, begin on the 12th July and last about ten days. A programme of proceedings and other particulars are enclosed herewith, and members' tickets will be issued with the ballot list.

Notice is hereby given that the numbers for January, 1882, 1883, and 1886, and February, 1886, are exhausted, and no orders for those copies can be executed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January, 1882, and February, 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once with Mr. Cresswell.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given that the subscription list to the funds of the Imperial Institute from Fellows of the Chemical Society and Institute of Chemistry and Members of the Society of Chemical Industry will close on August 1st next. Dr. W. J. Russell, treasurer to the fund, announces that the total amount already received is 363*l.* 16*s.* 6*d.*

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

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Benjamin, M., l/o 43; 51, East 67th Street, New York, U.S.

Best, T. T., l/o Erlangen; Sliema, Victoria Park, Wavertree, Liverpool.

Beveridge, Jas., l/o Frodsham; Northfleet Paper Mills, Kent.

Brunner, J. F. L., l/o Cambridge; Winnington Old Hall, Northwich.

Chance, J. Frederick, l/o Oldbury; 51, Prince's Gate, London, S.W.

Claisen, Dr. L., l/o Sophienstrasse; Luisenstrasse 28 3, Munchen, Bavaria.

Claus, Carl F., jun., l/o Hampstead; Shortland House, Mumbles, near Swansea.

Cook, E. M., Journals to Carteret Chemical Co., 115, Broadway, New York, U.S.

Davis, A. R., l/o Woodhouse Hill; 40, Prospect Terrace, Hunslet Moor, Leeds.

Dukes, T. W., l/o London; c/o B. G. Lennon & Co., Cape Town, South Africa.

Frew, Wm., l/o Marshall Place; 2, King James' Place, Perth.

Gill, A. H., l/o Boston; retain Journals until further notice.

Greenwood, Holmes, l/o Accrington; Holland Bank House, Church, near Accrington.

Hammersley, W. A. L., l/o Daisy Bank Cottage; Bridge House, Leek, Staffordshire.

Joynson, F., l/o St. Helens; The Aluminium Co., Ld., Oldbury, near Birmingham.

Kiddie, Thos., l/o New York; San Pedro Mines, Golden, New Mexico, U.S.

King, C. M., l/o Hornsey; Elm Tree Lodge, East Finchley, N.

Knight, J. J., l/o Guildford; 2, Albert Terrace, Carlos Road, Godalming.

McFarlane, J. F., l/o Dalkeith; 9, Greenhead Street, Glasgow.

McKinlay, Wm., l/o Charlton; 121, Main Street, Alexandria, Dumbartonshire.

Markel, Dr. K., l/o Castle Street; Winnington, Northwich.

Riley, Jno., l/o Castleton; Sunnyside, near Rawtenstall.

Sanderson, T. C., l/o Camberwell; retain Journals until further notice.

Schreiber, F. T., l/o Bolton; Salford Ironworks, Manchester.

Schroeder, C., l/o Bloom Street; 8, Chatham Street, Piccadilly, Manchester.

Shadwell, J. E. L., l/o Melksham; Highfield, Southborne, Christchurch, Hants.

Stebbins, J. H., jun., l/o 117; 114, Pearl Street, New York, U.S.

Thorne, Dr. T. L., l/o Fortess Road; 19, Dafforne Road, Upper Tooting, S.W.

Tomlinson, G. G., l/o London; Post Office, Valparaiso, Chili.

Williams, E., l/o Manchester; Folly Farm, Warrington.

Wilton, Thos.; Journals to Winsor House, Beckton, E.

LIST OF MEMBERS ELECTED, 22nd JUNE, 1888.

Batchelor, Telford C., 8, Barons Court Road, West Kensington, W., mechanical engineer.

Bevan S. Howel, Goring Road, Llanelly, South Wales, chemical manufacturer.

Blumann, Moritz, 43, London Wall, E.C., merchant.

Bower, Frank, 37, Lansdowne Road, Clapham Road, S.W., analytical chemist.

Brown, Wm., 10, Colne Road, Brierfield, near Burnley, chemist.

Fonlieron, Ernest, 73, Boulevard de Strasbourg, Paris, chemical engineer.

Fukahori, Yoshiki, 6, Sanjikkenbori, Sanchome, Tokyo, Japan, examiner of patents.

Kipp, F. W., 1, New London Street, London, E.C., tar distiller.

Lombard, Emile, Rue Grignan 32, Marseilles, France, director Rio Tinto Co.

McDougall, Arthur, Clifton Lodge, Gore Street, Greenheys, Manchester, manufacturer.

MacLean, Alex. S., c/o Alex. Scott and Sons, Berry Yard, Greenock, sugar refiner.

Makin, James, Wallhead Mills, Rochdale, paper stainer and tinfoil manufacturer.

Mercer, Thos., The Brewery, Edenfield, near Bury, Lancashire, chemist.

Ogata, Saburo, c/o T. Hirano, 11, Ginza Shichome, Tokyo, Japan, assayer.

Potter, Chas. J., Heaton Hall, Newcastle-on-Tyne, Portland cement manufacturer.

Reckitt, Ernest, Caen Wood Towers, Highgate, N., metallurgical student.

Saito, Kenji, 5, Yamamotocho itchome, Kojimachi, Tokyo, Japan, student.

Shidzuki, Iwaichiro, Eng. Coll., Imp. University, Tokyo, Japan, assistant professor of chemistry.

Weir, Surgeon-Major P. A., 7, Kelvinside Gardens, Hillhead, Glasgow, principal assistant opium agent, Benares Agency.

Deaths.

Cooke, Leonard, Horwich Vale, Bolton le Moors.

Taylor, James, l/o The Farmer's Club; at 115, Forest Road, Dalston, E. May 1st.

London Section.

Chemical Society's Rooms, Burlington House.

Chairman: David Howard.

Committee:

Sir F. A. Abel.
H. E. Armstrong.
W. Lant Carpenter.
W. Crowder.
W. J. Dibdin.
C. Graham.
S. Hall.
C. C. Hutchinson.
R. Messel.
B. E. R. Newlands.
B. Redwood.
T. Royle.
John Spiller.
Wm. Thorp.
C. R. Alder Wright.

Hon. Local Sec. and Treasurer:
Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

SESSION 1887-88.

Meeting held Monday, June 4th, 1888.

DR. H. E. ARMSTRONG, F.R.S., IN THE CHAIR.

THE MODE OF USING CHAR IN SUGAR REFINING.

BY MESSRS. B. E. R. AND J. A. R. NEWLANDS.

The ordinary process of sugar refining in a refinery turning out crystals and soft sugars, or, as they are technically named, "pieces," may be conveniently divided into five important stages.

1. Solution in the melting pan or blow-up.
2. Filtration by means of the Taylor filter.
3. Decolourisation by animal charcoal.
4. Evaporation in the vacuum pan.
5. Turbination in the centrifugal machine.

Though the art of sugar refining has been practised for some centuries in Europe, it is interesting to learn that all these processes are of a comparatively modern origin, with the exception of the first, Taylor filters being introduced in 1830 by Taylor, their inventor, the use of animal charcoal in refining being suggested early in this century, but only practically employed, as at present, by Derosne in 1830. The vacuum pan patented by Howard in 1813, and the centrifugal machine, as applied to sugar, by Hardman in 1843. Since that date nearly all that has been done by inventors has been in the direction of improving these processes.

Up to the time of Howard and Derosne, decolourising and defecating agents, such as lime, wood-charcoal, blood, alumina (Nash's finings), &c., were used to partially remove the colour from solutions of sugar and to facilitate their filtration. After the addition of one or more of these agents, the solutions were filtered through blankets placed over tanks, and then evaporated in open pans by means of fire or steam, and when the granulating point was reached the mass was stirred until crystallisation ensued. The massecuite was then filled into moulds, and, after the crystallisation was complete, the sugar having been covered with a layer of pipe-clay or soft sugar, was washed with water or a nearly saturated solution of white sugar, which removed the colour from the surface of the crystals. The purified sugar was then either crushed to form soft, or as it was called, "crushed" sugar, or dried in a stove, forming the well-known loaf-sugar, and the mother liquid or syrup was evaporated and treated again in the same way.

This process was extremely tedious, taking, from first to last, two or three weeks to complete. By means of the vacuum pan, animal charcoal, and the centrifugal machine, the process, so far as the production of crystals and pieces is concerned, has been so much improved that it is now possible to convert raw sugar into refined in little more than a day. This saving in time is at least half due to the employment of animal charcoal in place of the washing or liquoring process.

Manufacture.

Animal charcoal should be made from well-selected clean bones of compact structure. These are first boiled or treated with a solvent such as benzene to remove the fat they contain, and they are then carbonised in vertical or horizontal cast-iron retorts, the whole carbonising apparatus being similar to a small gasworks. The volatile products pass up ascension pipes and then through a hydraulic main to scrubbers and washers, in which the bone-tar and ammonia-liquor collect, the residual gases finally finding their way to a gas holder. The passage of the volatile matters is assisted by an exhaust fan. After being heated to a red heat for from 8 to 10 hours, the charcoal is withdrawn from the retorts and cooled in iron canisters, which immediately on being filled are covered by lids and luted with water or charcoal paste round the edge to exclude the air. When the charcoal is quite cold it is crushed in a suitable mill into different sizes of grist. Before crushing, any pieces of iron which may be mixed with the bones are removed by means of electro magnets. Dried blood, leather, horns, and other animal matters yield, on being carbonised, a charcoal possessing great decolourising power, and, though, on account of its friability, such charcoal is not suitable for sugar refining, it is employed to some extent in bleaching oils, fats, glycerine, &c.

In new charcoal the carbon should range from 9 to 11·5 per cent., the siliceous matters should not exceed 0·5 per cent., the ferric oxide 0·15 per cent. and the calcic sulphate 0·2 per cent. A cubic foot should not weigh more than 52 lbs. When incinerated the ash ought to be of a uniform white or cream colour. The grain or grist should be even, and the colour black or dark brown. It should be hard, but at the same time porous in structure, adhering strongly to the tongue. These are the principal characteristics of a good sample of charcoal, but there are many others which the limits of this paper will not allow us to mention. Charcoal manufactured in this country is nearly always of good quality, but the same cannot always be said of that made on the Continent. The foreign manufacturers often combine the manufacture of gelatine with that of charcoal, making the latter from the partially degelatinised bones, and we fear occasionally supplying the resulting deficiency of carbon by a judicious admixture of spent or exhausted charcoal containing a superabundance of that element. This adulteration can be easily detected by calcining a small quantity, when the ash will be found to present a speckled appearance. The ash of spent char is either grey or red. Even if the foreign charcoal is honestly manufactured, the small grist which finds its way here is generally the softer portion resulting from the production of the large hard grist required by the beet-sugar manufacturers. We do not by any means wish to universally condemn all foreign charcoal, as some continental manufacturers make a perfectly good article. It is important that charcoal should be hard, otherwise considerable inconvenience and loss will be experienced from the production of dust. Even with good charcoal, however carefully it may be handled, it is impossible to avoid the destruction of a certain amount by the attrition to which it is subjected in its journeyings in the refinery. With the object of ascertaining if it were possible to determine the relative power of various samples to resist the wear and tear of the refinery, we recently tried the following experiment. A number of samples of charcoal of known grist were subjected to the following treatment. 50 grams of each sample was introduced into a round tin box 4 inches in diameter and 2 inches wide, and then the whole of the boxes having been arranged side by side in a wooden frame, were revolved slowly, by being attached to the main shaft of an engine, 672,000 times, and the dust was then separated by means of a sieve having 60 holes to the linear inch.

—	Size of Charcoal.	Dust Produced.
	Holes in sieve to linear inch.	Per Cent.
Sample No. 1:— English charcoal.............	10 to 20	2·560
" "	20 to 30	2·560
" "	40 to 50	3·220
Sample No. 2:— English charcoal.............	20 to 30	1·414
" "	30 to 40	3·694
" "	40 to 50	8·720
Sample No. 3:— Russian charcoal.............	8 to 10	3·878

The small charcoal being evidently softer than the large, is destroyed to a greater extent.

When the percentage of dust in the working charcoal reaches a certain point, especially when the dust is very fine, it is a source of considerable trouble in various ways, and it is usual therefore to reduce its amount by passing the charcoal over a fine screen or by means of a current of air. Mumford and Moodie's newly-invented separator acts in the latter way and gives good results. The size of grist which it is most suitable to employ depends upon the purpose for which the charcoal is to be used. If the solution of sugar to be purified is of high specific gravity, then large grist should be selected, but fine grist is more suitable in the case of ordinary liquor of 28° to 30° B. At present most refiners prefer small grained char, and as fine charcoal removes more colour than coarse, this is quite correct; but as the difficulty of washing, and also the amount of sweet washings increase with the degree of fineness, this preference may be carried to too great an extent. The advantage of small charcoal in so far as colour is concerned is evident from the following experiment. 100 grams each of different grists of English charcoal, which had been carefully washed and dried, were placed in three flasks with 150 cc. of liquor 28° B., and made from 88 net beet sugar, and the flasks having been tightly corked, the whole were immersed in water heated to 150° F. and kept at this temperature for four hours. The colour remaining was then determined.

Original colour 23.

Char		Proportion of colour remaining
Char 10 to 20 hole sieve.	Proportion of colour remaining...	5
" 20 to 30 "	" "	... 4
" 30 to 40 "	" "	... 3·5

The reason that fine charcoal is more active than larger grist may be due to the fact that the larger grist retains the liquor to a greater extent and so prevents its circulation.

The temperature of the liquor has a considerable influence in aiding or retarding the action of the char, and it will be seen from the following results that the higher the temperature within certain limits the better is the result.

Five flasks had placed in each of them 50 grams of the same sample of char and 100 cc. of liquor 28° B. made with Natal sugar, and these flasks were corked and kept for four hours in water heated to different degrees, and the residual colour was determined —

Temperature		
Temperature 100° F.	Proportion of colour remaining...	64
" 125° F.	" "	... 58
" 150° F.	" "	... 46
" 175° F.	" "	... 32
" 200° F.	" "	... 32

Colour originally present 420.

The time during which the solution to be decolourised is kept in contact with the charcoal is also of importance.

Separate flasks charged in exactly the same way with 50 grams of char and 100 cc. of liquor 28° B. made respectively with Jamaica, Natal, and 88° beet sugar, were heated in a bath to 160° F. The flasks were removed from the bath at the intervals named, the colour after filtration being determined. From these results it appears that contact for six hours in the case of Jamaica and Natal, and eight hours in the case of beet sugar, gives good results. However, in the absence of more extended experimental evidence, it would not be safe to generalise too much on the results obtained. In the heat or time experiments our impression is that considerable variations might occur in the case of very good and very low qualities of even the same kind of sugar.

—	Jamaica Sugar.	Natal Sugar.	88 Net Beet.
Original colour	660	420	23
Proportion of colour left:— 2 hours	102	60	6
4 "	92	37	5½
6 "	60	28	5
8 "	64	29	4½
10 "	—	30	—

After the time is reached at which the best results are obtained, any further contact is attended by loss of colour, owing to the action of heat producing more colour than the char can, under the same conditions, remove. From these experiments it is also evident that cane sugar is more easily deprived of its colour than beet. This may be due to a great extent to the fact that cane sugar is almost always acid and beet sugar alkaline, and also that the easily removable colouring matter of the latter has been removed by the greater care taken in its manufacture. Before employing new charcoal for refining it should be carefully washed with hot water until the washings give with argentic nitrate and nitric acid no more indication of chlorine than is due to the washing water.

The peculiar action of char appears to entirely depend upon the carbon it contains, which exists in an exceedingly fine and porous state, the only useful purpose of the mineral matter, so far as decolourising action is concerned, being to act as a framework to support the carbon. If the mineral matter be removed the residual carbon will decolourise more effectively than the original char. Thus it was found by experiment that the decolourising effect of the carbon from 1,000 grams of old char was greater than that of the entire weight of the char from which it was obtained.

Unfortunately, however, the carbon of animal charcoal, when freed from its accompanying mineral matter, is in too soft a condition to admit of its use for refining purposes on account of the impossibility of passing liquor through a cistern containing it, and even if it were stirred up with the liquor, its separation therefrom would involve the expense and trouble of filter presses. Lastly, there is no known apparatus in which such carbon can be re-burned satisfactorily so as to enable it to be used over again. For these and other reasons the sugar refiner is content to avail himself of the more lasting, though less effective results, which can be produced by the use of char in its ordinary condition.

From the foregoing experiment it is evident that the decolourising action of char is dependent upon the carbon contained in it, and a further proof of this statement is afforded by the fact that if char be calcined so as to remove the carbon therefrom, it no longer possesses any decolourising power whatever. Whilst all authorities admit the above facts, they by no means agree as to the interpretation to be put upon them, and, accordingly, numerous theories have been from time to time propounded to account for the action which char, or the carbon it contains, is capable of exerting upon so many and such diverse substances.

Charcoal possesses, as is well known, the power of absorbing many times its volume of various gases, such as oxygen, nitrogen, carbon dioxide, and ammonia, and different investigators have given the credit of the work done to one or more of these gases ; but as it has been demonstrated that charcoal from which the absorbed gas has been driven out by heat, and which has then been allowed to cool in various gases and in a vacuum, has in all cases the same effect, it is evident that the gases play at most a very important part in the action.

It has been stated by P. Degener and Lack that hydrogen peroxide is generated when charcoal is exposed in the damp state to air, and that this is the reason to some extent why colour is removed ; but this cannot be the case, for hydrogen peroxide would undoubtedly destroy the organic colouring matter, or modify it to such an extent that it could not be recovered. In the case of charcoal, however, the whole of the absorbed colour can be dissolved out with a suitable solvent, such as a solution of ammonia, potash, or soda.

Charcoal seems to act by means of a surface attraction, merely withdrawing the colouring matters, &c., from the liquid passed through it, much in the same way as peat, earth, and many other substances do to a less degree.

Charcoal, in addition to its action on colouring matters, removes many mineral and organic bodies, and, particularly in the case of sugar solutions, the lime salts, gum, and albumen. New charcoal is most suitable for low sugars, as it produces a golden-coloured liquor which cannot be obtained from charcoal which has been in use for some time. This may be partly due to the fact that new charcoal gives off a large amount of ammonia which renders the liquor alkaline, so that if we wish to produce white liquor it is necessary to employ char which has been in use some time. We have found that new char gives liquors containing ferric salts, and old charcoal ferrous salts, when liquor containing iron is passed through it. This is probably due to the new char containing more oxygen than the old

Charcoal which has been freshly burned and cooled in a vessel from which air is excluded gives out a considerable amount of heat on being exposed to air, owing to absorption of the latter.

Mode of employing Charcoal in the Refinery.

The charcoal after it leaves the revivifying kilns, which will be described later on, is carried, generally by means of conveying bands, to the filters, or, as they are generally called, cisterns. These are usually made of cast-iron and are of a cylindrical shape, the usual size being 20 feet high and 10 feet in diameter. The cisterns are provided with a manhole at the top to admit the revivified charcoal, and one at the side, close to the bottom, for the removal of the used charcoal. Pipes for the admission of liquor of different qualities, water, and air are connected with the top. There is a perforated false bottom made of iron or wood, over which is carefully spread a cloth or blanket previous to the cistern being filled. The cistern is filled with charcoal through a jointed pipe at the top of which is a hopper into which the charcoal falls from the band conveyor. A man inside the cistern levels the char as it pours down the pipe, removing lengths of the latter as the filling proceeds. The operation of levelling the char manually is unpleasant and dangerous, and although generally employed, is in some cases replaced by an automatic leveller. It is doubtful if the levelling is of much importance, though the general opinion is that less sweet-water is made than is the case when the charcoal is simply run in without more being done to it than just to spread it evenly on the top. When the cistern is filled the top manhole door is replaced, and the charcoal having been cooled by water (though this is not done in some refineries), the filtered solution of sugar, termed liquor, usually of a density of 28° B. and at a temperature of 170° F., is run on in a slow even stream until the cistern is full, when it settles for some time before the purified liquor is permitted to run from a cock in the bottom connected with the space under the false bottom. As the liquor runs away it is replaced by more raw liquor at the top of the charcoal. When as much liquor is run on as the charcoal can economically purify (usually about twice its weight), hot water is run on in lieu of liquor, forcing the latter before it, and finally to a great extent removing the impurities which have been taken up from the sugar. Two or more qualities of raw sugar liquor are usually run on to the same cistern, beginning with the best and finishing with the worst. In this way the char water, which is always far more impure than the sugar from which it is derived, is formed at the expense of a cheap instead of a dear material. The process of washing with hot water is continued long after the sweet water ceases to come off. The exact degree of washing which is advisable must, however, depend upon the variety of sugar refined, the size of the charcoal, and the quality and cost of the water used. It also depends to some extent upon the price of new charcoal, for it is certainly better to spend money on new charcoal if we can save a greater amount than its cost in the water bill. To give an idea of the quantity of the water used in washing, we may say that it is generally from once to twice that of the weight of the charcoal. To ascertain if the washing has been carried to its full desired extent, the total solids in the last water coming off the charcoal may be determined and the result compared with the total solids in the water employed in washing. If these results are similar, it is evident that the washing is as complete as it can be with the water at our disposal, and the quantity used can be noted and continued so long as the same sugar is refined. Ammonium oxalate and sodium hydrate are sometimes employed as rough tests to determine if the washing has been prolonged sufficiently. Washing by an upward current of water has been patented and often tried. It is, however, obvious that the solution of sugar, however weak it may be, is heavier than water and will have a downward tendency, and so by continually mixing with the water will greatly increase the sweet washings and loss of sugar. When the charcoal has been thoroughly washed it is allowed to drain, and taken out of the cistern by men and carried by bands or trucks to the kilns.

Elwes suggested (Eng. Patent, No. 2189, 1875) passing the liquor in an upward direction, introducing fresh charcoal continuously at the top of the cistern, and removing the used charcoal also continuously at the bottom, and quite recently several very ingenious patents connected with a similar mode of working have been taken out by Matthiessen and also by Quimby.

Espeut, De Castro and others have patented emptying and filling the cisterns by means of a current of water under pressure, and this method, so far as emptying is concerned, answers well enough if the charcoal has only to pass through short straight pipes; but if the pipes are long, and especially if there are bends in them, they are certain to stop up and give much trouble. If this plan of emptying be used the bottoms of the cisterns should taper towards the centre to the extent of the angle of repose of wet charcoal, otherwise a considerable portion of their contents will have to be removed by hand.

Kilns.

These are of two kinds, revolving and pipe kilns. The former, which are now but little used, consist of cast-iron revolving cylinders placed horizontally and at a slight incline, and provided inside with ledges or lifters. The cylinders are heated externally by fires, and the charcoal is fed into the higher and gradually finds its way to the lower end or outlet, being turned over in its passage by the lifters. On leaving the cylinder it falls into a cooling chamber. Air is carefully excluded from the apparatus.

The pipe kiln which is commonly in use consists of a number, generally 64, of round or, better, of oval cast-iron pipes placed in a vertical position and enclosed in a brick chamber, at the bottom of which is a central fire. The pipes are arranged in sets of two or three rows on each side of the fire, and separated a short distance apart to allow the heat to penetrate to the back row or rows. The flues leading to the chimney are situated behind the pipes, so that the heated gases from the fire are divided, one half passing between each set of pipes. The temperature round about the pipes is from 1,200° to 1,400° F., but inside the pipes it is certainly much lower, particularly in the centre, as charcoal is a bad conductor of heat. From the kiln pipes the charcoal falls into cooling pipes or coolers, made of sheet-iron and usually provided with two sliding valves, one placed at the bottom of the cooler and the other a foot or 18 inches above the bottom. By opening these valves alternately, a quantity of charcoal equal in bulk to the space between them can be withdrawn without the admission of air. Many contrivances have been invented and employed, particularly in the United States, for automatically discharging the charcoal continuously or intermittently. As the charcoal is removed from the bottom of the kiln more wet charcoal is fed in at the top. The charcoal as it leaves the cistern, after washing and draining, contains from 22 to 25 per cent. of water, and this has to be evaporated in the pipes, and a large proportion of the fuel consumed is needed for this purpose. To economise this fuel and to render the work of the kiln more certain, the United States refiners have almost all adopted an addition to the kiln in the shape of what is called a drier. There are several varieties of these, but in all the charcoal is dried more or less by means of the waste heat. A commonly employed drier is Farley's. This consists of a cast-iron chamber of an A section, placed at the top of the kiln over the fire, and of equal length to each bed of pipes. At the top of the drier is a hopper of the same length into which the wet charcoal drops, sliding down a slit left between the sides of the hopper and this drier. The wet charcoal is held by a series of iron plates or louvres placed one above the other at an angle a short distance from the drier, the effect of which is to loosely hold the charcoal against the drier till it is dry enough to run easily, when it finds its way out of the apparatus into the top of one or other of the beds of pipes. The drier is divided into several flues through which the waste gases circulate on their way to the chimney. There is no doubt but that a considerable saving and improvement in results, in many ways, is effected by the employment of continuously-discharging apparatus and driers. The charcoal after leaving the cooling pipes should fall into storage tanks placed under the kilns, from whence it can be taken by means of a band to the cisterns as needed.

The principal objection to the pipe kiln is that however carefully it may be looked after there is always a danger of the pipes being unequally heated. To obviate this and to combine the drier and the continuous-discharging apparatus, Messrs. Buchanan and Vickess some years since devised their now largely-used kiln. This, as recently improved, consists of a number of vertically placed pipes each 12 inches in diameter and arranged in two sets of rows on either side of a furnace, the back rows being in such a position that half their circumference is exposed to the direct action of the heat. The pipes revolve slowly by means of suitable gearing. Within each pipe an internal small perforated pipe is fixed, and shields are cast on it over each perforation which serve the double purpose of preventing the charcoal passing into the internal pipes, and at the same time alter the direction of the falling charcoal, so that every particle has a chance of being equally heated. The steam and gases given off during the carbonisation pass freely through the perforations, and have their heat utilised in drying wet charcoal, which is heaped up over the main pipe, the latter being over the mouths of the kiln pipes into which all the vapours are led.

To the bottom of each pipe is attached a cooler composed of eight small thin iron pipes, which revolves with the carbonising pipe. The coolers are provided with a self-discharging apparatus by which the charcoal is let out in exactly equal quantities at short intervals. A kiln of this kind containing 22 pipes will re-burn about 20 tons in 24 hours. This ingenious apparatus gives good results as compared with other revivifying kilns. The charcoal during its passage through the pipe or revolving kiln is exposed to a temperature exceeding 1,200° F., which is much higher than is necessary to produce the maximum decolourising effect. The following experiments show that it is merely necessary to heat the char for a short time to a much lower degree to get results at least equal to those obtained by means of pipe kilns.

A high temperature, besides being a waste of fuel, causes serious injury to the char by contracting its pores and so rendering it, in the course of time, less active.

Working char heated in an oil bath to 550° F. for one hour had the same decolourising power as the same char re-burned in a pipe kiln, and the same char heated in a bath of melted lead to a temperature of about 617° F. for one hour gave also rather more decolourising power than similar charcoal re-burned in the kiln. We have made many other experiments of this kind which confirm these results, and are of opinion that a very short and intimate contact with heat not exceeding 700° F. is all that is necessary to obtain good results. It is impossible to work at so low a heat in a pipe kiln of the best design and with the most careful management. The pipes in the kiln, even if they revolve, are sure to be unequally heated, the row nearest to the fire having to be heated to a much greater extent than the others to make certain that the latter are raised to the required temperature. Owing to the difficulty experienced in evenly re-burning the charcoal many plans have been suggested and patented for improving the mode of working. The use of superheated steam and various gases have been much recommended, and in some cases employed on a large scale. This method of applying heat possesses the advantage of equally heating the charcoal ; on the other hand there is a danger, if the temperature is high, of a destruction of carbon by the action of the steam or gas. However, with care the loss from this cause may be reduced to an insignificant amount. In 1884—1885, M. P. W. Boulton, E. Perrett, and one of us, after making a considerable number of experiments in this direction, obtained a patent (No. 15,897, 1885) for what we believe to be a novel mode of working and form of apparatus. In our apparatus the steam or gas is caused to circulate by means of a fan through two vessels or chambers, one containing fire-bricks arranged as in the case of regenerators, and capable of being heated by means of a fire or by gas, and the other chamber containing the charcoal to be revivified. The latter is provided with sets of moveable shelves, one above the other, so arranged that the charcoal can be let down by inclining the shelves from one set to another, the charcoal coming in contact in every movement with more and more heated steam on its way to the bottom, and finally falling into cooling pipes. Working charcoal from a refinery containing 18·94 per cent. of carbon was passed through the apparatus 50 times, being moistened with water between each re-burning, and the carbon was determined at intervals to see if there was any loss of that substance.

	Carbon on dry.
Original char	18·94
After re-burning 20 times	17·83
„ 30 „	17·32
„ 40 „	17·20
„ 50 „	17·22

This number of re-burnings would represent six months' work in the refinery.

To ascertain if prolonged contact with the source of heat was necessary, the charcoal was left for the different periods of time under mentioned, on each of the six sets of shelves which the model kiln contained. The temperature at the bottom shelf was 650° F., and at the top 350° F.

A	5	minutes on each shelf	or	half an	hour	in kiln.
B	7½	„	„	¾	„	„
C	10	„	„	1	„	„
D	12½	„	„	1	„	„
E	15	„	„	1½	„	„

A gave the most decolourising power, and the results were gradually worse and worse with the remainder. This experiment was repeated with confirmative results. On being compared with the same charcoal from pipe kilns, A gave better results than the latter.

Repeated attempts have been made to revivify the used charcoal in the cisterns by means of superheated steam and gases, but without success.

As a rough means of ascertaining whether charcoal leaving a kiln has been sufficiently re-burned, it is usual to boil a small portion with a solution of soda, which turns brown, if, owing to the presence of organic matter, the carbonisation is not complete. Some refiners also employ a solution of plumbic acetate in addition to soda, when, if a blackening takes place owing to the presence of a sulphide, they regard this as an indication of over burning. The odour given off by insufficiently burned charcoal as it leaves the coolers is also characteristic.

Improvement of Working Charcoal.

Under certain circumstances the calcic carbonate, carbon, iron, and other constituents increase to such an extent during long use, as to render their reduction a matter of importance, and various means have been devised to attain this end. The treatment with dilute hydrochloric acid to convert the calcic carbonate into calcic chloride is the ordinary mode adopted on the Continent in the beet-sugar factories, but this plan is open to the objection that a certain quantity of calcic phosphate is sure also to be decomposed, and that the framework of the charcoal will consequently be injured. To obviate this to some extent it has been proposed to exhaust the air previous to the introduction of the acid, so as to bring the latter instantaneously in contact with every particle of the charcoal, and in this way equalise its action. To further overcome this difficulty, Beans used dry hydrochloric acid gas, which is said to have no action on calcic phosphate. Stenhouse and Duncan proposed to use dilute nitric acid in place of hydrochloric acid, and there is little doubt but that it possesses advantages over the latter. Cook has suggested treating the charcoal with a solution of ammonic chloride, and then re-burning so as to produce ammonium carbonate which goes off, and calcic carbonate, which is afterwards dissolved out. Cook also patented the use of phosphoric acid to decompose the calcic carbonate. Patrick, Beans, and others have proposed to dissolve out the calcic carbonate by means of a saturated solution of carbonic acid. In English refineries the calcic carbonate in all cases, so far as we can ascertain, decreases during use, and this appears to be due to the employment of cane sugar, which is generally slightly acid. It has been proposed to reduce the carbon by re-burning the charcoal after it has been saturated with a solution of ammonic nitrate, but we have not been able to ascertain if this has been done on a large scale.

In those refineries where the carbon in the char is kept as nearly as possible at the same percentage it was when new, or even less than this, the result is obtained in part by liberal washing, but it is chiefly due to the accidental introduction of air into the kiln pipes. This is evident, we think, from the fact that as there is a constant production of carbon going on from the carbonisation of the absorbed organic impurities which cannot be washed out, the total carbon must, of necessity, increase in the absence of atmospheric oxidation. The destruction of carbon in the kilns is partly that of bone carbon and partly that of sugar carbon. Of the two evils we think that the loss of carbon is certainly greater than a slight gradual increase such as one would naturally anticipate if the washing is properly performed and the kilns are in good order. Instead of revivifying by carbonisation, it has been proposed (and, to some extent, carried into effect) by Eisfeld, and also by Phillips, to digest the charcoal after use in a solution of ammonia, potash, or soda, in water or alcohol, the ammonia and alcohol being recovered by distillation. In this way the colouring matters and a large portion of other organic and mineral matters taken up from the sugar can be removed. This process has been worked on the Continent, but only experimentally in this country.

Removal of Iron.

Magnets have been used to remove the iron existing in the metallic state or as magnetic oxide, and we have found that a considerable amount can be removed in this way. The plan of souring the charcoal, as it is generally called, is often used as a means of improving the quality of old charcoal. The method of working is as follows: A cistern of charcoal, from which the sugar is nearly removed by washing, is allowed to stand for some days to ferment, when the sugar is converted into acetic and other organic acids, which act upon the calcic carbonate and sulphide, and, to some extent, dissolve the iron also. The resulting soluble lime and iron salts are removed by washing, and the charcoal, on being re-burned, generally shows a marked improvement.

In revivifying char, a curious deposit or scale forms inside the kiln pipes; this consists of ferrous sulphide. The sulphur possibly is derived from the sulphurous acid in the flue gases which finds its way through the porous red-hot cast-iron, and, meeting with reducing gases given off from the charcoal, is reduced to sulphur, which combines with the iron in the cool interior surface of the pipe, or, as it has been suggested, it may be formed from the sulphur existing as calcium sulphide in the char.

We have to acknowledge the kindness of Messrs. J. T. Hunt and Son, of Stratford, who have furnished us with the samples of charcoal exhibited, and also with those used in our experiments. We also acknowledge the assistance of Messrs. Manlove, Alliott, Fryer, and Co., of Nottingham, and Messrs. J. Buchanan and Son, of Liverpool, who have supplied the diagrams for the char cisterns and kilns.

In conclusion, we are aware that, owing to the shortness of the time at our disposal this evening, and from other causes, we have not done justice in the way we should have wished either to our subject, or to the labours of Wallace, Patterson, Stammer, Scheibler, and other investigators in this still, to a great extent, unexplored field of research.

* * *

NOTE ON CAMPHOROGENOL.

BY HIKOROKURŌ YOSHIDA.

In answer to an inquiry as to whether the main constituent of camphor oil, which yields camphor and water when heated for some time at or near 200° C., may not be a peroxide, and give hydrogen peroxide when shaken with water, I wish to state that camphorogenol shaken with water does not impart to it the least power of reacting with chromic acid. Even with Schönbein's iodide test for hydrogen peroxide, the indication is so very slight as to be of a most doubtful character.

* * *

Meeting held May 28th, 1888.

MR. D. HOWARD IN THE CHAIR.

Mr. Lewis T. Wright's paper on "The present position and prospects of the Coal Gas Industry" will be published during the recess.

* * *

Dr. Armstrong's paper on "The Synthesis of the Alkaloids, &c." will be published during the recess.

Liverpool Section.

Chairman: Prof. J. Campbell Brown.
Vice-Chairman: Dr. F. Hurter.

Committee:

J. Affleck.
E. G. Ballard.
Ernest Bibby.
H. Brunner.
J. C. Gamble.
D. Herman.
J. W. Kynaston.
E. K. Muspratt.
Jas. Simpson.
A. Norman Tate.
A. Watt.

Hon. Local Sec. and Treasurer:
W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

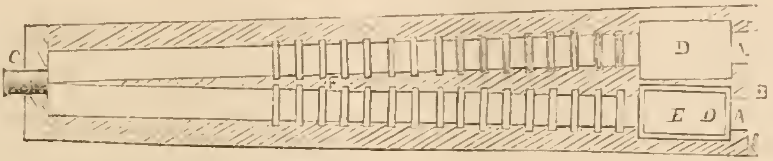
Meeting held June 1888, *at University College, Brownlow Street.*

PROF. J. CAMPBELL BROWN IN THE CHAIR.

A DESCRIPTION OF THE TINTOMETER, WITH SOME REMARKS ON ITS APPLICATION TO CHEMICAL ANALYSIS.

BY J. W. LOVIBOND.

In a paper of this nature it would be out of place to enter further into general laws than is necessary for the purpose of illustration. I have therefore confined my remarks, as far as possible, to a description of the construction and use of the instrument, which consists of a tube divided by a central taper partition B terminating in a knife edge at the eye-piece C. This knife edge, being inside the range of vision, is not seen when the instrument is in use. At the other end of the instrument are two apertures D D, of equal value, alterable in size and shape by means of diaphragms. The two apertures are here divided by the thick end of the central partition B, which, together with the sides, is recessed by grooves in order to hide the edges of the standard glasses and of the vessels placed in the tube for observation The top is provided with slots in line with the grooves, to admit and guide the standard glasses; and the whole is arranged in such a manner that the only light which can reach the eye must pass in equal quantities on each side of the partition, up the two tubes, illuminating the object under examination on one side and the measuring glasses on the other. A reference to the diagrams and to the standard instrument and glasses on the tables before you will show the arrangement.



For measuring colour in opaque objects the instrument is fitted to a hinged stand, capable of being placed at such an angle as reflects the light from the whitened bottom and sides through the tubes to the eye, so that on looking through the eye-piece two white equal fields of view are seen. The object to be measured is placed on the stage under one tube, and the standard glasses worked in the other, against the white background.

The instrument as now shown is the sum-total of attempts to overcome difficulties which were discovered and met in detail whilst carrying on colour investigations of a commercial character, and until remedied made the work unreliable and misleading. The causes of error were traced to many and various sources: to the intensity of light from opposite directions morning and evening, to the lights and shadows cast by large objects both outside and inside the room, to the window or apparatus not being central, to the bars of the window, and even to reflection from the section of wall outside the window. Also, until tubes were discarded in favour of parallel-sided vessels, the convexity of the tubes, which magnified these errors as by a lens, caused disappointment, after apparently obtaining a perfect balance of colour, to find that a small alteration of position entirely upset the most careful reading.

The Standard Glasses

Consist of coloured slips cut to a size fitting the grooves of the instrument. The slips are arranged in series, all the slips of each series are of the same colour, varying only in depth of colour; the variation is in regular degrees, each degree being of the same tint-value as that chosen for the starting point or unit of the series. Thus a single glass of 10 degrees tint-value has the same value as 10 glasses, each of one degree. Every slip is marked with the number of degrees or the tint-number which it represents, and also with a denominational or *colour-number* showing to which series the slip belongs.

The tint formed by the superposition of several glasses belonging to the same colour series is equal to the aggregate of tint-numbers on the glasses used, whilst the superposition of glasses from several series gives a compound colour which follows the laws applicable to the mixture of pigments, in contradistinction to the laws belonging to the mixture of spectrum colours.

The Unit.

In fixing the value of the unit the first effort made was to find a basis of common value applicable to all colours, but the unequal absorption of light by different colours proved an effectual barrier, some building into darkness by superposition of glasses at a much quicker rate than others, thus, with a medium north day light a red requires 77 of its own units, a blue 222, and a yellow 239. The differences are still greater in more composite colours.

From this it was evident that each colour having its individual rate of absorption, it must have its individual progressive unit, which, with a few exceptions, is not applicable to another colour.

This enforced limitation of the value of each unit to its own colour is, as regards a common basical unit, restrictive, but beyond that point very expansive, permitting the unlimited addition of new colours for standards without in any way altering the value of those already in use, or interfering with the value of registered work previously done. It was ultimately decided that the eye being the sole judge of difference, and noting that the powers of differentiation decreased as the tint increased in depth, the tint unit should be as light as consistent with the possibility of the addition of a single unit being distinguishable in the deeper shades; while for lighter shades, where the perception is keener, the tint unit may be divided, if necessary, into decimals of the original unit. The range of colour which can thus be brought to measurement is very wide, ranging from most of the brilliant aniline colours to the dingiest cloth, the only apparent limit lies in the variety of coloured glass obtainable for standards.

Measurement of Luminous Bodies.

Adopting Professor Church's definition of all visible bodies as being either luminous or illuminated, I propose first to deal with luminous bodies in reference to their measurement for intensity and colour.

For Intensity.

To measure for intensity, having closed one tube by a stop, it is necessary to pass the rays to be measured through the other tube, under definite conditions as to distance, area, screen, or other governing influences, then intersecting these rays with graded glasses of a neutral tint, until the light is entirely blotted out, when the number of degrees required to accomplish this can be read off and will be an index of intensity.

For Colour.

Circumstances have prevented much attention being as yet given to the colour of illuminants, and I can do little more than suggest some few precautions which would probably occur to any investigator. Rays from the illuminant should be caught on a screen commanded by one tube under known conditions, as already described in measuring for intensity, whilst the other tube should command a standard white field of view against which to work the measuring glasses.

One of the instruments on the table is roughly arranged to show the spectrum nature of the coloured light from red, blue, and green glass reflected from a whitened surface, and passed up one of the tubes, the glasses themselves being kept out of sight, as against the pigmentary nature of colours obtained when similar glasses are superimposed in the other tube; the use of graded glasses gives a new interest to this class of investigation.

MEASUREMENT OF ILLUMINATED BODIES.

Transparent.

For measuring and recording tint and colour in transparent liquids, a graduated series of accurately gauged vessels with parallel colourless glass ends are adapted to the instrument. These range in thickness from $\frac{1}{16}$ of an inch to two feet, the smaller vessels being suitable for the darker liquids, whilst the blue colour in distilled water can be easily measured in two feet. Care must, however, be given both in the distillation and to the pure whiteness of the background.

When the colour of a liquid represents a property or substance the graded glasses of different lengths and the colour-scale afford a ready means of quantitative estimation of extreme nicety and ease of management, carrying the accuracy of the balance beyond weighable quantities down to the smallest colour trace, as well as being available for larger percentages. The method has been applied to the estimation of colour in dyes, Nessler's ammonia test, carbon in steel, copper both as nitrate and ferrocyanide. It is also under examination for lead as sulphide; here the presence of iron would be a disturbing element. There must be many such possible applications, which would often effect a saving of time and labour by avoiding the necessity of evaporation, drying, and weighing, as well as estimating percentages too small for the balance.

The conditions to be complied with, are, first the colour must bear a definite relation to the substance producing it, and must be in most cases matchable by the glasses of a single colour series. Then by means of a solution of known strength in one of the gauged glasses, the percentage of substance represented by the tint of a single unit must be found by direct experiment. In estimating an unknown sample of a similar substance, it would therefore be theoretically only necessary to use the same gauged glass, and multiply the units required to match it by the percentage value of a single unit; but this cannot always be done, as the progressive variations in the colour properties of different substances require great care before finally deciding on the percentage value of a single tint-unit, for the law of regular progression does not always hold, and percentage estimations by means of colour can only be made within this law. The great majority of coloured solutions will, however, at some point of dilution, give the necessary conditions for a quantitative estimation.

In making preparations for colour testing by methods now in use, such as Eggertz' carbon test, and Nessler's ammonia test, the apparatus should be specially useful as a check upon all possible errors which may arise in preparation, and by bringing the practice of all laboratories to a common standard of reference. It is also found useful in noting and recording changes of colour and tint caused by chemical action, time, or other cause.

Opaque Objects.

In measuring colour in opaque objects the instrument is fitted to hinged stand capable of being placed at such an angle as reflects the light through the tubes from a stage on which is placed the object under examination, and a pressed plaster of Paris reflector as a standard white to measure from, or the substance to be compared or matched.

The calls upon my time in working out the details of construction, obtaining, and grading the coloured glasses, have been such that I must ask your indulgence for any faults of style, lucidity, and expansiveness in this paper, and I am also painfully conscious of having only touched the fringe of this comparatively new subject.

DISCUSSION.

The CHAIRMAN said that his attention had been attracted to Mr. Lovibond's tintometer when endeavouring to find a reliable means of measuring and recording the colour of potable waters, especially those of the peaty class, the great difficulty being to find a series of standard colours for comparison which could be at once permanent and easily multiplied. He had found the tintometer answered every purpose admirably, and considered it more accurate, more easily used, more permanent and uniform, and applicable to a greater variety of purposes than any other colour meter which had been introduced into the laboratory. The instrument must not be blamed if it did not accomplish impossibilities; for instance, there were mixtures of coloured substances whose resultant colours did not express the ratio of their constituents. The tintometer could not give a correct estimation of such substances as these; but it would correctly record the resultant colour.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in the Evaporating of Liquors containing Salts and in the Separation of those Salts. G. I. J. Wells, London. From S. Pick, Szczakowa, Galicia. Eng. Pat. 5124, April 6, 1887. *8d.*

THE new evaporating apparatus is based upon the same principle as the so-called Rillieux apparatus used in beet sugar works, though only for evaporating clear liquors up

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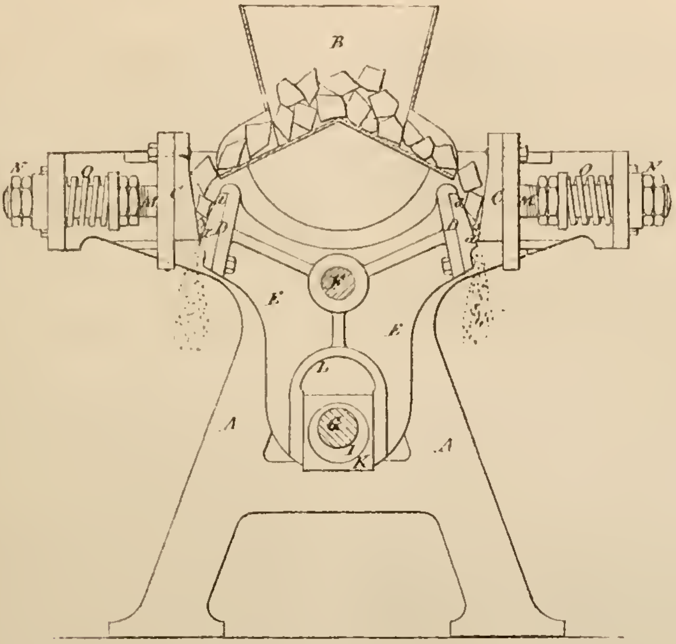
[*] Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed *8d.*			....	½*d.*
Above *8d.*, and not exceeding			1*s.* 6*d.*	1*d.*
„	1*s.* 6*d.*,	„ „	2*s.* 4*d.*	1½*d.*
„	2*s.* 4*d.*,	„ „	3*s.* 4*d.*	2*d.*

to a certain strength. In the improved apparatus liquors may be evaporated, from which salts are continually precipitating. There is considerable resemblance in design and effect to the "triple-effect" vacuum evaporator. At the bottom of each of the three evaporators is a sluice-valve permitting the salts which fall to deposit on a vacuum filter in which the liquor is withdrawn from them and returned to the evaporator.—W.S.

Improvements in Reducing or Grinding Hard Substances, and in Machinery or Apparatus employed therein. J. F. Brinjes, London. Eng. Pat. 6951, May 12, 1887. 8*d.*

The apparatus herein described aims at the reduction of substances by the combined and simultaneous action of impact and abrasion. The drawing annexed shows one of the forms of apparatus by which this is effected. A is the framework of the machine carrying an eccentric shaft G in bearings driven by a pulley. E is a reciprocating lever, pivoted at F, and carrying curved jaws D, which approach and oscillate in front of the fixed jaws C. The material under operation is fed in from the hopper B, and, as will readily be seen, is subjected not only to impact but to a rubbing action by the motion of the reciprocating curved jaws. O is a spring controlling the jaw C, enabling it to give way if any substance of undue hardness is introduced. The jaws C in some cases have a reciprocating motion similar to that of D imparted to them.—C. C. H.



Improvements in Filters. T. Nelson, Haslingden. Eng. Pat. 7466, May 23, 1887. 8*d.*

The patentee purposes to replace the sponge commonly used in the ordinary form of domestic water filter by an inverted conical-shaped vessel, provided with a central syphon pipe; the interior of such vessel is packed with filtering material held between perforated plates. A similar vessel is also employed in the centre of the filter above the outlet. Water introduced into the filter rises and syphons through the inverted conical vessel, and passes by the central pipe into the body of the filter; hence, any solid matter suspended in the water is not carried into the interior of the filter.—C. C. H.

Improvements in the Construction of Filter Presses. S. H. Johnson and C. C. Hutchinson, London. Eng. Pat. 9521, July 5, 1887. 8*d.*

The improvements herein described consist in forming the loose head or follower of a filter press with a hollow boss and a loose or sliding block, against which the end of the closing screw bears. The follower is also mounted on wheels, so that when it is desired to open the machine this may be accomplished quickly by dropping the block, without running back the screw as heretofore, and the follower can be then run back, telescoping over the screw. This is of special utility when the thread of the centre screw is of fine pitch. The screw is also tightened up by gear wheels and its thread is formed of a buttress section, so that even at high pressures the force requisite to close the press can be obtained by one man, and the time of opening or closing the machine reduced to a minimum. The patentees claim the several combinations of the parts required to carry the various arrangements into operation.

—C. C. H.

II.—FUEL, GAS, AND LIGHT.

On the Purification of Coal-Gas by Iron Oxide and Lime. G. Frère. J. des usines à gaz, 12, 8.

Many gasworks in England remove carbonic acid from illuminating gas by absorption with lime, whereas this method of purification has been nearly abandoned in Germany. The author tested the illuminating power of coal-gas, half of which passed through an iron oxide purifier, whereas the other half passed through a lime purifier. In both cases the luminosity, tested by the jet-photometer, was nearly the same, although the gas contained before the purification 1 per cent. of carbonic acid. It therefore appears that lime not only absorbs the carbonic acid but also a portion of the light-giving heavy hydrocarbons, whereby the increased luminosity caused by the absorption of carbonic acid is again diminished.—S. H.

PATENTS.

Producing Intense White Light. J. Imray, London. From C. Clamond, Paris. Eng. Pat. 2110, May 24, 1880. 8d. Amended Specification.

The reference here is to the production of intense light by igniting refractory material such as lime with a gas jet, the combustion of which is supported by air previously heated. Alternatively the flame may be produced by the combustion of solid carbonaceous material in heated air. Originally, along with the construction of specific apparatus, the patentee claimed the above-mentioned method of producing intense light and also the use of a sub-divided refractory body for purposes of ignition. The amendment consists in the abandonment of these two last claims.—A. R. D.

An Improved Process of Treating Tar for the Purpose of Producing Illuminating and Heating Gas and Coke. W. Bäcker, Budweis, Germany. Eng Pat. 7811, May 28, 1887. 6d.

Tar is intimately mixed with finely-divided coke, coal, soot, cement, or wood shavings, and subjected to a process of distillation similar to that in vogue in oil-gas works. Care must be taken to introduce the mixture directly into the hottest part of the retort.—A. R. D.

Improvements in Incandescence Gas Burners. J. Imray, London. From C. Clamond, Paris. Eng. Pat. 7990, June 2, 1887. 8d.

These improvements relate to that class of burners wherein a gas flame supplied with heated air is employed to heat to incandescence a magnesia hood. For magnesia alone it is now proposed to substitute a mixture of magnesia with from 15 to 20 per cent. of its volume of zirconia, which gives a more durable hood and a more agreeable light. The gas issues from a ring of small holes on the inside of an annular burner, and above the flame thus produced the hood is suspended from a wire suitably bent. The burner is enclosed with a chimney, and outside of this a glass bowl is so placed that the air required for combustion has to pass downwards between the chimney and the bowl, and is thus heated before reaching the burner. In the case of an inverted light the hood is suspended in a net of fine platinum wire.—A. R. D.

A novel Manufacture of Coke in Plain or Block Form for Metallurgical and other Purposes. A. Tack and F. Girard, Brussels, Belgium. Eng. Pat. 3802, March 12, 1888. 4d.

This "invention consists in manufacturing good coke by using semi-fat coals exclusively, or lean coals mixed with about one-third of fat coals, making use in both cases of the common coke ovens." Blocks or briquettes are moulded from the coal in the ordinary way with the aid of pitch or other agglutinating matter, and piled upon a metal plate in the retort.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Paraffin in Petroleum. R. Zaloziecki. Zeits. f. ang. Chem. 1888, 261—263.

The object of the present investigation is to ascertain whether paraffin is present as such in petroleum, or is formed by the subsequent treatment to which the oils are subjected, also whether the product thus obtained is identical with paraffin from other sources. The author was led to undertake this research by an observation made by Engler and himself independently, namely, that on subjecting petroleum residues to distillation, a crystalline paraffin is obtained, whilst the solid products prepared direct from petroleum are invariably amorphous in character, and resemble ozokerite in appearance. He has successfully prepared paraffin from ozokerite in the following manner:—Ceresine (bleached ozokerite) melting at 65° was dissolved in an excess of warm amyl alcohol. The mass which separated on cooling was found to be distinctly crystalline, being composed of minute nacreous plates. It was thrown on a filter, pressed and recrystallised repeatedly from amyl alcohol. The final product formed after fusion and solidification a translucent distinctly crystalline substance resembling paraffin in properties. The ingredients in solution in the different alcoholic fractions were pasty and soft, that from the original solution having a melting point of 32°—33°.

This result appears to show that in addition to the true crystalline paraffin ozokerite contains other colloidal constituents (amorphous paraffin), which hinder the crystallisation of the paraffin, but are more or less completely removed by amyl alcohol, owing to their greater solubility. The author expresses the opinion that the change in crystalline structure exhibited by the different fractions from the distillation of ozokerite is due to a similar cause; in this case the retarding ingredients are either converted or decomposed.—D. B.

German Petroleum. C. Engler. Dingl. polyt. J. **267**, 555–570, 592–597, and **268**, 76—90.

After giving a complete resumé of the investigations concerning the constitution of German petroleum, with numerous references to investigations previously published, the author describes in detail the petroleum oils found in different parts of Germany.

The oil from the Pechelbronn wells has a specific gravity of 0·878—0·885, and consists essentially of a mixture of saturated hydrocarbons. From the fraction distilling below 150°, pentane, hexane, and nonane (indirectly from nonylene) were isolated. The fractions boiling between 160° and 182° contain aromatic hydrocarbons, mainly pseudocumene and mesitylene, whilst the higher boiling distillates yield paraffin. In the vicinity of these wells natural gas issues from the soil, accompanied by flows of salt water. This gas contains marsh gas, olefines, carbonic oxide, carbonic anhydride, and nitrogen.

The Oelheimer and Wietzer petroleum oils have a specific gravity of 0·905—0·910; they yield nothing below 150°, and only a small percentage of distillate below 200°. They are consequently of very little value for illuminating purposes, but are of great utility as lubricants. They contain saturated hydrocarbons and the hydrides of aromatic hydrocarbons, but are almost free from paraffin.

The Tegernsee oil has a specific gravity of 0·812, and resembles the Pechelbronn oil in properties. It is especially rich in aromatic hydrocarbons, 50 grms. of the fraction boiling between 160° and 185° yielding 0·56 grm. of the double trinitro compound of mesitylene and pseudocumene. The author infers from these results that all German petroleum oils contain aromatic hydrocarbons.

In conclusion, the manufacture of lubricating oils from the Oelheimer petroleum residues is discussed in detail. As these oils are almost free from paraffin, it is possible to prepare a number of valuable lubricants therefrom. This may be done even without subjecting the residues to distillation. The Pechelbronn residues, after being freed from paraffin, are also well adapted for lubricating purposes. The author is of opinion that Krey's method of distillation under diminished pressure might be applied with great advantage to the treatment of these residues, the object being to obtain lighter oils which might be used for illuminating purposes.—D. B.

PATENTS.

Improvements in the Manufacture of Carbolic Acid and other Tar Acids. J. W. Knight, Cambridge, and W. D. Gall, Little Shelford. Eng. Pat. 5824, April 21, 1887. 6*d.*

The carbolic oil is treated with lime and agitated with a hot solution of sodium sulphate, the carbolate of lime first produced being converted into carbolate of soda with simultaneous formation of calcium sulphate. The watery liquid containing carbolate of soda is drawn off and decomposed with sulphuric acid. The carbolic acid rising to the top is then separated from the lower liquid, which consists of a solution of sodium sulphate ready to use for another treatment with a fresh quantity of oil. The exhausted oil may be passed through filters in order to remove the calcium sulphate.—D. B.

Improvements in Primary Distilling Apparatus for Shale or other Oil-yielding Mineral. W. M. Fraser and J. Snodgrass, Pumpherston Oil Works, Midlothian. Eng. Pat. 7867, May 31, 1887. 8*d.*

This invention is applicable to existing retorts as well as to the construction of new retorts. Such retorts are vertical, the upper parts are of cast-iron or fire-brick, whilst the lower parts are built of fire-brick. Each retort on one side of a series is dealt with as a pair with the retort adjacent to it on the opposite side, and the lower parts of each pair of retorts are built of a form of brickwork, which is rectangular in horizontal section, the compartments for the two retorts being divided by a brickwork partition having no flues. Flues are formed round the pair of lower parts for the passage of ignited gas to heat them, the gas finding its way into the oven space in which the upper parts of the retorts are placed, and from thence into a chimney. Thus overheating of the middle adjacent parts of the two lower retort spaces of a pair is avoided, and the formation of clinker at those parts prevented.
—D. B.

Improved Process of Distilling Petroleum. W. H. Pitt and G. H. Van Vleck, Buffalo, U.S.A. Eng. Pat. 3830, March 13, 1888. 8*d.*

In refining petroleum oils possessing a strong odour of garlic by the usual methods, it is not only difficult to remove the offensive smell, but the operation is greatly retarded or almost abandoned on this account. The object of this invention is to overcome this difficulty. The process consists in passing the hot vapours arising from the distillation of such petroleum oils over a heated metallic compound, applied in a fine state of division, which effectually deodorises the vapours. The material employed as deodoriser must have a strong affinity for the sulphurous vapours, iron being most suitable owing to its cheapness and durability.—D. B.

IV.—COLOURING MATTERS AND DYES.

Note on some Samples of West African Indigo. C. Rawson and E. Knecht. Jour. Soc. Dyers and Colourists, 1888, 66.

The samples examined were sent to the Bradford Technical College by Sir George T. Goldie, Deputy Governor of the Royal Niger Company, in order that he might glean information as to their commercial value.

The first specimen consisted simply of the leaves of the plant made up into balls varying in size from 2 to 4 ins. in diameter. In colour they varied from a dark brown to a dark dirty blue, and possessed, especially when boiled with water, a strong odour resembling that of cow's dung.

The substance was found to contain a large amount of a brown colouring matter soluble in water, and which it was necessary to remove as completely as possible before the indigotine could be estimated.

The determination was made as follows:—About 30 grms. of the dried and ground sample were first treated with boiling water for the purpose above-mentioned, and then reduced in a large closed flask with an alkaline solution of sodium thiosulphate. The reduction completed and the liquid settled, a known volume of the clear portion was then drawn off, the residual liquid being subsequently measured. The solution was then oxidised by aspirating a current of air through it, and after acidulating with hydrochloric acid the precipitate was collected on a weighed filter, washed with hot water, dried at 110°, and weighed. A weighed quantity of the precipitate was then dissolved in concentrated sulphuric acid, diluted with water to a known volume and an aliquot part titrated with a standard solution of potassium permanganate. The composition of the product was found to be:—Indigotine = 0·51, moisture = 14·75, organic matter sol. in water = 23·50, mineral and other matter = 10·11, organic matter insol. in water = 51·13 per cent. Besides the substances named the new product contained a considerable quantity of a green colouring matter insoluble in water, but easily soluble in strong sulphuric acid with an olive-brown colour. It is easily soluble in caustic soda with a dark green colour, from which solution it is completely precipitated by dilute sulphuric acid. Thus separated from the indigotine it was obtained as a dark green powder, on heating decomposing without sublimation and evolving the vapours of an oily substance. Aniline oil dissolves it with a fine green colour, and it is reduced by an alkaline solution of sodium thiosulphate.

The authors suspect that in an early stage of the manufacture a secondary fermentation has ensued, by which probably part of the indigotine has been converted into the brown and green substances already described.

It is well known in India and elsewhere, unless the greatest care is taken in the fermentation process, much of the indigo is lost by this secondary reaction, the ultimate product containing a large quantity of similar brown and green by-products. From such considerations the opinion is expressed that by careful treatment the African-grown indigo-plant ought to yield a much larger quantity of indigotine.

Three other samples obtained from Lagos were also examined, and in none of these was there any appreciable quantity of indigo present. The first of three further specimens, very different from the last, furnished a product of a much redder cast than ordinary indigo. It contained an exceptionally large proportion of indirubine and a quantitative analysis gave the following results:—Water = 7·50, indigotine = 39·12, indirubine = 4·75, foreign organic matter = 29·17, ash = 19·46 per cent. The other two specimens were very similar.—W. S.

Laws governing the Substitution of the Aromatic Amines. L. Limpach. Ber. **21**, 640—642.

The substitution of methyl for hydrogen in the benzene ring in aromatic amines was examined by the author in the following manner:—The substitution was effected by heating one mol. of the hydrochloride of the base with one mol. of methyl alcohol at 250°—300° under pressure.

Aniline hydrochloride treated in this manner yields paratoluidine with small quantities of a mixture of 1:3:4 metaxylidine and mesidine. Ortho- or meta-toluidine are not, however, produced. Hence the methyl group first occupies the para position with formation of paratoluidine, it then enters one of the ortho positions forming 1:3:4 metaxylidine, and finally takes up the second para position yielding mesidine. Ortho- and para-toluidine give similar results, both forming 1:3:4 metaxylidine and mesidine.

1:3:4 metaxylidine hydrochloride gives only mesidine, a result which confirms the researches made by Hofmann. In this case the attempts made to further methylate the benzene ring were unsuccessful, from which it would appear that the hydrogen atoms occupying the meta position relatively to the amido group cannot be substituted by alkyl groups.—D. B.

Methylation in the Benzene Ring of Symmetrical Metaxylidine. L. Limpach. Ber. **21**, 643—646.

The symmetrical metaxylidine prepared according to Wroblewsky's method was purified by conversion into the formyl compound and by isolation of the base by saponification. The hydrochloride was then methylated as described in the preceding abstract, isocumidine being obtained. This on further methylation gave a new tetramethylamidobenzene and Hofmann's pentamethylamidobenzene (this Journal 1885, 672).

Tetramethylamidobenzene, $C_6H(CH_3)_4NH_2$, crystallises in fine nacreous plates, melts at 66°, and is separated from Hofmann's compound by solution in water, in which the latter does not dissolve. It sublimes readily, boils at 259°—260° (uncorr.) and then solidifies in large prisms. The sublimed product melts at 64°. The formyl and acetyl compounds crystallise in silky needles melting at 143°—144° and 169·5° respectively.

Tetramethylphenol, $C_6H(CH_3)_4OH$, is obtained by dissolving the sulphate of the base in water and heating the solution with the requisite amount of a nitrite. It crystallises from dilute alcohol in long white needles, melts at 80°—81° and boils at 248°—250° (uncorr.). Metatoluidine hydrochloride on methylation yields 1:2:4 orthoxylidine, boiling at 222°. The formyl compound melts at 52°, and the pure base obtained therefrom melts at 47°—48° and boils at 223°. The acetyl compound melts at 96°—98°. Paraxylidine yields crystalline pseudocumidine, which on further methylation forms the tetramethylamidobenzene described in previous communications by Hofmann, Noelting, and Baumann.

—D. B.

Ketonaphthol (*Aceto-α-Naphthol*). H. Erdmann. Ber. **21**, 635—636.

In 1886 the author showed that on subjecting benzallevulinic acid, $C_{12}H_{12}O_3$, to distillation, ketonaphthol, $C_{12}H_{10}O_2$, is obtained. Witt has recently described the formation of α hydroxynaphthyl methyl ketone by sulphonating α-naphthol in acetic acid solution. This compound, although resembling ketonaphthol in some of its properties, is not identical with it. Both substances dissolve in sulphuric acids with a red, and in alkalis with a pure yellow colour, and yield azo-colours by combination with diazo compounds which are similar in shade to the corresponding compounds from α-naphthol. The author's product, however, showed a melting point of 167°, that described by Witt 103°. The former dyes cotton a yellow colour, the latter yields pale green shades. It is sparingly soluble in benzene and gives indophenol reactions with quinonechlorimides. Witt's compound is readily soluble in benzene, does not form an indophenol, but gives a colour reaction with orthonitrobenzaldehyde which ketonaphthol fails to produce.—D. B.

β-naphthylamine-δ-sulphonic Acid and β-Naphthylamine Sulphonic Acid. F. H. Erdmann. Ber. **21**, 637—639.

Bayer and Duisberg have recently described the preparation of β-naphthylamine-δ-sulphonic acid from β-naphthylamine, which is said to be identical with Cassella and Co.'s *naphthylamine sulphonic acid F.* As, however, some investigators appear to throw doubt on the identity of these acids, the author thought it desirable to make known the results which he obtained on converting the amido sulphonic acids into the corresponding dichloronaphthalenes. Both acids were diazotised and heated with phosphorus pentachloride, Clève's δ-dichloronaphthalene being produced in each case.—D. B.

PATENTS.

Improvements in the Production of Colourlike Bodies and of Dialkylised Amidobenzophenones therefrom. C. D. Abel, London. From the "Farbwerke vormals Meister, Lucius and Brüning," Hoechst on the Maine, Germany. Eng. Pat. 5257, April 9, 1887. 6*d.*

The substances used as starting-points are the anilides or naphthalides of benzoic acid, its homologues and substitution products, and of naphthoic acid, &c. The amides of aniline, methyl- and ethylaniline, toluidines and homologues, dimethyl-*p*-phenylenediamine, *m*-phenylenediamine, benzidine and the naphthylamines can be used in this process. The first step is the conversion of these anilides or naphthalides into their halogen derivatives by means of the haloid phosphorus compounds in the usual way, the haloid derivatives being then condensed with tertiary bases, such as the alkyl-anilines and homologues, alkyl-naphthylamines, *o*-anisidine, diphenylamine, phenyl-α and β-naphthylamine, &c. These condensation products are coloured compounds, soluble in water, which dye mordanted cotton of "a vivid yellow-orange to red-brown shade." They are readily decomposed by boiling with acids, the primary or secondary amine splitting off and the tertiary amine remaining attached to the benzoyl-residue in the form of a ketone. The following example illustrates the working of the process:—Benzanilide (20 parts), dimethylaniline (40 parts), and phosphorus oxychloride (20 parts), are mixed with agitation and heated on a water-bath till the temperature begins to rise spontaneously, when the heating is stopped and cooling resorted to if necessary. At the beginning of the reaction the temperature is not allowed to rise above 105°—110°. The operation is completed by heating on the water-bath for two hours.

The condensation-product can be obtained in the form of its free base by making the melt alkaline with dilute ammonia, diluting with five volumes of water and then adding dilute hydrochloric acid till the oil is entirely dissolved. The residue is separated by filtration and crystallised from alcohol; the base is obtained as a yellowish white crystalline powder melting at about 152° C. In order to obtain dimethylamidobenzophenone from the condensation-product, the melt is heated with 40 parts hydrochloric acid and 200 parts water till it is completely decolourised, filtered to remove unaltered benzanilide, and the filtrate diluted with 1,000 parts water, when a part of the ketone-base separates and the remainder is thrown out by soda lye. The precipitate is filtered off and the filtrate treated for the recovery of aniline and dimethylaniline.

—R. M.

Processes for the Production of Azo-colours that Dye Cotton direct from a Soap Bath. C. D. Abel, London. From the "Actiengesellschaft für Anilinfabrikation," Berlin, Germany. Eng. Pat. 6687, May 6, 1887. 8*d.*

The colouring matters claimed in this specification are arranged under four groups:—A. From diazoamido-compounds of tetrazodiphenyl and its homologues. The diazoamido-compound is in this method first prepared by the action of the diazotised benzidine, &c. upon the sulphonic acids of amidoazobenzene and homologues, one molecule of tetrazodiphenyl combining with two molecules of the amidoazosulphonic acid. The resulting diazoamido-compound is then allowed to act upon a salt of naphthylaminesulphonic acid, when the amidoazo-acid residue is easily replaced by the amidosulphonic acid residue with the formation of a secondary azo-colouring matter and the liberation of the amidoazo-acid. Thus one molecule of tetrazodiphenyl is first combined with two molecules of amidoazobenzenedisulphonic acid, and the diazoamido-compound then mixed with the necessary quantity of sodium naphthionate when Congo Red is formed and amidoazobenzenedisulphonic acid regenerated. The colouring matters are easily separated by the addition of hydrochloric acid to the aqueous solution, the Congo Red acid alone being precipitated. B. Mixed azo-colours from naphthylaminedisulphonic acids. Four examples are given in illustration of this method:—(1.) An intermediate compound is first produced from diazotised benzidine and β-naphthylaminedisulphonic acid R. (one molecule of each), and this is then made to act on β-naphthylamine (one molecule) till the desired secondary azo-colour is formed. (2.) Intermediate product from tetrazodiphenyl and the same disulphonic acid as before and then β-naphthylaminemonosulphonic acid. (3.) Intermediate product as before and allowed to act upon phenol. (4.) Intermediate product as before and then α-naphthol. (1) dyes cotton of a red similar to Congo, but more stable towards acids, (2) dyes cotton of a bright red which resists acids, (3) is a bright orange, and (4) a reddish-brown shade. C. Mixed azo-colours from diazotised benzidine and homologues with salicylic acid and α-naphtholdisulphonic acid. The intermediate product from tetrazodiphenyl and salicylic acid is combined with a second molecule of *m*-phenylenediamine (brown), α-naphthylaminesulphonic acid (yellow red), β-naphthylaminesulphonic acid (reddish yellow), phenol (yellow), resorcinol (yellow red), and the naphtholsulphonic acids which give various shades of red and brown. The intermediate product from tetrazodiphenyl or tetrazoditolyl and α-naphtholdisulphonic acid is combined with a second molecule of phenol, α-naphthol, α-naphtholsulphonic acid, or β-naphtholdisulphonic acid. The latter compound gives a blue colouring matter. D. Azo-colours from paradiamidoazobenzene, its homologues and derivatives. The base is the symmetrical paradiamidoazobenzene of Nietzki, three examples being given in illustration of its employment:—(1.) Tetrazo-salt of base (one molecule) and α-naphthylaminemonosulphonic acid (two molecules). Dyes cotton of a red violet shade. (2.) Tetrazo-salt and α-naphtholmonosulphonic acid. Dyes cotton violet. (3.) Tetrazo-salt and β-naphtholdisulphonic acid. A blue colour.—R. M.

Processes for the Production of Yellow, Orange, and Red Colours by the Action of Phenanthrene-quinone, Isatine, or Methyl-isatine upon the Sulpho-acids of Aromatic Hydrazines. C. D. Abel, London. From the "Actiengesellschaft für Anilinfabrikation," Berlin, Germany. Eng. Pat. 6688, May 6, 1887. 6*d*.

The hydrazinesulphonic acids employed are prepared by reducing the diazosulphonic acids by stannous chloride in the usual way. The colouring matters are condensation-products of which the sodium salts are soluble in water and dye wool from an acid bath of a yellow or red colour. They are produced simply by heating the phenanthrene-quinone, isatine, &c. with an aqueous solution of the hydrazinesulphonic acid. In combination with phenanthrenequinone the hydrazinesulphonic acids from the following amines are mentioned :—Sulphanilic and benzene-*m*-amidosulphonic acid (orange); *o*-toluidine-*p*-sulphonic and *p*-toluidine-*o*-sulphonic acids (orange); β-naphthylaminemonosulphonic acids (yellowish red); naphthionic acid (dark red); benzidinedisulphonic acid from *m*-nitrobenzenesulphonic acid (brownish red). An example giving the practical method of producing the colour from α-naphthylhydrazinesulphonic acid and the quinone is described in the specification. The corresponding sulphonic acids give with isatine and methyl-isatine colouring matters of various shades of yellow. An example illustrating the mode of working in this case is also given.—R. M.

A Process for Producing a New Monosulpho-acid of α-Naphthol. A. Liebmann and A. Studer, Manchester. Eng. Pat. 7812, May 28, 1887. 6*d*.

One part of α-naphthol is heated with four parts of strong sulphuric acid to 130° C. for about an hour, and the mixed acids converted into their barium salts. The latter are suspended in 10 parts of water, the liquid saturated with hydrochloric acid gas, and heated with a reversed condenser for two hours. The excess of hydrochloric acid is then evaporated off on a water-bath, the residue dissolved in water, the barium sulphate formed by the hydrolysis of the sulphonic acids filtered off, and the solution of the new sulphonic acid neutralised with barium carbonate. The barium salt is readily soluble in water and dilute alcohol, and can be purified by crystallisation from the latter. The new monosulphonic acid does not lose its sulphonic group on nitration, but yields dinitro-α-naphtholmonosulphonic acid: it combines with diazo-salts to form azo-colours. Modifications in the mode of working the process are described in the specification.—R. M.

Improvements in the Treatment and Preparation of Naphthazarine (Dioxynaphthaquinone) and the Production of a soluble Derivative thereof and the Application of the same in Dyeing and Printing. J. Y. Johnson, Lincoln's Inn Fields. From the "Badische Anilin und Soda Fabrik," Ludwigshafen on the Rhine, Germany. Eng. Pat. 7833, May 28, 1887.

The inventors commence by pointing out that the want of success which has hitherto attended the attempts to employ naphthazarin for dyeing and printing is partly due to the insolubility of the colouring matter in water and partly to the want of a suitable mordant. The chrome-lakes have been found suitable for this purpose if produced within or upon the fibre, the colours thus produced varying from intense black to light grey and resisting the action of light and air, soap, or acids. The chrome-lakes of naphthazarin can be used in combination with those of other colouring matters, such as alizarin, &c., and thus serve to deaden the brilliancy of the latter when required. In order to produce the chrome-lake a 10 per cent. naphthazarin paste is employed and the dyeing effected with chromium mordants in the usual way. The following example illustrates the method of producing a fast black:—100 parts of cleansed wool are boiled for 1½ hours with water containing three parts of potassium dichromate and about 2½ parts of "bitartrate of potash." The goods are washed and immersed in a dye-bath containing about 40 parts of the 10 per cent. paste and a little acetic acid to neutralise the calcium carbonate in the water. The bath is kept at the boiling point for 2—3 hours till exhausted. Grey or slate coloured shades are produced by using a smaller proportion of naphthazarin paste. In order to convert the colouring matter into a soluble compound 100 parts of 20 per cent. paste are mixed with 35 parts of a solution of sodium bisulphite (1·357—1·383 sp. gr.), and the mixture digested at 50°—70° C. for about eight days or at 100° C. for about half a day. The product is "Soluble Naphthazarin," and is converted into a marketable form by evaporating the aqueous solution to dryness, or by salting out the colouring matter, collecting, pressing, and drying. The dry substance is a dark brown powder readily soluble with a brown colour in hot or cold water, the solution showing a strong bluish-green fluorescence. The soluble compound is very stable towards acids and readily decomposed by alkalis with the formation of the original insoluble naphthazarin. The application of "soluble naphthazarin" to printing by means of chromium acetate mordant and decomposition by steaming in the usual way is described in the specification.
—R. M.

The Manufacture of a New Naphtholdisulphonic Acid and of Dye-stuffs therefrom. Sydney Pitt, Sutton. From L. Casella & Co., Frankfort on the Maine, Germany. Eng. Pat. 8265, June 8, 1887. 6*d*.

The β-naphtholmonosulphonic acid F. described in Pat. 12,908 of October 9, 1886, can be converted by further sulphonation into a new disulphonic acid which the inventors term β-naphthol-δ-disulphonic acid. In order to prepare this acid the sodium salt of the F-acid is heated with twice its weight of sulphuric acid of 66° B. at 120° C. until a sample gives with α-diazonaphthalene a claret-red colour. The acid is converted into the calcium and then into the sodium salt by the usual methods. The purification of the new acid is best effected by crystallising the barium salt, which is difficultly soluble in boiling water. As examples of the production of azo-colours from the δ-acid the following are given:—(1.) Diazotised aniline and the new acid gives an orange crystallising in leaflets. The homologues of aniline give scarlets. (2.) Napthionic acid gives a claret-red, α- and β naphthylamine give the same colour and β-naphthylaminesulphonic acid gives a scarlet. (3.) Amidoazobenzene gives a dark claret and its homologues darker shades of the same colour. Amidoazonaphthalenedisulphonic acid gives a bluish black. (4.) Benzidine and its homologues, diamidodiphenol-ethers and diamidostilbene, give blue colours of a greenish shade.—R. M.

A Process or Processes for the Production of Colours from Tetrazodiphenyldicarbonic Acid and from its Methyl and Ethyl Ethers. Ludwig Paul, Fürstenberg on the Oder, Germany. Eng. Pat. 8296, June 9, 1887. 6*d*.

The acid referred to is the meta-dicarboxylic derivative of benzidine, The azo-colours to which it gives rise are typified by the following examples :—(1.) The diazotised acid (1 mol.) and β-naphtholdisulphonate of sodium (R salt, two molecules). (2.) The diazotised acid and two molecules of sodium naphthionate. (3.) The diazotised acid and two molecules of diphenylamine dissolved in alcohol and hydrochloric acid. Instead of two molecules of the same amine or phenol, two dissimilar molecules may be combined with the diazotised acid, giving rise to the formation of mixed azo-colours.—R. M.

Process or Processes of Producing Mono- and Diamidoazobenzidines, Transformation of them into Tetrazo-compounds, and their Combination with Amines and Phenols (Naphthols) or the Sulpho-acids of these Bodies. Ludwig Paul, Fürstenberg on the Oder, Germany. Eng. Pat. 8437, June 11, 1887. 8*d*.

The products and processes described in this specification are grouped under three divisions, each containing examples of the mode of working. A. Diamidoazobenzidines and the colours derived therefrom. (1.) The metadicarboxylic acid described in the foregoing specification is diazotised and combined with two molecules of α- or β naphthylamine, or with one molecule of α-naphthylamine and then with a second molecule of another amine, phenol, or sulphonic acid. The colours thus produced dye cotton of a yellowish colour. (2.) The yellow colouring matters formed in the last example are again diazotised and the tetrazo-salts combined with two molecules of β-naphthol sodium disulphonate (R salt) or two molecules of β-naphtholmonosulphonate of sodium. The products dye cotton violet. (3.) The diazotised dicarboxylic acid is combined with two molecules of aniline or its homologues. (4.) The moist precipitate resulting from the last process is again diazotised and combined with two molecules of naphthionic acid (red dye), β-naphtholdisulphonic acid R salt (red dye), or α- or β-naphtholmonosulphonic acid (orange dye). (5.) Benzidine is diazotised and combined with two molecules of aniline or its homologues or the naphthylamines. (6.) The compound obtained in the last example from aniline is again diazotised and combined with two molecules of naphthionic acid (red), β-naphtholdisulphonic acid R (blue), or α- or β-naphtholmonosulphonic acid (violet). (7.) The amidoazo-compound of example (5) from tetrazodiphenyl and aniline is diazotised and combined with two molecules of resorcinol (red). (8.) The last process repeated, resorcinoldisulphonic acid being used instead of resorcinol (bluish red). (9.) Similar colouring matters are produced by substituting for tetrazodiphenyl in examples 1 to 8 tetrazodiphenyldicarboxylic acid and its ethers, the homologues of tetrazodiphenyl, tetrazo-compounds of diphenol and tetrazofluorene and stilbene. B. Monoamidoazobenzidines and colours derived therefrom. The colours referred to in this section are mixed, *i.e.*, contain dissimilar amine or phenol residues. (10.) Diazotised benzidine is first combined with one molecule of aniline and then with one molecule of one molecule of β-naphtholdisulphonic acid R (blue), α- or β-naphtholmonosulphonic acid (violet), or naphthionic acid (red). (11.) Same as preceding, homologues of benzidine being employed. (12.) Monoamidoazobenzidine of (10) and (11) substituted for diamidoazobenzidines of (7) and (8). (13.) Benzidine of (10) replaced by homologues, metadicarboxylic acid and ethers, ethers of diamidodiphenol, diamidofluorene and stilbene or sulpho-acids. (14.) Diamidoazobenzidine :—

$$NH_2.C_6H_4.N_2.H_4C_6.C_6H_4.N_2.C_6H_4.NH_2,$$

prepared from monoamidoazobenzidine of 10 by combination with a second molecule of aniline. C. Transformation of the monoamidoazobenzidines into hydroxyl combinations by boiling with water, diazotising the hydroxyl compounds thus obtained and combining them with phenols, amines, &c. The intermediate products containing one free diazo-group are made use of in this process, the following examples being quoted :—(15.) The intermediate compound from one molecule of tetrazodiphenyl and one molecule of aniline or homologues, or the naphthylamines and their sulphonic acids, is boiled with water till no more nitrogen is evolved. The colouring matters thus formed dye cotton red or yellow : those not containing sulpho-groups are sulphonated by the usual methods. The intermediate products from one molecule of tetrazodiphenyl and one molecule of the naphthols or their sulphonic acids are similarly decomposed by boiling with water. (16.) The compounds resulting from the decomposition of the intermediate products as in the last example can be again diazotised when they contain an amido-group, as in the case of the colouring matter derived from diazotised benzidine (1 mol.) and naphthionic acid (1 mol.) by boiling with water.—R. M.

Improvements in the Manufacture of Colouring Matters C. A. Bennert, Hebburn-on-Tyne. Eng. Pat. 8504, June 13, 1887. 6*d*.

The colouring matters claimed are produced by the action of phenylhydrazine and its homologues, α-naphthylhydrazine, &c. upon the nitrotartaric acid of Dessaignes (Comp. Rend. **34**, 731). Thus the parasulphonic acid of phenylhydrazine gives, with the nitro-acid, a yellow colouring matter, of which the sodium salt is readily soluble in water. The following example is given :—Nitrotartaric acid (8 parts) is dissolved in iced water (10 parts), and mixed with the hydrazinesulphonic acid (12.5 parts), emulsified in water (30 parts) containing a little strong sulphuric acid (0·5 part). The mixture is heated on a water-bath, and a stream of sulphuretted hydrogen passed through, so as just to decompose the nitrous gases. When the reaction is finished the excess of hydrazinesulphonic acid is filtered off, and the colouring matter precipitated in the usual way.

—R. M.

Manufacture of New Azoic Colouring Matters. J. Imray, London. From "La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, Z. Roussin, and D. A. Rosenstiehl, Paris, France." Eng. Pat. 9257, June 29, 1887. 4*d*.

These colouring matters are secondary azo-compounds prepared by combining diazotised amidobenzenesulphonic acids and their homologues, the naphthylaminesulphonic acids, &c. with α-naphthylamine, and then again diazotising the products, and combining with metadiamines or resorcinol. As an illustration the inventors describe the preparation of a colouring matter by the action of diazotised metasulphanilic acid on α-naphthylamine, the resulting compound being diazotised and combined with metaphenylene diamine.

—R. M.

Manufacture of Yellow, Orange, Red, and Violet Azo Colouring Matters. J. Imray, London. From "La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, Z. Roussin, and D. A. Rosenstiehl, Paris, France" Eng. Pat. 9414, July 2, 1887. 6*d*.

The amido-compound, which is the starting point in the preparation of these colouring matters, is produced by the reduction of dinitrobenzil, obtained by the nitration of benzoin (Sagumenny, Ber. **5**, 1100). The first part of the specification treats of the reduction process, which is carried out by boiling the dinitro-compound with soda lye and adding zinc dust (proportions given in specification). When decolourised the liquor is acidified with hydrochloric acid, neutralised with sodium carbonate, boiled, and filtered. The diamido-compound in the filtrate is diazotised and used for the preparation of colouring matters in the usual way, the second part of the specification dealing with the manufacture of the dye-stuffs. Thus the diazotised diamido-compound gives with α-naphthol-α-sulphonic acid a violet dye soluble in water; with metaphenylene diamine a reddish-brown colour. The same diazotised compound gives with β-naphtholdisulphonic acid a violet colour; with the naphthols, red-violet; with naphthionic acid, red; with α-naphthylamine and resorcinol, orange; and with salicylic acid, yellow. All these colouring matters dye cotton from an alkaline bath without a mordant.—R. M.

Production of a New Red Azo-Colour. T. R. Shillito, London. From J. R. Geigy, Basle, Switzerland. Eng. Pat. 9468, July 4, 1887. *4d.*

The colour claimed is prepared by the action of diazotised paranitraniline on α-naphthylaminedisulphonic acid.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENT.

Improvements in the Treatment of Cotton Seed for the Removal of Fibrous Matters therefrom, and in Apparatus therefor. W. H. Stead, Liverpool. Eng. Pat. 10,992, August 11, 1887. *8d.*

In a former patent (No. 13,831, 1884) the inventor claimed the use of commercial sulphuric acid for the purpose of removing the fibre from cotton seed. In the present specification he claims the use of other acids, such as nitric or hydrochloric. After the acid treatment the seeds are shaken up with sand or other pulverulent matter, in order to remove the excess of acid before the treatment with lime.

The seeds are polished by brushing with oil or grease. A modification of the original false bottom of the vessel in which the operations were conducted is also introduced.

—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Process for the Preparation of a more Basic Sulphocyanide of Aluminium. J. Hauff.

Basic sulphocyanide of aluminium can be prepared in various ways, such as the double decomposition of other basic aluminium salts with sulphocyanides, by dissolving alumina hydrate in neutral aluminium sulphocyanide, or by adding an alkali to the neutral sulphocyanide. L. Liechti and W. Suida give to the salts obtained by the last method the formula $Al_2(CNS)_2(OH)_4$. The author obtains a more basic salt by dissolving alumina hydrate in neutral sulphocyanide of aluminium, and then adding soda to this salt. The most basic salt thus obtained has the formula $Al_6(CNS)_2(OH)_{16}$.

The calculated amount of alumina hydrate is dissolved in the neutral sulphocyanide of aluminium by gradually raising the temperature of the mixture.

The compounds thus obtained are more stable than the neutral salts.

The compound $Al_5(CNS)_3(OH)_{12}$ can be evaporated to dryness without any liberation of sulphocyanic acid, and can again be dissolved in water unchanged. The basic compounds resemble in instability the neutral aluminium sulphocyanide, which, on evaporation, forms sulphocyanic acid, persulphocyanic acid, cyanic acid, and soluble basic aluminium sulphocyanide. These basic sulphocyanides, according to the statement of the author, ought to form excellent mordants for dyeing and printing.—W. S.

The Application of Fluoride of Chromium in Wool Dyeing. H. Lange. Leipziger Monatsh. für Textil Industrie (3), 1888.

Fluoride of chromium is offered as a green crystalline powder, containing 42—43 per cent. of chromic oxide. It has the formula $Cr_2Fl_6 + 8 H_2O$, and is easily soluble in water, forming a green solution.

The author has compared this chromium salt with bichromate of potash, as a mordant for wool, in the cases of alizarin red, orange and blue, and cœrulein, logwood, and fustic.

A number of experiments was made, mordanting with 1½ per cent., 3 per cent., and 5 per cent. of potassium bichromate, and with the fluoride of chromium, using proportions which contained amounts of chromium equivalent to the chromium in the bichromate, with additions of tartar, sulphuric acid, bisulphate of soda, and acetic acid, and employing the above-mentioned dyestuffs.

The experiments proved the fluoride of chromium to be a good mordant for wool.

The shades obtained with it are bright and full. Logwood gives a beautiful blue, fustic a bright yellow.

Alizarin orange and alizarin red give a fine brown. Alizarin blue is somewhat redder than when obtained by using bichromate of potash as the mordant. Wool mordanted with fluoride of chromium is quite green; it precipitates chromic oxide upon the fibre. With bichromate of potash the wool is yellow or greenish. If it is greenish the chromic acid has been reduced to chromic oxide, and the wool fibre is simultaneously oxidised and attacked, making it harder and coarser.

By the use of fluoride of chromium the amount of colouring matter fixed is in direct proportion to the strength of the mordant bath used; the stronger the mordant bath the more colouring matter will be fixed.

This is not always the case with bichromate of potash, as chromic acid on the fibre destroys much colouring matter by oxidation. Thus, by mordanting with 5 per cent. bichromate of potash, logwood gives only a grey colour. Woollen yarn boiled with fluoride of chromium a long time shows no inclination to felt, and remains very soft. No injurious action upon the wool fibre and dyes can be effected with this salt; colours produced with it are as fast on exposure to light as those produced with bichromate of potash.

The colouring matter is slowly and evenly fixed, and the dye-bath well exhausted. Cloth is dyed more evenly and thoroughly by alizarin blue with this mordant than with chrome.

Since copper is strongly attacked by chromium fluoride, wood vessels have to be used.

The value of chromium fluoride depends upon its ready decomposition, and the non-injurious action of the liberated hydrofluoric acid upon fibres and colours.

In cases where bichromate of potash is injurious, owing to its oxidising action, chromium fluoride can be used. Thus, it is not possible to chrome indigo-blue wool with bichromate of potash without considerable loss of indigo, whereas, by using chromium fluoride, the indigo remains unaffected.

The fluoride of chromium seems particularly applicable where bright colours are needed, and where heavy material has to be dyed through; in such cases it will replace bichromate of potash with advantage.—W. S.

PATENTS.

Improvements in the method of and means for Dyeing Yarns. K. Lockwood and E. L. Adamson, Huddersfield. Eng. Pat. 7556, May 25, 1887. *8d.*

For the purpose of immersing each portion of the yarn in the dye liquor in such a manner that an equal shade is produced throughout the whole of the yarn being dyed, and also for traversing the yarn through the dye liquor in order that the liquor may penetrate to the inner or covered portions of the yarn, a stationary rack is employed, extending across the top of the dye vessel, into the teeth of which rack gear a number of pinions supported by a suitable cover which is capable of sliding endwise across the dye vessel. The shaft of each pinion is sufficiently long to allow of one or more reels or bobbins being placed on each end thereof. The yarn to be dyed is placed partially around the reels and also around a set of reels submerged in the dye liquor. A "to-and-fro" motion is then given to the sliding cover, which draws the yarn through the liquor, thereby forcing the liquor into and through the yarn, whilst the endwise motion of the cover also causes the pinions, by reason of the rack, to be rotated first in the one and then in the opposite direction, thus causing the yarn to be partially rotated in the liquor. When the process is complete, the rack and pinion and attached parts can be raised from the liquor and the yarn removed.—W. E. K.

Improvements in "Automatic" Dyeing Coppers or Vats. W. Brierley, Halifax. Eng. Pat. 7911, June 1, 1887. 8*d.*

The improved copper consists of two vessels, an inner one containing the material to be dyed, resting by means of a flange upon the flange of the larger outer vessel. In the centre of the inner vessel is a tube, open at its lower end and perforated at the upper end. The bottom of the inner vessel is also perforated. The dye liquor being put into the outer vessel and heated, finds its way up the central tube, and flows over the material contained in the inner vessel. In this way a thorough circulation of the liquor is maintained.—E. J. B.

Improvements in Black Liquids for Dyeing, Printing, Painting, Varnishing, and the like. L. A. Groth, London. From C. Collin and L. Errani, Paris, France. Eng. Pat. 17,925, December 30, 1887. 6*d.*

A liquid black, antiseptic and insoluble in water, is prepared from the different kinds of black obtained by the chemical treatment of aniline and its derivatives (and known as *black aniline, blue-black, compound black, Unitarian black*) by dissolving them in aniline, nitrobenzine, carbolic acid, or other solvent of the same kind, and then adding resin, bitumen, or fat substances, the proportions varying according to the purpose for which the product is to be used.—W. E. K.

Apparatus for dyeing Wool and other Filamentous Material in Bobbins, Hanks, and other aggregated Forms. A. Harmel, M. Harmel, and F. Harmel, Marne, France. Eng. Pat. 3753, March 10, 1888. 11*d.*

The apparatus consists of a metallic frame carrying cages into which the material is packed, the whole being placed in a dye bath. Arrangements are made for causing the circulation of the dye liquor through the material. The specification is accompanied by nine drawings, without which the construction cannot well be explained.—E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Notes on the Chemistry of the Ammonia Soda Process. H. Schreib. Zeits. f. angew. Chem. 1888, 283—288.

Considering the enormous importance the ammonia-soda process has gained within the last decade, very little information on the chemical part of the process can be gathered from technical journals. What concentration of the solutions and what proportion between ammonia and sodium chloride is found most suitable and economical in practice are questions hitherto unanswered. The author has attempted to supply this deficiency by some laboratory experiments, but how far these will be found applicable in working on the large scale must remain undecided for the present. One litre of saturated brine contains, at 15° C., 317·8 grms. of sodium chloride, but the solubility of the latter is modified by the amount of ammonia present. The following table, which does not claim to be absolutely correct, gives an idea of the influence of ammonia on the solubility of sodium chloride.

NH_3.	NaCl.	NH_3.	NaCl.	NH_3.	NaCl.
Per Cent.*	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
3·5	29·5	6·5	27·7	9·5	25·7
4·0	29·2	7·0	27·4	10·0	25·4
4·5	28·9	7·5	27·1	10·5	25·1
5·0	28·6	8·0	26·8	11·0	24·8
5·5	28·3	8·5	26·4	11·5	24·4
6·0	28·0	9·0	26·1	12·0	24·1

* "Per Cent." in this and the following tables, means the quantity of salts in grammes per 100 cc.

A solution, which contains 7·8 per cent. of ammonia and 26·8 per cent. of sodium chloride, contains both ingredients in their molecular proportion, and for the purpose of the experiments two series of solutions must be considered, viz.:—1. Concentrated solutions, which contain as much sodium chloride as can be taken up in the presence of a certain amount of ammonia; and 2. Dilute solutions which are not fully saturated with sodium chloride. Both kinds of solutions were treated with carbonic acid until no more bicarbonate separated out, and the mother liquor was examined with a view to finding out the proportion of sodium chloride which had been converted into bicarbonate. The result is tabulated in Tables I. and II. on. p. 435.

On the large scale solutions like No. 6 and No. 7 of Table I. are most frequently used. Dilute solutions of the composition of Table II. are never used, as there is great difficulty in carbonating them completely. Besides, the yield is smaller owing to the dilution, and although the rate of decomposition appears to be more favourable, the saving in sodium chloride does not compensate for the increased trouble. The best result in the laboratory experiments was a conversion of 73·6 per cent. of the sodium chloride employed, but in practice such a result is never attained. The amount of bicarbonate actually obtained is less than the equivalent of the sodium chloride converted, for on freeing the bicarbonate from the mother liquor by washing, a loss of 5 to 10 per cent. is incurred. This considerable loss of sodium chloride in the working of the ammonia-soda process is an unfavourable feature of the process; and whereas 100 kilos. of sodium carbonate theoretically require about 115 kilos. of commercial salt, few manufactories will work with less than 200 kilos. of salt per 100 kilos. of sodium carbonate. Lately an improvement has been introduced with a view to lessening this loss. It has been found that a liquor which was saturated with sodium chloride at the commencement, is able to take up another portion of sodium chloride at the end of the carbonation. This fact led to the conclusion that if ammonia in excess were present at the beginning, and arrangements were made to add an equivalent amount of sodium chloride during the progress of carbonation, the latter should be dissolved and more bicarbonate should be precipitated. This proved indeed to be the case, and as a result a conversion up to 80 per cent. of the sodium chloride used has been reached. The author modified this improvement, whereby the result is still more favourable. Ammonia and carbonic acid are passed into the residual mother liquor while it is in intimate contact with solid sodium chloride. After some time, ammonium chloride is precipitated in large quantities, whereas ammonium carbonate and sodium chloride remain in solution. The precipitate is separated, and the filtrate can be directly used for further carbonation. The following example shows the working of this process. The residual mother liquor showed:—9·4 per cent NaCl and 19·8 per cent. NH_4Cl. After treatment with NaCl, NH_3, and CO_2, and filtration, it showed:—23·1 per cent. NaCl, 5·9 per cent. NH_4Cl, and 18·5 per cent. $(NH_4)_2CO_3$. A liquor of this composition is very suitable for direct carbonation. The author promises to publish later on further details on the theory and practice of this improvement.—S. H.

TABLE I.

CONCENTRATED SOLUTIONS.

	Original Solution.			Carbonated Solution.					
No.	° B.	NH_3.	NaCl.	° B.	NH_3.	NaCl.	NH_4Cl.	Rate of Decomposition.	Na_2CO_3 in Grms.
		Per Cent.	Per Cent.		Per Cent.	Per Cent.	Per Cent.		Per Litre.
1	22·4	3·4	29·6	21·4	0·6	20·1	9·1	33·1	90·0
2	21·0	4·5	29·1	20·2	1·0	17·9	10·8	40·0	..
3	20·8	4·9	28·6	..	..	14·8	14·9	52·3	..
4	19·1	5·9	27·9	..	..	11·0	16·8	62·5	..
5	19·0	6·1	27·6	17·2	0·7	11·0	16·4	62·0	..
6	19·0	6·3	27·1	17·1	1·2	10·9	16·4	62·5	138
7	18·9	6·6	27·3	..	1·3	10·2	16·1	63·1	146
8	18·7	6·8	27·4	..	..	9·9	19·0	67·6	156
9	18·4	7·2	27·2	..	1·3	9·3	17·9	67·8	154
10	17·4	8·9	25·8	..	1·3	7·1	18·8	76·3	168
11	14·4	11·5	24·3	..	1·3	7·3	18·5	73·6	145
12	13·4	13·2	23·5	..	2·9	9·5	14·2	62·0	132

TABLE II.

DILUTE SOLUTIONS.

	Original Solution.			Carbonated Solution.					
No.	° B.	NH_3.	NaCl.	° B.	NH_3.	NaCl.	NH_4Cl.	Rate of Decomposition.	Na_2CO_3 in Grms.
		Per Cent.	Per Cent.		Per Cent.	Per Cent.	Per Cent.		Per Litre.
4	15·8	5·9	22·9	..	..	7·4	15·2	69·1	..
8	13·6	6·8	20·5	..	..	5·9	14·7	70·3	..
9	14·8	7·2	22·6	..	..	6·9	15·3	70·5	..

PATENTS.

Improvements in the Manufacture of Metallic Sulphates. W. N. Hartley, Dublin, and W. E. B. Blenkinsop, London. Eng. Pat. 6029, April 25, 1887. 6*d*.

THIS invention deals with the sulphatising of easily oxidisable metals, whose sulphates are not decomposed at a red heat, such as manganese and the frequently associated metals, copper, nickel, and cobalt. The oxide ore is mixed under edge runners with pyrites, or with any sulphurised material which, on heating with manganese or nickel oxides, will yield a sulphide or oxysulphide. A suitable proportion is 91½ parts of pyrites "smalls" (containing 47 per cent. S) to 116 parts of manganese ore (with 59—70 per cent. MnO_2). This charge, which is at first black, is heated in a reverberatory or muffle furnace to a temperature of about 360° C.; here it is left in a 4-inch layer for six hours for the formation of sulphide and oxysulphide, indicated by the greenish-brown colour of the mixture. Air is now freely admitted, when, on stirring, combustion occurs beneath the surface, and the oxidation to sulphate gradually proceeds downwards, attended by a change in colour to pinkish grey. After heating finally to a dull red heat, the charge, while still hot, is shovelled into water, by which the soluble sulphates are extracted. If copper, nickel, and cobalt be now present in the solution, they may be removed as sulphides by exchange on the addition of manganese sulphide or oxysulphide, using either a portion of the charge at the greenish-brown stage, or other specially prepared. The mixed sulphides separated may be treated by known methods; the manganese sulphate is obtained by evaporation or crystallisation. The presence of ferrous sulphate indicates an insufficiently high roasting temperature; it may be removed by mixing with water (say 4 gallons per 100 lbs.), and exposing to the air for some hours; the iron is thus peroxidised, and may be separated as a basic ferric sulphate by adding more water and boiling the solution. A little iron may be removed by boiling the original solution with a little of the brown manganese sulphide as in the separation of copper.

—W. G. M.

Improvements in the Manufacture of Soda by the Ammonia-Soda Process. C. F. Claus, H. L. Sulman, and E. F. Berry, London. Eng. Pat. 7701, May 27, 1887. 6*d*.

THE improvements consist in decomposing solid sodium chloride by means of a solution of ammonium bicarbonate, whereby sodium bicarbonate and ammonium chloride are formed. The resulting liquor is run off, and any ammonium chloride left adhering to the sodium bicarbonate is removed by washing with a fresh solution of ammonium bicarbonate, this being finally separated by the application of heat. For carrying out this process, a series of closed vessels, connected with each other, is employed, and they are charged with sodium chloride in a state of fine division. The bottom is covered with a cloth, so that clear liquor only can leave the vessels. A solution of ammonium carbonate is then run on the sodium chloride and carbonic acid pumped into it, and as the whole mass is kept well agitated, the decomposition proceeds at once. When all the sodium chloride has been converted into bicarbonate, the mother liquor is filtered by the pressure of the carbonic acid gas into the next vessel, where the excess of ammonium carbonate is acted upon by fresh quantities of sodium chloride and carbonic acid. The bicarbonate is washed with ammonium carbonate and the washings are also discharged into the next vessel, whereas the sodium bicarbonate, now freed from chloride, is heated for the recovery of ammonia and carbonic acid.—S. H.

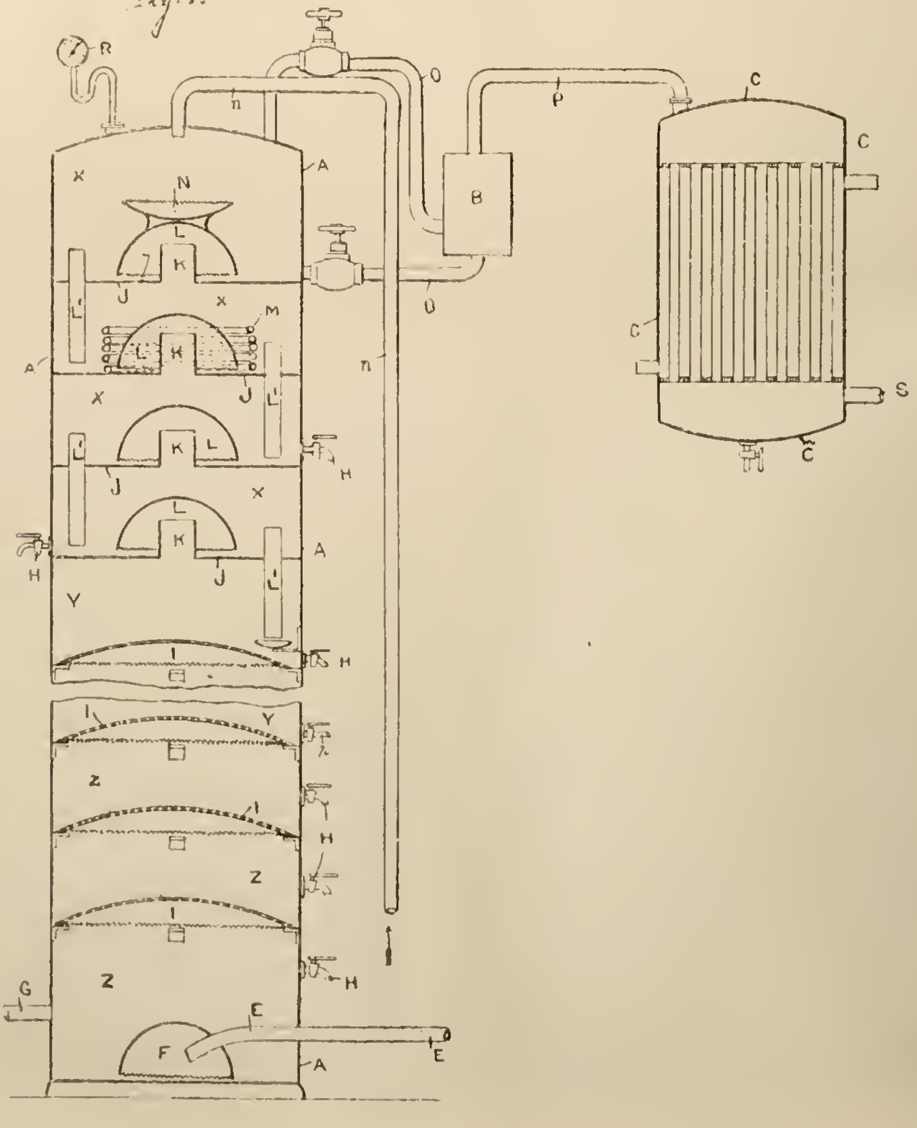
Improved Process of producing Hydrate of Baryta from Sulphate of Barium. R. Schneider, Dresden, Saxony. Eng. Pat. 7906, May 31, 1887. 8*d*.

Barium sulphate in a fine state of division is mixed with various carbonaceous substances such as saw dust, coal, tar, &c. The mass is now heated, raising the temperature above a red heat towards the end of the operation. During the whole time, water-gas, or other gases containing hydrogen, is passed over the surface in excess. In order to completely eliminate the sulphur as sulphuretted hydrogen gas, it is sometimes advantageous to force the gas through the molten mass in an apparatus similar to a Bessemer converter. The mass is now allowed to cool somewhat and non-superheated steam blown over it to facilitate the conversion of the oxide into the hydrate, and then finally and for the same reason the viscid mass is run into water. The amount of hydrogen, or hydrogen containing gas, required, may be lessened by the addition of the oxides or hydrates of zinc, copper, manganese, or iron, the metal of the oxide combining with a part of the sulphur of the barium sulphate.—S. G. R.

Improvements in the Manufacture of Carbonate of Soda and Carbonic Acid from the Bicarbonate and in Apparatus therefor. L. A. Staub, Northwich. Eng. Pat. 7859, May 31, 1887. 8*d*.

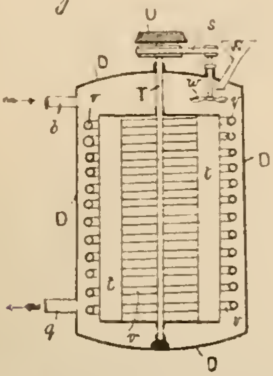
Relates to the manufacture of sodium carbonate and almost pure carbonic acid from the sodium bicarbonate, as obtained by the ammonia-soda process. The inventor has found, that if ammonia or any of its compounds with carbonic acid or sulphuretted hydrogen be mixed in solution with bicarbonate and heated to somewhat below the boiling point, the carbonate of ammonia thus formed is decomposed into carbonic acid, which escapes, and ammonium hydrate, which partly remains in solution. The latter appears to form again a carbonate at the expense of the carbonic acid of the sodium bicarbonate, and this is in turn redecomposed. The alternate reactions continue, until there remains a solution of sodium carbonate and ammonia, the latter being ultimately driven off by boiling. Similar reactions take place if ammonia or its compounds in gaseous form are passed through solution of bicarbonate at a temperature below the boiling point. Pressure favours the reaction by increasing the solubility of ammonia without appreciably affecting the dissociation of ammonium carbonate. The apparatus employed for carrying out this invention consists of an upright cylinder A (Fig. 1), which is

Fig. 1.



sub-divided into different compartments by perforated diaphragms I, with serrated edges and other diaphragms J, with vertical tubes K, to allow of steam and gaseous matter being passed through. The mode of operating is as follows: sodium bicarbonate is mixed with ammoniacal liquor at a temperature of about 60° C. in a closed mixer U (Fig. 2), which is fitted with a heating coil and agitator.

Fig. 2.



The mixture is then pumped into the column A near the top at *n*. At the same time ammonia is introduced at *p*, where the temperature is sufficiently high to prevent the absorption of the ammonia. The latter, together with the steam, entering through the pipe E ascends through the liquor, which gradually flows down from the top and combines in the zones X X with part of the carbonic acid of the bicarbonate. As soon as the ammonium carbonate, thus formed, approaches the lower parts, it is decomposed in the zones Y Y into free ammonia, which remains in solution, and carbonic acid, which ascends and escapes at O. As the liquor ultimately reaches the hottest zones Z Z, sodium carbonate alone remains in solution, while ammonia is driven out and ascends, being absorbed by the liquors in the upper part of the column, and acts again in the zones X X, as just described. If a column be once properly started, only sufficient ammonia need be introduced to make up for any losses. The sodium carbonate liquor is drawn off by the pipe G, whereas the carbonic acid escapes at O and passes through the gas-trap B into the tubular condensor C, where it is separated from the steam and ammonia.—S. H.

Improvements in the Manufacture of Carbonate of Soda. L. A. Staub, Northwich. Eng. Pat. 8129, June 6, 1887. 6*d*.

This relates to the manufacture of hydrates of sodium carbonate by a new method. If a strong solution of sodium carbonate be saturated with ammonia at a temperature and pressure varying with the desired amount of hydration of the carbonate, the sodium carbonate is directly precipitated in the desired form. Thus, monohydrated sodium carbonate is formed by saturating a sodium carbonate solution with ammonia at a temperature of 55° to 60° C., and under a pressure of not less than five pounds per square inch. Instead of using a concentrated sodium carbonate solution alone, such a solution mixed with sodium bicarbonate may be employed. In this case, however, the mixture is treated with ammonia under high pressure at a temperature somewhat below the boiling point. The bicarbonate is by this treatment decomposed into monocarbonate, which is precipitated, and carbonic acid.—S. H.

Improvements in or relating to the Manufacture of Permanganate of Soda, or of a Mixture of the same, with other Disinfecting or Oxidising Matters. G. H. Bolton, J. R. Wylde, and H. Auer. Eng. Pat. 8217, June 8, 1887. 6*d*.

The patentees claim the use of chlorine as the oxidising agent in converting potassium manganate into comparatively pure potassium permanganate. At the same time both potassium chlorate and hypochlorite are formed from the excess of alkali employed in the manufacture of the manganate. On concentrating the liquid the hypochlorite is decomposed, forming chlorate and also chloride. The chlorate and permanganate can be separated from one another by crystallisation, or the solution containing them can be used as a new or improved disinfecting or oxidising material.—S. G. R.

Improvements in obtaining Chlorine or Hydrochloric Acid from Chloride of Calcium. W. Bramley. Eng. Pat. 8289, June 9, 1887. 6*d*.

Chloride of calcium, either in the form of a very strong solution, or in the anhydrous state, is mixed with, preferably, finely-ground iron ore, in the proportion of about one part to one or 1½ parts of the ore. The mixture is then raised to a red heat in a current of dry or moist air. In the former case chlorine is liberated and in the latter hydrochloric acid gas is obtained. The residue, now containing the lime as oxide, can be used instead of limestone in the manufacture of iron.—S. G. R.

Improvements in the Manufacture or Preparation of Cobalt Sulphate and its Separation from other Sulphates. W. N. Hartley, Dublin, and W. E. B. Blenkinsop, London. Eng. Pat. 8922, June 22, 1887. 6*d*.

The ores of cobalt best suited for this process are non-arsenical oxides or sulphides, with or without nickel, or artificial mixed oxides or sulphides may be used. The crushed material is mixed with sulphur or pyrites (5·5 parts of S or 28 parts of a 45 per cent. pyrites per 10 parts of oxides used), and heated to the melting point of zinc. Air is then admitted, and the temperature maintained constant until combustion slackens, when the temperature is raised so long as any absorption of oxygen is observed. Finally the charge is withdrawn at a temperature sufficient to break up the sulphates of iron or alumina; leaching with water now extracts the cobalt sulphate, leaving any calcium sulphate for the most part insoluble. The mixture of pyrites and oxide may be calcined at once, or the ore may be mixed with calcium sulphide (either made for the purpose or "tank waste" or "gas lime") or with barium or strontium sulphides and pyrites, and roasted. In any case the cobalt sulphate may be purified by recrystallisation. To separate zinc sulphate from cobalt sulphate, the substance is heated to redness with sufficient cobalt oxide, which thus becomes sulphatised whilst the zinc is left as insoluble oxide; if in solution, cobalt hydroxide or carbonate is added for a similar purpose when the liquid is boiling, or if preferred, the precipitation of the zinc may be effected by an addition of sodium carbonate in exact quantity to precipitate the zinc. 470 parts of galena calcined with 75 parts of cobalt oxide also give practically pure cobalt sulphate on leaching. If the ore contain copper and manganese, the sulphate solution is treated with metallic iron to precipitate the former, and then with manganese sulphide or oxysulphide (*vide* Eng. Pat. 6029 of 1887) to thrown down cobalt sulphide. The sulphide may then be roasted at a temperature below redness and leached, any residual cobalt sulphide being recovered by a second roasting with pyrites; or this latter roasting may be effected at once.—W. G. M.

An Improved Process for the Manufacture of Sulphate of Ammonia, the Recovery and Purification of the By-products arising therefrom, and Apparatus therefor. H. C. Bull and Co. and W. E. Sendey. Eng. Pat. 9543, July 6, 1887. 8*d*.

The aluminous substance such as clay is first thoroughly mixed with an excess of water until it assumes the consistency of a thin slush. This is then passed through a series of settling weirs, in which the heavier impurities are deposited. The finely-divided clay is now allowed to settle, and then delivered into cylindrical vessels, preferably of lead, which are furnished with a shaft provided with propeller blades. Here, by the action of sulphuric acid, the alumina is converted into the sulphate of alumina, and the solution is again, if necessary, allowed to settle. It is then brought into contact with gaseous ammonia, whereby ammonium sulphate is produced, and the alumina is precipitated as hydrate. In order to purify the latter it is then dissolved in hydrochloric acid and subjected to a high temperature, whereby the chlorides of the various impurities are volatilised and pass away, leaving the alumina substantially pure. The sulphate of ammonia is evaporated to dryness.—S. G. R.

Improvements in the Production of Sulphuretted Hydrogen in Combination with the Manufacture of Alkali by the Ammonia Process. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 9873, July 14, 1887. 6*d.*

According to previous patent specifications (Eng. Pat. 1885, 381 and 1937, and 1886, 47), the inventors heated the residual liquors from the ammonia-soda process previous to treating them with Leblanc vat waste. The ammonium carbonate was thus driven off. It is now proposed to dispense with the preliminary heating and distil the residual liquors directly with vat waste, as ammonium carbonate decomposes vat waste in the same way as the chloride, viz., with formation of ammonium sulphide.—S. H.

Improvements in or Appertaining to the Manufacture of Phosphorus. A. Nicolle, Paris. Eng. Pat. 1693, February 4, 1888. 6*d.*

The mineral phosphate, either natural or artificial, is treated with nitric acid, and then, on the addition of potassium sulphate, the calcium is precipitated as sulphate. This is removed by filtration, and mercurous nitrate in proper quantity is introduced. The phosphate of mercury thus obtained is distilled with carbon when, first mercury and then phosphorus, are distilled over. To the calcium nitrate solution more potassium sulphate is added, and the resulting potassium nitrate crystallised.—S. G. R.

Improvements in Apparatus for the Manufacture of Monocarbonate and Bicarbonate of Soda and Allied Products. M. R. Wood, Brooklyn, U.S.A. Eng. Pat. 4284, March 20, 1888. 8*d.*

The apparatus consists of a number of cylindrical vessels superposed one above another and connected with each other by unobstructed passages. The lower or primary vessel, which is fitted with an agitator and a coil for the circulation of a refrigerant, is intended to do the principal work, and for this purpose it is charged with ammoniacal brine, into which a regular supply of carbonic acid is pumped. The greater portion of the gas is here absorbed, while the remainder ascends into the next vessel, where it meets with fresh liquor of suitable composition, and is thus completely utilised.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

The Influence of the Composition of the Glass on the "Depression" of a Thermometer. R. Weber. Ber. **21**, 1086—1096.

The author draws the following conclusions from a large number of examinations of different varieties of glass from various sources—glasses prepared in the laboratory and on the large scale :—

1. The amount of silicic acid may vary between wide limits. 2. The amount of lime exercises no special influence. 3. Alumina has little direct influence on the "depression," but is of importance in helping the fusion and vitrification of the charge. 4. The glass must be homogeneous. 5. Finally, the behaviour of a thermometer with regard to the constancy of the zero point *depends upon* the purity of the alkali material employed, *i.e.*, the freedom of the potash from sodium and the absence of considerable quantities of potassium from soda-glass.—O. H.

PATENT.

Improved Process or Means of Producing a Crystalline Effect on the Surface of Glass or other Vitreous Substance. G. J. Atkins, London. Eng. Pat. 16,142, November 24, 1887. 6*d.*

The inventor uses a contractile coating of glue, gelatin, or other similar substance in combination with chrome alum, tannin, alcohol, bichromate of ammonia, potash, or soda. With this coating there is much less danger of bending or breaking the glass object, owing to there being more points of rupture formed in the film, whilst, at the same time, the crystalline appearance is effectually produced. The object can also be dried at a temperature of about 100° F. instead of requiring the excessive stoving commonly employed.—S. G. R.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Improvements in the Method of and Means or Apparatus Employed for Drying "Slip" or "Slurry" from which Portland Cement is produced. T. H. Lodge, Tynemouth. Eng. Pat. 5814, April 21, 1887. 8*d.*

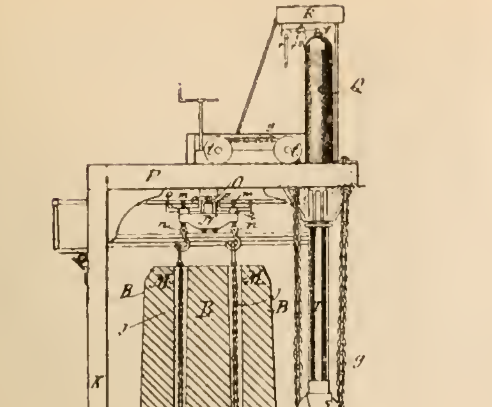
The slurry is run into trays arranged in tiers on cars, which are then introduced into a long rectangular fire-brick chamber heated by waste kiln gases circulating through it. The cars are suspended from cross beams provided with flanged wheels which run on rails on the top of the walls of the drying chamber. The wheels are thus kept fairly cool, and can be got at for lubrication.

Plates are placed on the top of the chamber to form a roof, the ends are closed by doors, and the whole made tight with slurry used as a lute.

The temperature is regulated by a heat indicator, consisting of some substance that fuses at a known temperature, and thereby sets in motion a suitable mechanical device such as a pivoted arm,—which may be coated with luminous paint,—and thus warns the attendant.—B. B.

Improvements relating to the Manufacture of Portland Cement and in Apparatus employed in Connexion therewith. T. H. Lodge, Tynemouth. Eng. Pat. 5815, April 21, 1887. 11*d.*

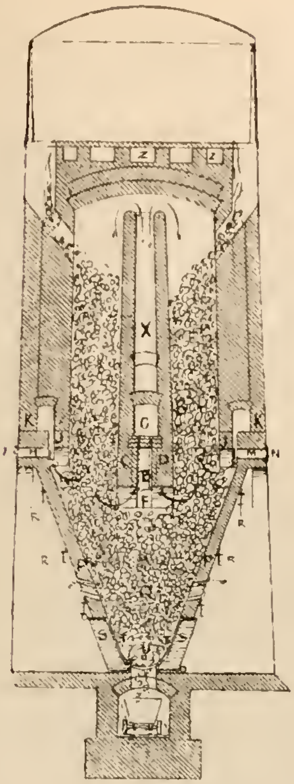
The improved kiln is shown in the annexed illustration. The slurry is built up outside the furnace into a block or mass B, provided with suitable passages for the proper circulation of heat. It is then lowered by the hydraulic



crane Q into the furnace A, which is provided with a sliding arched fire-brick cover E, and capable of being fired either by gas or solid fuel at I. The products of combustion pass off at C. When the mass of slurry is sufficiently burned, the drawbars upon which it rests are withdrawn, and the broken slurry thus formed descends into a cooling chamber, leaving the furnace ready for another similar operation.—C. C. H.

Improved Method of Manufacturing Portland Cement and in Apparatus therefor. B. H. Thwaite, Liverpool, D. L. Collins, London, and D. Wilson, Grays. Eng. Pat. 6701, May 7, 1887.

The cement slurry, made in the usual way, is first partially dried on floors heated by the waste gases from the kiln hereafter described. It is then made into pipes or tubes, in any machine suitable for the purpose, cut off into short lengths, and fed into the kiln as shown in the drawing. This kiln is fired by gas from a producer, entering the interior at K, K, meeting with air entering at M, M, and G. The sides of the furnace are constructed in wrought-iron plates, and slope towards an archimedian screw at U, running in a water-jacketed trough at S; this serves for the automatic withdrawal of the clinker when burned. Air is supplied also through openings P, and serves to cool the clinker. The waste gases pass up through the furnace down the flue X, and by side flues into the passages Z below the heating floor on which the preliminary drying above mentioned is carried out.—C. C. H.



Cement adapted for Artificial Stone-Work, and for Coating Walls with a suitable Surface for the Reception of Weatherproof Painting. L. G. Knemeyer, London. Eng. Pat. 7243, May 18, 1887. 6*d*.

Finely ground Tufa stone four parts, Portland cement two parts, and one to two parts of good ground lime, all by measure, are well and evenly mixed. Walls are coated as follows:—The cement is rendered into a stiff plastic mass and applied to the surface of the wall, the face of which is previously well watered. A smooth face is produced by floating in the usual manner, and when dry is washed with dilute muriatic acid. If subsequently painted a fixative of nine parts silicate of soda and one part ammonia is applied before and after painting. When moulded, the cement in a plastic mass is applied to the surface of the mould, and the body filled with mortar or concrete; the block takes several days to properly harden. The cement may be coloured by the addition of finer mineral pigments dissolved in water and mixed therewith.—C. C. H.

Improvements in the Manufacture of Cement for Building and General Constructing Purposes. A. Busch, Stockton-on-Tees. Eng. Pat. 7411, May 21, 1887. 6*d*.

Two parts by weight of granulated blast furnace slag are mixed with one part of magnesia and one part of chalk, or the two latter may be replaced by calcined dolomite, and finely ground. The mixture thus made constitutes an excellent cement.—C. C. H.

Improvements in the Manufacture of Cement. J. S. Rigby, Holywell. Eng. Pat. 10,244, July 22, 1887. 4*d*.

The lime mud from the Leblanc process is treated with the gases given off by a lime kiln or by a kiln in which clinker is being burnt. The carbon dioxide from either source decomposes the sulphides present, and thereby makes the lime mud fit to be used in the manufacture of Portland cement by mixing with clay or other aluminous material, and calcining in the ordinary manner.—B. B.

Improvements relating to the Manufacture of Portland Cement and in Apparatus therefor. T. H. Lodge, Tynemouth. Eng. Pat. 5333, April 10, 1888. *8d.*

In order to fill the trays mentioned in the previous specification, the inventor uses a gridiron valve with openings corresponding to the relative positions of the trays, each opening having a Y-shaped mouth-piece, so that two trays on the same level may be filled simultaneously.

Each tray of slurry when dried is raised by a travelling hoist, covered by "covering plates," and run along to an apparatus, called an invertor, consisting of a frame provided with catches which seize the tray, and then, rocking on a spindle, inverts it so that the slurry rests on the covering plates only.

By another movement the tray is withdrawn, and the "covering plates" are then pulled from under the slurry, which is thus built into a "stack." The "stack" is lowered into the kiln by means of a worm wheel and worm, provided with a counterweight, so that the tackle resumes its original position automatically.

The clinker passes from the furnace into a receiving chamber with an inclined floor, down which it slides, and is cooled by air entering to supply the kiln.—B. B.

X.—METALLURGY, MINING, Etc.

The Stripping of Tinned Iron Plates. L'Industrie Moderne, 1888, 113.

A short outline of the previous history of tin recovery is given, and it is stated that at the Nickel Works of Val-Benoît, near Liège, over a million kilos. of scrap have been treated by the Trottier and Fuchs acid processes for solution. The stripping was effected in six or seven acid reservoirs, each of 3 cb.m. capacity, which sufficed to deal with four tons *per diem*,—a very considerable amount, considering its bulkiness and the inconvenience attending the handling of scrap. The residual iron was at first forged with the intention of working it up into sheet, but owing to the worthless quality of the finished material, this was abandoned in favour of producing sulphate of iron, which, however, was turned out at the rate of 20 tons a day, so that this treatment was also given up.

The latter part of the paper describes Lambotte's process, which is being carried out successfully on a large scale at his works near Brussels. Into a vertical tower of masonry or iron the raw scrap is introduced above, and passing downward meets an ascending current of heated air or neutral gases containing chlorine, finally passing away at the bottom of the chamber completely denuded of tin. The chlorine is introduced in such proportion, and heated in flues to such a temperature, that it will attack the tin and cause the volatilisation of the resulting chloride, without in the least affecting the iron. The heating flues surround the tower and thus check radiation. The gases containing the chloride pass over a series of water trays in such a manner that they meet a gentle stream of water flowing through them in a contrary direction, the flow of which is regulated so that the outgoing stream is completely saturated with chloride. It is proposed also first to introduce an amount of water vapour into the gases, exactly sufficient to form the crystallised hydrate, which should thus separate at once in the solid form. The iron, being completely freed from tin, has been already worked up in the forge into metal of high quality to the extent of several hundred tons. It is hoped that the works may be able to treat 2,000 tons per annum.—W. G. M.

PATENTS.

Improvements in Processes for obtaining Sulphur from Iron Pyrites, Copper Pyrites, Zinc Blende, and other Metallic Sulphides. C. F. Claus, Wimbledon. Eng. Pat. 6909, May 11, 1887. *6d.*

The sulphide, in pieces of suitable size, is introduced through a bell hopper into a brickwork kiln where it is submitted to the action of steam, highly superheated in stoves of the Whitwell type. Polysulphides thus give off their excess sulphur, and are then, in common with monosulphides, attacked by the steam, hydrogen sulphide being formed. Air is admitted at intervals in quantity sufficient to burn the hydrogen of the H_2S, the separated sulphur being subsequently collected in condensing chambers. The spent sulphide is withdrawn from beneath. A kiln consisting of a series of compartments through which the steam is successively led may be substituted if preferred. —W. G. M.

Improvements in the Manufacture of Aluminium and its Alloys and Apparatus for the purpose. J. B. Thompson, Peckham, and W. White, Cheshunt. Eng. Pat. 8127, June 11, 1887. *6d.*

To produce pure aluminium a mixture of three parts of metallic sodium with four parts of cryolite are heated to 100° C., whereby the metal will become pasty and suitable for the thorough incorporation of the charge by means of an iron spatula; when cold four parts of aluminium chloride are added and the whole is introduced into a moveable hopper, which is then placed above a previously heated cup-bottomed reverberatory furnace. The charge is then run into the furnace, and when the reaction is complete it may be tapped out beneath. To produce alloys, 16 parts of cryolite are mixed with five parts of sodium, the necessary copper or other metal being added before reduction. By this means the occurrence of explosions is avoided. The preliminary preparation is effected in a cast-iron pot set in a cavity in the lid of a water reservoir connected with a circulating boiler.—W. G. M.

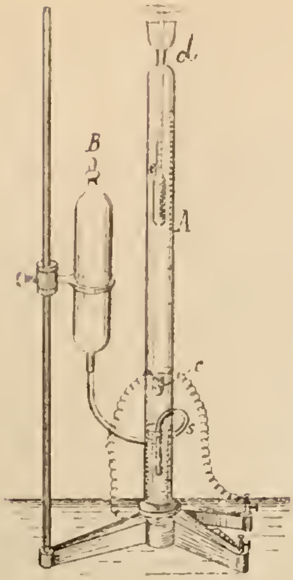
Improvements in the Manufacture of Sodium and Potassium, and Apparatus for the purpose. J. B. Thompson, Peckham, and W. White, Cheshunt. Eng. Pat. 8126, June 11, 1887. *6d.*

Dry sodium carbonate is intimately mixed with a liquid carbonaceous material, preferably tar; it is then heated to a dull red heat in iron pots by the waste heat of flue gases. When all volatile matter has thus been removed, the charge is distilled in a fire-clay tubular retort, connected with a tightly-closed receiver, containing a little paraffin oil to ensure a non-oxidising atmosphere, and also provided with an escape pipe for the carbonic oxide.—W. G. M.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

A Voltameter. C. H. Wolff. Zeits. f. angew. Chem. 1888, 296.

The voltameter here described is applicable for measuring small electric currents, such as are employed for electrolytic purposes. The vertical tube A holds 30 cc., and is divided in 0·2 cc. The top end of the tube is funnel-shaped and can be closed by a ground plug at *d*, the continuation of which forms a small thermometer *e*; *c* represents the two platinum electrodes, one of which is bent in a right angle round the other. The overflow tube *s* is bent downwards and connected by india-rubber tubing with the levelling vessel B, which readily slides up and down on an upright. The apparatus is filled with



dilute sulphuric acid of 1·14 sp. gr. (20 per cent. SO_4H_2). For electrolytic work the electric current is measured with sufficient accuracy by simply reading off the cc. of oxyhydrogen gas at equal levels in both tubes: for accurate determinations the amount of gas evolved must be reduced to 0° C. and 760 mm. pressure by the following formula.—

$$V_1 = \frac{V.273.B - (f.0{\cdot}88)}{273.t.760.},$$

where f expresses the vapour tension of water at t° C., and $f.0{\cdot}88$ expresses the tension of dilute sulphuric acid of 1·14 sp. gr. The figure obtained for V_1 divided by 10·436 (1 A = 10·436 cc. oxyhydrogen gas at 0° C. and 760 mm.) gives the strength of the electric current in ampères.—S. H.

PATENTS.

Improved Means of Oxidising and Decomposing by Electrical Action Organic Matter and Inorganic Salts in Sewage, Water, and other Liquids. W. Webster, jun., Lee. Eng. Pat. 1333, January 27, 1887. 8*d*.

The invention is for electrolytically oxidising and precipitating organic matter, and decomposing inorganic salts, in sewage; and for oxidising organic compounds in water. At the negative electrode nascent hydrogen, ammonia, &c. are set free by the current, and produce an alkaline reaction; and at the positive electrode, nascent chlorine or oxygen, producing an acid reaction. The negative electrode is of iron, and the positive of iron, carbon, platinum, &c. In treating water the negative electrode is often of carbon, and may be separated from the positive electrode by a porous pot to keep ammonia from the water treated. The remainder of the invention relates to methods of arranging the tanks, electrodes, and mode of circulation of the liquid. —E. T.

An Improved Process for the Preparation of Aluminium, Aluminium Bronze, and Alloys of Aluminium by Electrolysis. A. C. Henderson, Dublin. From P. L. T. Heroult, Paris. Eng. Pat. 7426, May 21, 1887. 8*d*.

To produce pure aluminium, cryolite mixed with alumina is fused in a crucible of agglomerated carbon, contained within another of plumbago, set in a wind furnace. The inner crucible, which itself serves as a cathode, is provided with a lid twice perforated (to carry the carbon connecting-rod to the cathode, and also a central carbon anode), the cover is then banked up with loam and garden mould. The two carbon rods are protected from oxidation by earthen tubes, which pass through the arch of the furnace. By using a current of 3 volts E.M.F. the alumina is electrolysed, aluminium being deposited on the crucible walls, and a corresponding amount of oxygen being liberated in contact with the carbon, which is thus gradually consumed, forming carbon monoxide. The alumina and anode must be renewed from time to time, as required. To form alloys (*e.g.*, of copper) the copper is melted in a carbon crucible by means of the voltaic arc, and alumina is introduced by degrees; the alumioa fuses and becomes electrolysed, between the melted copper, which is used as a cathode, and a carbon anode above. The alloy is tapped off, and fresh materials are added at intervals. A convenient strength of current for a crucible of 20 cm. depth (inside) by 14 cm. diameter at top, with a carbon of 5 cm. diameter, is found to be 400 ampères with an E.M.F. of 20 to 25 volts. An ampère meter introduced in circuit indicates the progress of the operation, and the necessity for tapping or adding material.—W. G. M.

Improvements in the Production of Aluminium. C. A. Burghardt and W. J. Twining, Manchester. Eng. Pat. 9389, July 2, 1887. 6*d*.

To a solution of sodium or potassium aluminate containing about 7·2 ozs. of aluminium per gallon, are added 4 lbs. of 95 per cent. potassium cyanide dissolved in a quart of water, and then, gradually, 2·25 lbs. of potassium bicarbonate; the whole is boiled for 12 hours, and made up to a gallon. For aluminium plating, the bath is used at a temperature of 175° F., with aluminium or platinum electrodes; for extracting the metal, a carbon or copper cathode is employed. The addition of a little free hydrocyanic acid ensures a deposit of bright aluminium.—W. G. M.

Improved Process and Apparatus for Tanning by Aid of Electricity. E. Worms and J. Balé, Paris, France. Eng. Pat. 9515, July 5, 1887. 8*d*.

See *this Journal*, 1888, *p.* 443.

Improvements in Galvanic Batteries. J. Noad, East Ham, Essex. Eng. Pat. 734, January 17, 1888. 8*d*.

The containing vessel, preferably of metal, has a tap in the bottom to let off the liquid when desired. The negative electrode is a perforated cylinder of negative metal resting in a tray of the same material containing a suitable oxide. Its top contains a crate or basket filled with the necessary exciting salt. The positive electrode is a cylinder surrounding the other, and making an air-tight joint at the top of the cover. If the gas formed by the action of the battery is not allowed to escape, it compresses the liquid to the edge of the positive electrode or of some hole in it. The exciting salt in the crate is then out of reach of the liquid, and local action ceases. By turning a tap, however, the gases are allowed to escape, the liquid rises and covers the exciting salt, and the battery is ready for work.—E. T.

Improvements in and relating to Galvanic Batteries. H. H. Lake, London. From H. Walter, Cincinnati, U.S.A. Eng. Pat. 3995, March 15, 1888. 8*d*.

In this cell the negative electrode is a carbon rod packed round with crushed carbon, which is separated from the zinc by a bag of canvas, or some such material, or by a perforated glazed cell, the zinc being at the same time wrapped round with some absorbing material for the same purpose. The object is to get large negative surface with low resistance. The binding post is attached to the carbon by screwing or soldering to one end plated for the purpose, or by means of a piece of platinum wire plugged into a hole, the binding screw in that case being attached to a separate bridge or support. All parts requiring it may consist of or be plated with platinum.—E. T.

Improvements in or relating to Storage Batteries. W. P. Thompson, London. From C. D. P. Gibson, New York, U.S.A. Eng. Pat. 4274, March 20, 1888. 6*d.*

The active material is placed in small capsules of thin lead, and covers of the same material put on. These are placed in perforations in the plates, and the whole passed through rollers. These flatten the projecting ends of the capsules, compress the active material so that it fits the perforations, and at the same time slightly thin out the plates. If required for use at once, the ends of the capsules may be perforated.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

A New Iso-oleïc Acid, Solid Oleïc Acid. M. Const and A. Saytzeff. J. Prakt. Chem. **37**, 269—290.

Hydroxystearic acid, prepared by the action of sulphuric acid and water on ordinary oleïc acid, when distilled under diminished pressure, yields between 285° and 300°, a distillate consisting of a mixture of ordinary and solid oleïc acids, together with some unchanged hydroxystearic acid. To obtain the solid product, the acids are converted into their sodium salts, and these, by the addition of zinc sulphate into the zinc salts. These are extracted with boiling alcohol, in which the salts of the two oleïc acids dissolve, that of the solid iso-oleïc acid separating out on cooling. The free acid is obtained by boiling the zinc salt with sulphuric acid, and can be recrystallised from ether. Thus purified it melts and solidifies at 44° to 45°; analyses agree with the formula $C_{18}H_{34}O_2$. The sodium salt of the acid is obtained by warming an alcoholic solution of the acid with sodium carbonate, and recrystallising from alcohol. Other salts are prepared by double decomposition of the sodium salt; the calcium, barium, and zinc salts are described, all of which are insoluble in water. The free acid is readily soluble in ether and alcohol, especially in the latter. Treated with bromine, a dibromide, $C_{18}H_{34}O_2.Br_2$, results, as is the case with ordinary oleïc acid and with elaïdic acid, and this, on reduction with zinc and hydrochloric acid, forms the solid oleïc acid again. The dibromide of the iso-acid reacts much less readily with silver oxide than that of ordinary oleïc acid does, requiring a high temperature. The resulting fatty acid is a dihydroxystearic acid, which differs, however, in its properties from that obtained from ordinary oleïc acid; treated with hydriodic acid, iodostearic acid results, which yields stearic acid when reduced in alcoholic solution. The iso-oleïc acid, when acted upon by hydriodic acid, forms iodo-stearic acid, which is a thick, amber-coloured liquid resembling the corresponding acid obtained from oleïc acid, and which reacts with silver oxide at a high temperature, forming a hydroxystearic acid identical in its melting and solidifying points with the hydroxystearic acid from ordinary oleïc acid, but differing in its solubility in alcohol and ether, as also in the fact that it distils without decomposition. The iodo-stearic acid from oleïc acid is converted into a liquid and a solid oleïc acid by the action of alcoholic potash. The isomeric acid from iso-oleïc acid yields solid oleïc acid only; and mainly on account of this decomposition the authors assign the following formulæ to the two isomeric oleïc acids:—

(1.) Ordinary oleïc acid—

$$CH_3(CH_2)_{13}.CH : CH.CH_2.CO.OH.$$

(2.) Iso-oleïc acid—

$$CH_3.(CH_2)_{13}.CH_2.CH : CH.CO.OH.$$

Iso-oleïc acid yields the same products as oleïc and elaïdic acids when fused with alkali, viz., acetic and palmitic acids; it is therefore suggested that in the case of oleïc acid, an intermediary reaction takes place in the decomposition, otherwise the above formula speaks against such a result. An alkaline solution of potassium permanganate oxidises iso-oleïc acid to dihydroxystearic acid, which melts at 77°—78° and solidifies at 66°—65°; the sodium, calcium, and silver salts are described. This acid is identical with that obtained by the action of silver oxide on the dibromide of iso-oleïc acid. The action of concentrated sulphuric acid on iso-oleïc acid appears to vary with the temperature; below 50° a hydroxystearic acid is formed which distils almost without decomposition; but with the temperature of the reaction at 65° the acid obtained decomposes on distillation into oleïc acid and water, as is the case with the hydroxystearic acid prepared in a similar way from ordinary oleïc acid. These facts favour the above suggestions on the constitution of the two isomeric oleïc acids, the acid which distils without decomposition is most probably α-hydroxystearic acid, that which yields oleïc acid and water, the corresponding β-acid, which would be less stable. Both these acids can be derived from iso-oleïc acid constituted as above, as follows:—

$$(1.)\ CH_3(CH_2)_{14}.CH : CH.CO.OH + H_2O = CH_3(CH_2)_{14}.CH_2.CH.OH.CO.OH.$$

$$(2).\ CH_3(CH_2)_{14}.CH : CH.CO.OH + H_2O = CH_3(CH_2)_{14}.CH.OH.CH_2.CO.OH.$$

Two hydroxystearic acids could likewise be derived from the alternative formula for ordinary oleïc acid suggested above, one of which would be a β-acid, the other a γ-acid, of which the latter would be characterised by its instability and tendency to form a lactone, properties in no way in accordance with the above observations.—C. A. K.

The Oil from Seeds of Jatropha Curcas. F. M. Horn. Zeits. Anal. Chem. **27**, 163—165.

This oil is used for illuminating purposes, for the manufacture of soap, for adulterating olive oil, and for the preparation of Turkey red oil. The oil has a yellow colour and solidifies at 0° C. It is only slightly soluble in alcohol, which distinguishes it from castor oil. It is saponified with alcoholic KOH apparently readily in the cold; but as the oil is insoluble in alcohol, saponification is best conducted with solid potash in the cold, and alcohol then added when the potash salt dissolves. The excess of alkali is titrated with hydrochloric acid, phenolphthalein being employed as indicator. It differs from castor oil in that it is almost insoluble in alcohol, and has a lower specific gravity and a higher saponification and iodine co-efficient.—J. B. C.

PATENTS.

An Improved Method and Apparatus for Filtering Spent or other Oils. T. Turner, Preston. Eng. Pat. 6756, May 9, 1887. 6*d.*

A cylindrical tank, fitted at the upper part with a funnel and filtering sieves, packed with cotton waste, forms a receiver for dirty oil; the lower portion separated by a partition forms a receiver for clean oil. Tubes filled with cotton waste set in the interior of the upper part of the filtering tank act as filters for the oil, which is heated by a steam pipe. The filtered oil passes into a funnel fitted with sieves and filled with water, through which it ascends, the clean oil overflowing at the top into the storage tank.
—C. C. H.

Improvements in the Manufacture of Soaps and Cleansing Compositions. F. Rainbow, Luton. Eng. Pat. 16,329, November 28, 1887. 6*d.*

Two ounces of kerosene or petroleum are mixed with 1 lb. of soap dissolved in alkali. The mixture is heated, and, while in a liquid state, poured into moulds. The mineral oils are said to neutralise the injurious action of any excess of alkali not taken up or destroyed by the other ingredients.—D. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

PATENTS.

Improvements in Treating or Imparting Body or Opacity to Sulphate of Baryta and other Sulphates and Substances, and the Manufacture from Materials so treated of White and Tinted or Coloured Pigments. J. C. Martin, Hammersmith. Eng. Pat. 6619, May 5, 1887. 6*d.*

Barium sulphate and calcium sulphate, alone or together, are ground either wet or dry with slaked or quick lime. With such a mixture, white lead, zinc oxide, iron oxide, or zinc sulphide is incorporated; the resulting material is of greater sp. gr. than its constituents, and forms a tougher compound with oil, resembling white lead in texture.

The lime may vary in quantity up to 30 per cent. of the total weight of the pigment, but commonly 3 per cent. to 7 per cent. is used.

Its function appears to be twofold :—

(1) To form compounds, of considerable density, with less basic oxides;

(2.) To saponify a portion of the oil with which the pigment is mixed.—B. B.

Improvements in the Treatment of India-rubber, Caoutchouc, Gutta-percha, and Analogous Gums. A. M. Wood, Westminster. Eng. Pat. 6875, May 10, 1887. 6*d.*

Several mixtures of asbestos, whalebone, camphor wood, catechu, tannin, gum kauri, ammonium sulphate, chloride, tungstate, and carbonate, sodium tungstate, and borate, boric acid, alum, arsenic, &c., are incorporated with india-rubber and similar bodies in order to produce cheap and durable rubber-substitutes.—B. B.

Improvements relating to the Preparation of Oxides of Iron and to Apparatus therefor. E. A. Jones, Middlesbrough, and F. F. Jones, London. Eng. Pat. 7761, May 27, 1887. 6*d.*

To obtain coloured oxides from hammer scale or natural oxides of iron, the crushed material is treated in shallow pans with sulphuric acid at a temperature of 180° F.; the resulting sulphate after crushing is subjected to a roasting process until the whole of the sulphur has been driven off. This operation is best effected by allowing the sulphate to fall in a gentle stream from the top of a high furnace, containing a number of transverse bars to impede its progress, and thus ensure thorough calcination. Below the chamber is a grate to control the temperature, and air (heated by the waste flue gases in a recuperator) is led in beneath. The coloured oxide is withdrawn through doors provided at the bottom. Or the scale may be heated at once in such a chamber, in an atmosphere preferably surcharged with oxygen.—W. G. M.

Improvements in Pyroxyline Compounds and Varnishes. F. Crane, New Jersey, U.S.A. From W. D. Field, New Jersey, U.S.A. Eng. Pat. 8253, June 8, 1887. 6*d.*

Propyl and butyl acetates alone, together, or mixed with benzene, light petroleum, acetone, methyl and ethyl alcohols, and amyl acetate, are used as solvents for pyroxyline for the manufacture of varnishes and lacquers, and for the production of celluloid.

The advantages claimed for the propyl or butyl acetates are their good solvent powers, the sufficient but not too great rapidity with which they evaporate, their non-hygroscopic character, the ease with which they mix with the other substances mentioned above, and their comparatively agreeable odour.—B. B.

Improved Anti-corrosive and Anti-fouling Compositions for Coating of Submerged Surfaces. J. O. Wallace and W. Ward, North Shields. Eng. Pat. 1101, January 24, 1888. 1*d.*

The surface to be protected is first coated with the anti-corrosion, and then with the anti-fouling composition. The former consists of kerosene, gum kauri, Stockholm tar, tallow, zinc oxide, ferric oxide, lead acetate, pine varnish, gutta-percha solution and red lead, while the latter comprises kerosene, gum kauri, resin oil, white zinc, pine varnish, acetate of copper, cuprous or cupric oxide, "mineral green," Venetian red, and lead acetate.

In both cases all the ingredients need not be used, and the proportions and mode of incorporation may be varied at discretion.—B. B.

Improvements in the Manufacture and Application of Incombustible Paint. F. de Coninck, San Francisco, U.S.A. Eng. Pat. 3795, March 12, 1888. 4*d.*

Two and a quarter parts of finely pulverised asbestos are mixed with one part of zinc oxide, by weight; a solution consisting of 30 parts of zinc chloride sol., 56° B., 50 parts ammonia borate sol. 3° B., 20 parts of a solution (warm) containing 25 per cent. of dry glue, all by weight, is then prepared. 40 parts of the powder are then mixed with 60 parts of the solution, forming a liquid capable of being used as a paint, either alone or in conjunction with an oil paint. It is found that a coating of paint weighing 65 grms. to the square yard is sufficient to render cloth uninflammable. —B. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Improvements in Tanning and Apparatus therefor. E. I. Lanvin-Schraen, Lille, France. Eng. Pat. 17,103, December 12, 1887. 8*d.*

The hides to be tanned are subjected alternately to the action of any suitable tanning liquid, and to a vacuum. The hides are suspended on wooden frames, to which a rocking motion can be given by means of a rod and eccentric, within a cylindrical vat provided with a lid which can be closed air-tight. At regular intervals the tan liquor is run off from the hides and a vacuum produced in the vat, and when the hides have been exposed to the vacuum sufficiently long, tan liquor is again run in. Contact with steam or air is to be avoided during the tanning.—B. H.

A Manufacture of Tannins, Gallates, Kinos, and other Vegetable Extracts from a certain Tree Bark and Wood, and Treatment and Processes employed for obtaining such Articles. H. J. Simpson and G. de M. Mackirdy, Liverpool, and A. Taylor, Edinburgh. Eng. Pat. 8816, June 18, 1887. 6*d.*

This invention has for its object the utilisation of the wood and bark of the Californian red wood tree (*Sequoia Sempervirens*). The wood or bark is steeped in a solution of caustic alkali at a temperature of 80°—212° F. for about four hours. The red liquor is then concentrated by evaporation or precipitated by a mineral acid, or treated in any way in accordance with the purpose for which it is being manufactured, so as to prepare it for the uses of the tanner, or as a pigment, a wood stain, an insecticide, or for sanitary durposes.—B. H.

Improved Process and Apparatus for Tanning by Aid of Electricity. E. Worms and J. Balé, Paris, France. Eng. Pat. 9515, July 5, 1887. 8*d.*

This invention relates to the application of electricity in tanning by rotating drums. A drum of the ordinary construction is used, and a current of electricity is caused to pass through the contents of it by fixing on the circumference of the drum two metallic rings which are electrically connected with circular conductors placed in the interior of the drum. Bearing against the external rings are two spring rubbers connected to the two poles of a battery or other generator of electricity. The tanning in the drum is conducted in the ordinary way, the patentees recommending the addition of some essence of turpentine. Drawings are given.—B. H.

Improvements in the Process of Tanning. W. Zahn, Newark, U.S A. Eng. Pat. 2353, February 15, 1888. *4d.*

An improved process of making kid leather. The skins are unhaired by treatment with "sulphate of sodium" or arsenic and are then "pured" with dog manure. The skins are next soaked for 1½ hours in a 5 per cent. salt solution. They are then placed in a vat containing for every 100 lbs. weight of skins—5 lbs. potassium bichromate, 2 lbs. salt, and 2½ lbs. muriatic acid in 5 gallons water. After remaining about 4 hours in this the skins are transferred to a vat containing 12 lbs. "hyposulphate of soda" and 3 lbs. muriatic acid of 70° B. in 10 gallons water. When sufficiently treated the skins are placed in a solution of saponified neats foot oil and quercitron extract or other tanning material. The skins are then ready for dyeing and finishing.—B. H.

Preparation of Glue Stock for the Production of Gelatine, Glue, and Size. T. P. Milligan, New Jersey, U.S.A. Eng. Pat. 3393, March 6, 1888. *6d.*

The following illustrates the process as applied to the treatment of fresh pieces and fleshings from the tanner's beam. After washing in clean cold water, the stock is placed in a suitable basket and plunged into boiling water for less than one minute. This causes the stock to shrink, hardens the tissues, and diminishes the weight by over 10 per cent. The stock is now dried in a properly ventilated loft heated to 125 —170 F. The stock when bone dry is put in a basket and plunged for 10 minutes in a boiling solution of 12 lbs. soda crystals in 100 gallons soft water, which removes the grease. The alkali and grease are rinsed off with hot, followed by cold water. The stock is now soaked till hard in alum solution containing 10 lbs. alum in 100 gallons water. The stock may be now at once converted into gelatin or glue, or it may be dried for future use.—B. H.

An Improved Method of and Means for rendering Tanned Hides and Skins Soft, Flexible, and Waterproof, and Mordanting the Same. V. Riviere, Newark, U.S.A. Eng. Pat. 4211, March 19, 1888. *4d.*

The inventor first makes a neutral or basic solution of sesqui-oxide of chromium in a suitable vat, and adds an excess of the salt so as to have three or four inches of the salt on the bottom of the vat. To about 100 gallons of the chromium solution he adds 5 to 10 gallons of a saturated solution of nitrate of iron, and mixes thoroughly. Freshly tanned skins, after washing in warm water containing an alkali, are suspended in the solution for from 5 to 15 hours. The skins are then removed and coloured in the usual manner. The sesqui-oxide solution is agitated, and after being allowed to settle, is ready for another lot of skins.
—B. H.

XV.—AGRICULTURE, MANURES, Etc.

Production of Indigo in China. Journ. Soc. Arts, May 4, 1888.

According to the last report of Consul Jones, of Chin Kiang, the indigo plant is cultivated as part of the crop of every farmer in that province, and upon its manufacture into the dye is employed by each family for dyeing the cotton goods used for the clothing of the people. That which is not consumed in this way is put upon the market for sale and exportation. The indigo is easily cultivated, of prolific growth, and little subject to disease or the ravages of insects. The ground is prepared by the plough and harrow, thoroughly pulverised and enriched by liquid manure, which is in common used by the Chinese in the cultivation of all their crops. As in the cultivation of rice, the seed of the indigo plant is sown in patches of ground, and as thickly as possible. In a month, when the plants are several inches high, they are transplanted into a larger piece of ground, and in rows about 18 inches apart. From that time until they are required, they need very little care, with the exception, in a scarcity of rain, of being occasionally watered. When they reach a height of about two feet, and the leaves have assumed a dark rich blue colour, they are cut to the ground, and gathered for the manufacturing process. From the roots, when the plants are cut down, another growth springs up, and two crops are obtained in the year. In every farm there are a dozen or more large earthen jars or kongs, of the capacity of barrels, which are used for the manufacture of indigo. Anyone engaging extensively in the manufacture has a large brick-lined tank built in the ground, six or eight feet in depth, and of a diameter of 10 or 15 feet, with a capacity of many hundred gallons. The plants are placed in such a receptacle, and covered with fresh clear water, where they are allowed to lie for several days till the indican is decomposed by fermentation. This process is aided by the application of a little slaked lime and frequent stirring. The indigo is precipitated in the form of a dark blue sediment, which, when dried, forms the article of commerce. The quality of the indigo is characterised by its colour; the richer and darker the blue the more it is esteemed, and the higher price it will fetch in the market. During the process of manufacture, women with flowers in their hair (a universal custom in China) are not permitted to approach the kongs, as it is a belief that their presence is prejudicial to the quality of the indigo, and for a like reason the kongs are removed to a situation protected from the atmosphere of the fields.—W. S.

On the Origin and Alteration of Nitric Acid in Plants. B. Frank. Deutsch. botan. Ges. Ber. **5**, 472.

The author endeavours to prove that the former views with regard to the source of nitric acid in the plant and the changes it undergoes are incorrect. In his experiments he has availed himself of the reaction with diphenylamine sulphonic acid. When he had determined that a large number of seeds were absolutely free from nitrogen, he allowed them to develop in nutritive solutions containing either nitrates or ammonia, or altogether free from nitrogen. It was found that the plants only contained nitrates, when these had been supplied to the roots, and that plants are not capable, neither in darkness nor in light, of forming nitrates from ammonia, and also not from ammonia or nitrogen contained in the atmosphere.

The author also found by the examination of a number of plants known to be particularly rich in nitrates that during the period of vegetation considerably more nitric acid is stored up than is required for the formation of new organs. The parenchyma cells of the root and bark, and the pith-parenchyma of the stalk, and the pedicle and ribs of the leaf are the localities of this storage. The nitrates thus stored up are employed for the formation of fruit.

The examination of other plants, formerly supposed to be free from nitrates, showed that they also take up nitrates, which, however, is not stored but at once assimilated. Regarding the assimilation, it was found that this takes place, not in the green leaf tissue, but in all the organs of the plant which contain vascular bundles, as the roots, stem, pedicle and ribs of leaf, &c. In the plants which take up little nitric acid the assimilation takes place in the root.—G. H. M.

XVI.—SUGAR, STARCH, GUM, Etc.

Inactose. Maumené. Jour. des fabr. de Sucre, **28**, No. 48.

Twenty years ago the author prepared this compound by the action of argentic nitrate on sugar in little water at a temperature above 140° C. Lately the same author, in repeating the experiment with pure candy sugar, failed to obtain the optically inactive compound, and as a result of the experiments he then instituted in order to learn the conditions under which inactose may be prepared, he found that the presence of a very small quantity of alkali, soda, potash, or lime, was essential. This quantity he found to be about 6 to 10-thousandths parts. With a quantity of between 1 and 2-thousandths of these bases inversion occurred rapidly, argentic nitrite and nitrous acid were formed, and the solution became acid. Pure inactose may be separated from the argentic nitrate by exactly precipitating the latter with calcium chloride and evaporation of the filtrate, after addition of alcohol, under a bell-glass over quicklime. The water is thus absorbed, leaving eventually inactose and an alcoholic solution of calcium nitrate. This process requires to be repeated but once, when the inactose separates from the alcohol as a syrup and quite pure. Inactose does not reduce alkaline solution of a cupric salt, but in an acid solution it becomes more readily inverted than cane sugar. With calcium hydrate it forms a salt, which is not decomposed by carbonic acid. The calcium salt is optically inactive.—J. W. L.

Crystalline Levulose. M. Hönig and St. Schubert. Sitzungsber. der Kaiserl. Akademie der Wissens. **96**, June No.

By operating in the following manner the authors have succeeded in obtaining levulose in the crystalline form.

Inulin is heated on the water-bath for one hour with half per cent. sulphuric acid, the concentration of the solution of inulin being about 18—20 per cent. By this means the inulin is completely transformed into levulose, and the solution is but little coloured and quite clear.

After precipitation of the sulphuric acid with barium carbonate, the filtrate is gently evaporated on the water-bath to a syrup, is taken up again with absolute alcohol and, after evaporation of the latter, is allowed to remain for several days in a desiccator. Of this syrup about 50 to 200 cc. are dissolved in hot absolute alcohol, and after standing for 24 hours the clear solution is poured off. By the introduction of one or two crystals of levulose, a good crop of the crystalline variety gradually separates after standing one or two days. The crystalline form is right rectangular prismatic, the crystals being of such size as to enable the authors to measure the angles.—J. W. L.

Levulose. H. Winter. Annalen, **244**, 295—329.

Levulose may be completely dehydrated over phosphoric anhydride at 50°, and thus the percentage of levulose in a solution of the same determined; results obtained thus agree with those given by a combustion of the substance. The specific rotatory power of levulose was found to be − 71°·47 at 20° for a 20 per cent. solution, both for solutions prepared from the crystallised and from the non-crystallised substance, the levulose in both cases being obtained from inulin. Levulose separated from invert sugar by Dubrunfaut's calcium method gives the value α D = 73°·54 at 20° for a 4·5 per cent. solution and therefore the specific rotatory power of levulose is independent of the origin of and of the method of preparation of the substance. A mixture of pure levulose and dextrose in the proportion of their molecular weights (taking $C_6H_{12}O_6$) was found to have a specific rotatory power, α (D) = − 9°·94 at 20°; taking that of levulose as − 71° and that of dextrose as + 52°, the mean for the mixture would be − 9°·5, and hence the optical properties of this mixture are different from those of ordinary invert sugar (α (D) = 19°·98), which latter, according to the above figures, would be a mixture of four parts of levulose with three parts of dextrose. The specific rotatory power of a levulose solution is considerably decreased by the addition of alcohol, whilst that of a dextrose solution is slightly increased. The specific rotatory power of anhydrous levulose in absolute alcohol is − 17° for a 7·78 per cent. solution at 20°. Levulose appears to form, with alcohol, an ethyl ether of the formula $C_6H_{11}O_6(C_2H_5)$, and the author suggests that the crystalline levulose obtained by repeated treatment of levulose with absolute alcohol may be this compound. Levulose forms molecular compounds with calcium oxide, lead oxide, lead nitrate, lead chloride, iron and bismuth nitrate; an acetyl derivative of levulose could not be obtained.—C. A. K.

Levulose. A. Herzfeld. Annalen, **244**, 274—295.

The author prepared crystalline levulose from inulin by treating the syrup first obtained with absolute alcohol, when the whole separates into two layers, of which the upper one contains the greater portion of the levulose, which is in part precipitated as a yellow precipitate on the addition of ether. This product may be purified by dissolving it repeatedly in warm alcohol and then distilling off the latter, and it is then obtained in the form of colourless crystals. The temperature of the alcohol should not be above 40°, otherwise the substance darkens in colour owing to the formation of dehydration products: the yield of crystalline levulose is $3\frac{1}{3}$ per cent. on the inulin taken. The crystals are very hygroscopic, even when quite free from alcohol; this is contrary to the observations of Jungfleish and Lefranc (Compt. Rend. **93**, 547). Owing to this fact it was found impossible to weigh out an exact quantity of the pure levulose, nor did the author succeed in determining the amount of moisture in a sample taken, for the substance undergoes decomposition even when dried in a current of hydrogen. For the following experiments, therefore, on the specific rotatory power of the pure substance, the percentage of levulose in the syrup employed, which was freed from alcohol by warming to 50°, was determined by a combustion on the assumption of the formula $C_6H_{12}O_6$ for levulose. The specific gravity of levulose solutions containing from 5·22 to 83·14 per cent. of the pure substance are given, and the specific rotatory power of such solutions is calculated from the formula—

$$\alpha\,(D) = \frac{100 \times \alpha}{l \times p \times d},$$

where α is the angle of deviation of the solution, l the length of the solution in decimetres, p the per cent. of levulose in the solution, and d the specific gravity of the solution. The observations were taken with a Laurent's half-shadow apparatus, using a sodium flame. The following table gives the values of − α D for solutions containing 5—40 per cent. of levulose and for the temperatures 20°, 30°, and 40°; they are interpolated from the actual observations.

Values of − α (D).

Temp.	5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.
° 20	67·51	69·67	70·59	71·02	71·97
30	—	64·81	65·80	66·07	66·85
40	—	60·00	60·69	61·48	60·27

From these results the value of α and D for pure levulose at 20° is calculated to be − 77·81, a result considerably lower than that recorded by previous observers, as is seen from the following table :—

Observer.	Temp.	Value found.
Dubrunfaut	14	$\alpha\,(j) = -106$
"	52	$\alpha\,(j) = -79\cdot5$
"	90	$\alpha\,(j) = -53\cdot0$
Neubauer	14	$\alpha\,(D) = -100\cdot0$
Jodin	12·8	$\alpha\,(j) = -104\cdot0$
Prantl..............	—	$\alpha\,(j) = -103\cdot86$*
"	—	$\alpha\,(D) = -92\cdot6$
Kiliani	14	$\alpha\,(D) = -93\cdot7$
"	13	$\alpha\,(D) = -92\cdot5$
Allen..............	15	$\alpha\,(j) = -108\cdot8$
Dragendorff	22	$\alpha\,(j) = -130\cdot7$
"	22	$\alpha\,(j) = -82\cdot9$
"	15	$\alpha\,(j) = -136\cdot4$

* According to Kiliani this should be − 347°·3.

The specific rotatory power of levulose decreases as the temperature rises; with an 8·51 per cent. solution the decrease from 10° to 90° at intervals of 10° is :—

From 10° to 20° .... = 5°·6
" 20 " 30 .... = 4·7
" 30 " 40 .... = 5·1
" 40 " 70 .... = 5·3 (for every 10°).
" 70 " 90 .... = 6·1 (" " ").

These values are interpolated from the actual observations; above 70° a slight decomposition appears to have taken place. This decrease only takes place gradually, and the solution must be kept for at least half an hour at the temperature of observation before taking the reading. The specific rotatory power increases with the strength of the solution, as is seen in the above table of the author's results; this is also the case with glucose. Levulose further resembles glucose in the fact that the rotatory power of its solution on dilution only diminishes gradually, becoming constant after long standing; but if the diluted solution be warmed and then allowed to cool, the degree of rotation becomes constant at once (birotation). The great difference between the value obtained by the author for the specific rotatory power of levulose and the values given by previous experimenters (v. ante) is ascribed to the impurity of the substance used by the latter and also to their not having taken due account of the sp. gr. of the solutions employed. The general assumption that invert sugar is a molecular mixture of equal parts of glucose and levulose is not in accordance with the above figures, for levulose should have a specific rotatory power of − 90° in a 20 per cent. solution, instead of − 69°·2 as observed.

Oxidation of Levulose.—Levulose when oxidised by means of bromine yields a small quantity of tri-hydroxy-butyric acid, whilst with nitric acid, oxalic acid and tartaric acid, appear to be the main products.—C. A. K.

The Manufacture of Sugar from Sugar-Cane in Louisiana. Sugar Cane 20, 181.

Wilkinson reports that the experiments on the extraction of sugar-cane juice by diffusion resulted in a great success, inasmuch as the extraction of the juice is very complete. But it is questionable whether the diffusion process will ever drive out the empirical press process to any extent, as by the introduction of the former all the stages of the manufacture, as hitherto conducted, must be improved and subjected to chemical control, and this will be found impracticable and uneconomical in many instances. Kleeberg's clarification process with brown coal, which was tried under the direction of the inventor, proved a failure, and had to be abandoned.—S. H.

Amrad-Gum. H. Unger and Kempf. Pharm. Zeit. 33, 218.

Owing to the high price of gum arabic, the authors recommend amrad-gum as a substitute. It was brought into the market three years ago, and comes from the Abyssinian highlands, and is probably obtained from *Acacia Abaica* (*Schweinfurth*). The gum forms white, yellow, and brown lumps of a sweetish taste and resinous smell. The viscidity of a solution (1:2) is very good. It also gives, with oil, excellent emulsions, which keep very well. Dried at 100° C. it showed 4·90 per cent of water, and the dry substance left behind 5·61 per cent. of ash. The latter consists of carbonic acid, lime, iron, magnesia, traces of phosphoric acid, and some quartz.—S. H.

PATENTS.

Improvements in the Treatment of Starch and Starchy Substances, and the Production therefrom of a Compound Body capable of being used as a Substitute for Malt in Brewing, and for other purposes. C. O'Sullivan, Burton-on-Trent, W. G. Valentin, South Kensington. Eng. Pat. 3909, November 12, 1874. Second Edition. 6*d*.

This invention consists in producing from starch or starch-yielding substances, preferably from rice, a compound solid body which the inventors term "dextrin-maltose," consisting of the same proportional quantities of dextrin and maltose as are ordinarily obtained from malt by a properly conducted mashing process, and which it is intended should replace a portion of the malt used in brewing.

When rice is employed in the preparation of this body it should be husked and ground fine. In this state it is introduced gradually and with constant stirring into boiling water to which about 2½ per cent. of strong sulphuric acid had previously been added, in the proportions of 100 parts of rice meal to 250 parts by weight of acidulated water. The operation of transformation or conversion of the starch into dextrin-maltose may be carried on in an ordinary mash tun or other suitable vessel of either wood or iron. The conversion is arrested when the liquid contains in solution the requisite proportions of maltose and dextrin. This may easily be ascertained by taking samples of the acid liquid from time to time, neutralising with baryta water, filtering, determining the specific gravity of the filtrate as well as its optical activity. From these data the specific rotatory power is calculated. When this has reached 171° for the transition the transformation is complete. At this stage the whole bulk of acid liquid is neutralised as quickly as possible by means of finely-divided chalk in sufficient quantity to neutralise about 90 per cent. of the free acid, completing the operation by the use of milk of lime. The liquid is then freed from the precipitated sulphate of lime and insoluble portions of the starch or starchy substances by efficient filtration and evaporated in vacuum pans until the compound body retains only from four to five per cent. of moisture, when on being cooled rapidly under the diminished pressure, it acquires a crumbly, sticky, semi-crystalline condition, and by means of special stirring apparatus is removed from the pans.—J. H.

Improvements in the Method of Clarifying and Saturating Sugar Solutions, especially Beet-root Rob by the means of Tannic Acid or Tannin. P. J. E. Heffter, Altjaner, Germany. Eng. Pat. 6936, May 12, 1887. 6*d*.

In order to obtain satisfactory results in the clarification of solutions of sugar by means of tannin, four conditions must be fulfilled. These are as follows: (1) the syrup must have a certain alkalinity due to lime; (2) it must be in a concentrated state; (3) it must be cooled before and during the addition of tannin; (4) it must afterwards again be heated to complete the clarification.

The degree of concentration should be that of the rob, the minimum alkalinity 0·05, and the amount of tannin added is so proportioned that the alkalinity after clarification is 0·02 to 0·04. Instead of using tannin alone to neutralise the lime, the latter may be first partially precipitated by carbonic acid gas, sulphurous acid, or some other lime precipitant.—A. J. K.

Improvements in the Manufacture of Sugar and in the Apparatus used in connexion therewith. W. R. Watson, Glasgow. From A. Young, Honolulu. Eng. Pat. 7087, May 14, 1887. 11*d.*

The object of the invention is to prevent or diminish as far as possible the deterioration of saccharine liquids during the process of boiling. The means used to attain this end consist of a vacuum pan of special construction, in which the ebullition takes place only in one portion of the pan, which is depressed below the other parts thereof. The impurities thrown off from the boiling portion rise to the surface of the liquid mass, whence they flow off or are removed to cooler parts of the vacuum pan, and from here they are finally removed by revolving skimmers or other mechanical means. Full drawings of the specially constructed pans are given.—A. J. K.

Improvements in the Method of Filtering and Refining Sugar. F. Bosshardt, Manchester. From Gustav Bocquet, Ham, France. Eng. Pat. 7813, May 28, 1887. 6d.

Some sugar refiners employ in the clarification of their syrups before filtering over animal charcoal a certain dose of impalpable charcoal, varying from $1\frac{1}{2}$ to 3 per cent. in weight of the sugar contained in the fluid syrup, ox-blood is also added, and this latter coagulates on heating, carrying down the charcoal and the impurities of the sugar. This is then filtered from the syrup by various processes. According to this patent the residue, consisting of char, coagulated blood, &c., is taken from the filters without any special previous treatment, and heated to a dull red heat in the absence of air. A granulated charcoal is thus obtained, which, after cooling, treating with weak muriatic acid, and washing well, is said to be superior to the original impalpable char for decolourising purposes.—A. J. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

Recent Improvements in the Manufacture of Spirit. Dingl. Polyt. J. **266**, 418–429.

The German Union of Spirit Manufacturers recently instituted an inquiry concerning the distribution of the different varieties of potatoes, the method of their culture, and the amount of the produce, &c., &c. Prof. Maercker undertook to arrange and classify the large amount of information obtained, and the result is given in the *Zeitschrift f. Spiritusindustrie*, 1887, 50.

E. Hesse has noticed that pressed potato juice sometimes contains 0·4°—0·5° of acid, and the mash prepared from the residue 0·7°—0·9° acid before the addition of yeast; the fermentation was defective. Steaming under strong pressure and particularly hastening the steaming as well as the blowing-off, lessened the evil, so that mashes of 24·75—26·75 per cent. fermented to 1·3—1·8 per cent. in spite of the high amount of acid (compare this Journal, 1887, 830).

Müller of Thurgau has shown that cane-sugar, as well as glucose, is present in sweet potatoes. Dextrin, however, could not be detected.

Nafziger has carried out experiments on the use of the Jerusalem artichoke for the manufacture of spirit (compare this Journal, 1887, 830).

1,160 kilos. of Jerusalem artichoke gave 120 litres of spirit of 87·8 per cent. or 10,536 litres of 1 per cent., and deducting the spirit of the malt (525 litres of 1 per cent.), 100 kilos. of artichoke gave 863 litres of 1 per cent. The spirit had a peculiarly penetrating odour, and was therefore more suitable for industrial purposes than for the production of refined alcohol.

Gumbinner gives directions for the employment of *Dari* for the manufacture of spirit and pressed yeast.

Schrohe states that the state of division of the raw material has the greatest influence on the production of alcohol and yeast. Whilst the interior of the grain must be ground as fine as possible, the hulls must only be ground to a certain extent. The rolling mill is most suitable for dry material, whilst for wet a disintegrator is the best.

The question of how high the temperature of a mash should be allowed to go is treated by Delbrück and others. It is considered that 27°—28° is the maximum limit, and that the limit for thick-mashes (dickmaischen) is lower than that for thin-mashes (dünnmaischen). Delbrück and Foth carried out a series of experiments on this point, using cane-sugar with asparagine and nutritive substances; they found that the fermentation carried on at 27·5° gave the best result, the loss of carbonic acid was greater, the fermentation was more complete, and the amount of alcohol produced larger. Other workers agreed with these results.

E. Müller has made experiments with an apparatus for removing hulls and other impurities from the fluid mash. The experiments have been carried out with potato mashes and were generally favourable.

A trial of Cuisinier's method of preparing mashes has been made by *Saare*. The process consists in completely converting the starch into maltose, first by liquefying the starch at a high temperature (69°—75°) and then saccharifying at a lower temperature (50°). The author has shown that the complete conversion only takes place with weak mashes, and he concludes from his results that the process is not suitable for German distilleries under the present conditions, since the difficulties in the way far exceed the advantages to be obtained.

Delbrück has contributed an article to the *Zeitschrift für Spiritusindustrie* on the preparation and fermentation of concentrated mashes. This must depend on the dryness of, and consequent amount of starch in the potatoes. Another point is the employment of malt carefully dried at the temperature of the air, in place of green-malt. *Mittenzweg* observed in Belgian distilleries that good results were obtained when very concentrated mashes were made at 71°. Delbrück confirms this from his own experiments.

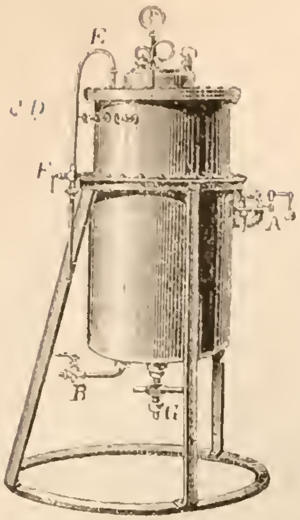
In the course of his experiments Delbrück found that the presence of grains considerably diminished the loss of alcohol from fermenting mashes.

von Tiedemann states that he has used air-dried malt, in place of green-malt, with great success for some years.
—G. H. M.

Pure Yeast in the Brewery. H. Elion. Ztschr. f. d. gesammt. Brauwesen, **11**, 33.

When Hansen had shown that it was possible to select a suitable variety of yeast, and had devised methods for this purpose by which large quantities of pure yeast could be prepared with certainty from a single cell by continued growth, he constructed, in conjunction with Kühle, an apparatus for the preparation and growth of pure yeast on a large scale; this apparatus has been in use for some time in the breweries of Alt- and Neu-Carlsberg. The author, in conjunction with Feltmann, has also devised an apparatus, with some alterations, for the same purpose, and this has been in use in the Heinecken brewery, Rotterdam. The apparatus consists of two parts, a steriliser and a fermenting vessel, of tinned copper. The steriliser (Fig. 1) is 1·20 m. high, and 0·6 m. diameter; it is closed by an air-tight lid, and has a jacket through which steam or cold water can be passed. A is a safety-valve, B the inlet for cold water. Two ventilators, C and D, admit filtered air and pass into the wort; the bent tube, E, is for the exit of

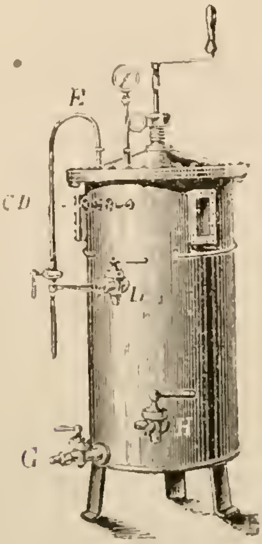
Fig. 1.



the steam generated in the vessel; it is regulated by the tap F. A delicate manometer and thermometer allows the pressure and temperature in the vessel to be observed. The wort is drawn off by the three-way tap G. The vessel is two-thirds filled with wort from the cooler, and this, after replacement of the lid, is boiled. It is then stirred and aërated, whilst excess of pressure is prevented by means of air filtered through sterilised cotton-wool.

The fermenting vessel (Fig. 2) has also two ventilators, C and D, for aëration, an exit tube, E, for the carbonic acid, manometer, and also sight-hole, stirring apparatus, three-way taps, G, H, L, for the inlet and outlet of wort, beer, and yeast, and is surrounded by a pipe, through which water can circulate, in order to be able to maintain the fermenting liquid at the correct temperature.

Fig. 2.



Into the apparatus, previously sterilised by steam, the wort from the steriliser is forced, and pure yeast from the laboratory added. When the fermentation is at an end, the beer is run off, the apparatus filled with wort, stirred, and very nearly emptied. The wort so obtained, and containing yeast, is then transferred to the brewery vessels; the residue in the vessel, with the addition of wort, serves for the further production of the yeast. Pure yeast can thus be continually obtained, without fresh inoculation, since the small amount remaining in the fermenting vessel serves this purpose.

In the brewery mentioned above, two varieties of yeast were cultivated at the same time, and used on a large scale. They not only gave certain characteristics, as taste and smell, in different worts, but also showed a marked difference in attenuation at the end of the primary fermentation. This affords fresh evidence of the constancy of the varieties of *Saccharomyces cerevisiæ*.—G. H. M.

Improvements in the Manufacture of Alcohol. Dingl. Polyt. J. **268**, 91—95.

According to E. Holtz (Ger. Pat. 39,146, September 9, 1886), the purification of alcohol is effected by passing the vapours through a hot Fehling's solution or other alkaline solution of copper. The fusel oil is oxidised by this treatment, whilst the ethyl alcohol remains unaltered.

Reinke is of opinion that in estimating starch the mode of treating the raw products should be taken into consideration. He gives a description of two processes, the one being applicable to cases in which the raw materials are worked up by subjecting them to high pressure (as in the manufacture of alcohol), whilst the other method is adapted to the treatment of the raw products without the application of high pressure as practised in brewing and in the preparation of starch. The estimation of starch according to the former method is performed in the following manner:—3 grms. of the finely-ground substance are treated with 25 cc. of lactic acid (1 per cent. solution) and 30 cc. of water and heated in Soxhlet's steaming apparatus for 2½ hours at a pressure of 3·5 atmospheres. The mixture is diluted with 50 cc. of hot water allowed to cool, made up to 250 cc. and filtered. 200 cc. of the filtrate are then inverted with 15 cc. of hydrochloric acid (sp. gr. 1·125) by boiling for 2½ hours in an Erlenmeyer's flask with upright condensing tube. The mixture is neutralised with sodium hydroxide and made up to 500 cc. with water. 25 cc. are then reduced with Fehling's solution. In the second method 3 grms. of the finely-ground substance are mixed with 50 cc. of water, heated to boiling, allowed to cool to 62·5, and maintained at that temperature for one hour, 0·05 grm. of diastase (prepared according to Lintner's process) being previously added. The mixture is then diluted with water to 250 cc. and filtered, 200 cc. of the filtrate being inverted with hydrochloric acid as above described.

According to Asbóth, starch is estimated by triturating 3 grms. of the substance with water and transferring the mixture to a 250 cc. flask. It is then made up to 100 cc., heated for half an hour, allowed to cool, agitated with standard barium hydroxide, and made up with alcohol to 250 cc. 50 cc. are then titrated with decinormal hydrochloric acid, phenolphthalein being used as indicator.

—D. B.

The Activity of Different Varieties of Malt. Th. Thorawski and M. Gläser. Mittheil. d. k. k. technolog. Gewerbe-Museums, Wein, 1887.

The former views regarding the activity of the different varieties of malt must, according to the investigations of the authors, be corrected as follows: 1. Rye malt has a much greater saccharifying power than malt from oats. 2. Wheat-malt is by no means the most inactive; it surpasses oats-malt very considerably, and, if not superior to, is about equal to rye-malt. 3. The saccharifying power of carefully-prepared rye and wheat-malt is a little less than that of barley-malt; in some cases it has even been found equal. 4. Malt from oats has a less saccharifying power than malt prepared from any other species of corn. 5. Maize-malt prepared at ordinary temperatures has a still lower saccharifying power. If maize-malt is grown at 30°, and the growth stopped when the acrospire has reached 2—3 times the length of the corn, the saccharifying power is considerably increased and reaches that of malt from oats.—G. H. M.

The Decolourisation of Beer by Sarcina. O. Reinke. Wochenschr. f. Brauerei. **5**, 83.

During fermentation the colour of most beers becomes lighter. Chiefly owing to the increase of alcohol, coloured extractive matters, darkened albuminoids, traces of caramel derived from the carbohydrates of the malt by the action of heat, become insoluble, and the yeast from such beers is often coloured dark brown from this cause. The author has now found that bright beers, which at first were very good in the lager cellars, but which after 6 to 12 weeks become turbid and lighter, owe their loss of colour to sarcina. Cultivations of sarcina in sterilised beer-wort also cause a considerable decolourisation after some time.—G. H. M.

Purification of Yeast. Dingl. Polyt. J. **268**, 238—239.

For some time concentrated yeast has been prepared by means of centrifugal machines (*Ibid.* **191**, 337). Lately a successful attempt has been made not only to do this but also at the same time to separate the living yeast cells from the dead ones and bacteria. To the yeast is added a dilute sugar solution, and it is then run into the "separator," in which, by means of centrifugal power, the division of living from dead yeast cells takes place, the former leaving the machine in the desired concentrated condition, the latter being accompanied by bacteria and most of the water. The separation is so perfect that nothing but healthy yeast cells could be observed in the one portion, while in the other but very few such cells were observable. This purified yeast has a remarkable germinating power, a tumbler, one quarter filled with it became filled to overflowing in the course of a quarter of an hour.—J. W. L.

PATENT.

Improvements relating to the Separation of Fusel or Ethereal Oil from Substances containing the same. I. Traube and G. Bodländer, Hanover, Prussia. Eng. Pat. 8387, June 10, 1887. 6*d.*

This relates to the separation of fusel and ethereal oils from aqueous ethyl or methyl alcohols. It has been found that if mixtures of methyl and ethyl alcohols, and water in which ethereal oil or fusel oils are contained be nearly saturated with certain salts, such as sodium carbonate, ammonium sulphate, &c., a separation of the entire liquid into two well-defined layers takes place at certain degrees of concentration and temperature, and upon examination it was ascertained that the upper stratum of liquid contained nearly all the admixture of ethereal and fusel oils that were originally present in the alcoholic liquids.

In practice, in order to arrive at the most favourable results the following method is recommended: 30 to 40 kilos. of anhydrous sodium carbonate or of ammonium sulphate are dissolved in 1 hectolitre of water; to this solution is added, at a temperature of from 20 to 40 degrees Centigrade, 50 litres of raw spirit (of about 80 per cent.) or of raw methyl alcohol at the aforesaid temperatures, two strata of liquid will be formed, the upper of which can be readily decreased or augmented by slightly heating or cooling the liquid, or by adding water or salt. The two strata of liquid are then separated in a suitable manner, and by repeating the treatment once or more with the upper layer, highly concentrated solutions of fusel oil or ethereal oil may be obtained.

From the lower stratum, which consists of mixtures of pure ethyl or methyl alcohol and water, a separation of the alcohol from the solution of the salt is effected by distillation: the distillate will then contain pure alcohol free from fusel oil.—J. H.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

Experiments on the Poisonous Effects of Saffron Surrogate (Dinitrocresol). Th. Weyl. Ber. **21**, 512.

Dinitrocresol, when given in small doses to rabbits, was found to have fatal results. Doses of 0·054 grm. (for every kilog. in weight of the animal experimented upon) suspended in milk or water and poured directly into the stomach, was found in the case of dogs (weighing 5—7 kilog.) to cause vomiting, followed by difficulty of breathing and finally severe seizures of cramp in the extremities, which in the majority of cases ended fatally. Experiments were next tried by injecting 0·02 grm. in dilute alcoholic solution under the skin of medium-sized dogs, with the result that the same symptoms were developed. A few dogs recovered, but the majority succumbed to the effects of the poison. These results show that dinitrocresol should not be used for the purpose of colouring foods.—G. D.

Peptone Preparations and their Valuation. J. König. Dingl. Polyt. J. **268**, 44—46.

Kühne and Chittenden having asserted that the products of artificial peptone digestion brought into commerce mostly contain little or no peptone, the author examined a number of preparations. The following methods were used:—

1. *Moisture* determined by drying 3 to 5 grms. of the sample at 100°—105°.

2. *Total nitrogen* determined by Kjeldahl's method in 1—2 grms.

3. *Fatty matter,* 10—15 grms. mixed with pure sea sand in a Hoffmeister glass dish are dried and powdered, and the anhydrous powder extracted with ether in Soxhlet's apparatus.

4. *Mineral matter* estimated by incinerating the preparation, washing with water, and again igniting.

5. *Peptone* soluble in 80 per cent. alcohol. Five grms. are digested with 20 cc. of water and 100 cc. of 90 per cent. alcohol.

6. *Nitrogenous matter* is separated as follows:—Five grms. are dissolved in 150—200 cc. of water. The solution is boiled for some time, the precipitate collected on a filter and washed with water until the filtrate measures 500 cc. The albumen is determined by drying and weighing the precipitate or by estimating the nitrogen and multiplying by 6·25. 200 cc. of the filtrate which contains the soluble albuminoid matter are heated to boiling with 20—25 cc. of a concentrating solution of acetate of iron. The precipitate is washed and dried and the nitrogen contained therein determined. The weight represents propeptones. The filtrate is evaporated to a volume measuring from 30 to 50 cc. and precipitated with an acid solution of sodium phosphotungstate. After washing the precipitate with dilute sulphuric acid the nitrogen is determined, which when multiplied by 6·41 gives the quantity of peptone present in the sample under examination.

According to Guido Bodländer the peptone is determined in the following manner:—5 to 10 grms. of the sample are dissolved in 300 cc. of water and treated with 5 cc. of acetic acid. The precipitate of albumen and phosphate is collected on a filter, washed, dried, ignited, and the ash deducted. The filtrate and washings are divided into two equal parts and treated as follows:—One half is heated and saturated with sodium sulphate, the precipitate is collected on a tared filter, washed with a saturated solution of sodium sulphate acidified with acetic acid, dried and ignited. The residue is treated with sulphuric acid and the quantity of the latter determined in the sodium sulphate thus formed. The weight obtained is then deducted from the total quantity of precipitate, the difference representing *propeptone.* The second half of the solution is precipitated in the cold with ammonium sulphate, the precipitate collected, washed with a saturated solution of ammonium sulphate, dried and weighed. The ammonium sulphate is then determined by estimating the sulphuric acid and the weight deducted from the total precipitate. The difference, less the amount of propeptone previously determined, gives the *mesopeptone* contained in the sample.—D. B.

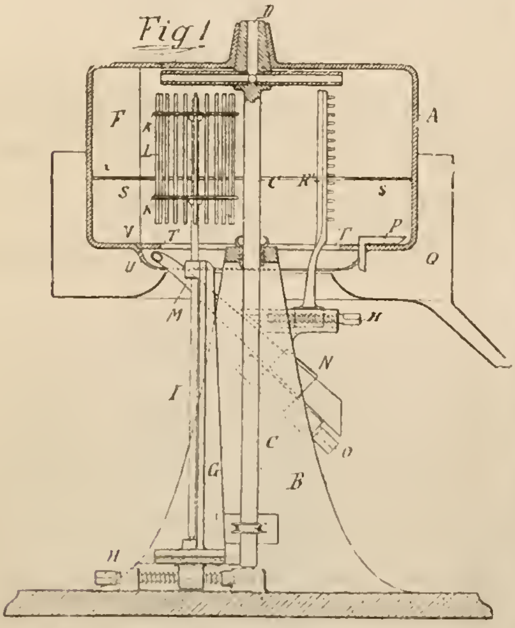
Have Vegetable Albuminoids the same Nutritive Value for Man as the Animal Albuminoids? F. Rutgers. Ztschr. f. Biol. **24**, 351.

From the author's researches it appears that the animal albuminoids can be replaced by the vegetable with the same amount of nitrogen, without the balance of nitrogen being sensibly altered, but with the Leguminosæ the alimentary canal is more loaded than with flesh diet. The amount of acid in the stomach and in the urine is less with a pure vegetable diet than with a mixed diet with flesh.—G. H. M.

PATENT.

Improvements relating to the Manufacture of Butter, and to Apparatus therefor. C. A. Johansson, Stockholm. Eng. Pat. 3994, March 15, 1888. 8*d*.

The improvements embraced in this invention have for their object the production of butter direct from new milk without the previous separation and subsequent churning of the cream. The whole operation is accomplished in one apparatus. The accompanying drawing shows an apparatus resembling the well-known "cream separator" or centrifugal skimming machine. Milk is run into the vessel A, at D, which revolves at 6,000 to 8,000 per minute. The milk proper, of course, as the heavier body, clings to the side of the vessel, and passing through pipe P emerges from the casing Q by the outlet-pipe. The cream being lighter takes the inner path, and whilst revolving at this high speed is beaten by the wheel L, which may be of several shapes, and is adjusted by the screw H to the correct depth. The membrane of the fat globules is burst, and butter formed, which passes over the lip T, and is scooped out of the lower part of the vessel by the pipe M in a continuous stream.—C. C. H.



(B)—SANITARY CHEMISTRY.

The Poisonous Character of the Bases formed in the Alcoholic Fermentation. R. Wurtz. Compt. rend, **106**, 363.

The author shows by experiments with frogs, guinea-pigs, and rabbits the poisonous nature of the bases, boiling at 171°—172°, isolated by Morin. Frogs with an average weight of 10 grms. died in 2—3 minutes with a subcutaneous injection of 0·005 grm. of the base in 1 : 10 aqueous solution.—G. H. M.

The Antiseptic Properties of α-Naphthol. J. Maximovitch. Compt. rend. **106**, 366.

α-Naphthol is insoluble in cold water. One litre of dilute alcohol, containing 400 cc. of absolute alcohol, dissolves 10 grms. of the substance. The author has studied the antiseptic action of this substance towards 14 different microbes, and finds that α-naphthol acts more strongly antiseptic than does β-naphthol, according to the recent researches ot Bouchard (this vol., p. 225). At the same time α-naphthol is less injurious to the animal organism than β-naphthol. In order to kill a rabbit 9 grms. of α-naphthol must be used for every kilo. of the weight of the animal, showing that it is three times less poisonous than β-naphthol, and 700 times less than mercuric iodide.
—G. H. M.

PATENTS.

Improvements in and connected with the Manufacture of Material for Purifying and Filtering Water, Saccharine, and Alcoholic and other Fluids. H. Rimmer, Liverpool. Eng. Pat. 8357, June 10, 1887. 8*d*.

The object of this invention is to enable comparatively impure iron ores to be used for the manufacture of "magnetic carbide of iron." The ore in small pieces mixed with 25 per cent. of coke fragments and 5 per cent. of sawdust is introduced through a series of hoppers on to the bed of a specially arranged gas-heated muffle furnace. Here it is maintained with frequent stirring at a cherry-red heat for about two hours, by which time the peroxide will have become converted into magnetic oxide, though no further reduction to the metallic state is to be permitted. The "magnetic carbide" thus produced is drawn out into barrows, quenched in cold water, and treated with hydrochloric acid of 1° to 2° Tw. for from two to six hours, to remove lime, magnesia, phosphorus, and sulphur. After washing and drying the material is ready for use as a filtering medium.—W. G. M.

Apparatus to be used in the Disinfection, Deodorisation, and Purification of Foul Matters. J. Hanson, Wakefield. Eng. Pat. 8441, June 11, 1887. 8*d*.

The apparatus consists of a closed box in which are placed sulphites or hyposulphites or the like. A syphon communicates with a vessel containing acid, the flow of which is regulated as desired. The sulphurous acid given off may be stored in a gas holder, from whence it is conveyed by a pipe to the sewer or other place which requires disinfection.
—C. C. H.

Improvements in Absorbing Moisture from and Deodorising Fæcal and other Refuse Matter and Utilising the whole as a Manure. D. McGregor and J. McArthur, Dundee. Eng. Pat. 8528, June 14, 1887. 4*d*.

Pulverised slag, clinker, and materials of a like nature is used in closets, ashpits, urinals, or other such places where fæcal matter or urine may be deposited.—C. C. H.

Improvements in Apparatus connected with the Treatment of Sewage. F. W. Lacey, London. Eng. Pat. 8800, June 18, 1887. 8*d*.

The various improvements described consist of (1) the admission of air, by means of a cock, into the suction pipe of sewage pumps for the purpose of oxidation; (2) passing the effluent from precipitating tanks through porous or textile materials to secure classification and disinfection; (3) the application of a suction or vacuum pump to the delivery pipe of a filter press; (4) constructing filter press plates in the form of a grating, each side covered with a perforated plate so as to effect the cleansing of the cloths on the machine by means of steam or water; (5) forming the bearing studs or stays, used to prevent breakage, from a pin in combination with a peg, washer, or collar.—C. C. H.

A New or Improved Process for preserving Fish, Meat, and other Victuals. J. F. V. Steenberg, Copenhagen. Eng. Pat. 9247, June 29, 1887. 4*d.*

The fish is packed in peat dust or charcoal, and separated therefrom by layers of porous paper. Materials not in themselves antiseptic, *e.g.*, rice husks or sawdust, are also used, and effect the desired object merely by the exclusion of the atmosphere.—C. C. H.

A Water Softening Apparatus. W. Tapp, Bristol. Eng. Pat. 10,023, July 18, 1887. 4*d.*

A closed porous pot containing borax, sodium bicarbonate, lime, or other reagent suitable for softening the water, is immersed therein. The invention is only intended for use with vessels such as ewers where the supply of water is poured off daily, and then renewed.—C. C. H.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

Improvements in the Production of Sulphurous Acid or Salts, or Solutions containing Sulphurous Acid, and in the mode of applying the same to the Treatment of Wood-Pulp and other Purposes. I. S. McDougall, Chadderton, near Manchester. Eng. Pat. 1349, March 13, 1883. 4*d.* Second Edition.

The object of this invention is to do away with the condensing towers or columns, the proper working of which is troublesome. The inventor burns sulphur, pyrites, or spent oxide of iron in closed vessels, into which a current of air is driven by a fan or pump. The current of air is sufficiently powerful to drive the sulphurous acid gas formed into a vessel containing the wood or other fibrous material to be treated, and water or a solution of an alkali or alkaline earth. Or the gas may be driven into a separate vessel containing water or alkaline solutions. The working of the apparatus is completely under control.—E. J. B.

Improvements in Boilers or Vessels employed in the Treatment of Fibrous Materials for the Manufacture of Paper Pulp, or for other Purposes. I. S. McDougall, Manchester. Eng. Pat. 3257, June 30, 1883. 6*d.* 2nd edition.

This invention relates to a method of lining iron vessels with lead for treating wood with solutions of sulphurous acid, and for other purposes.

Great difficulties have hitherto been experienced in all such lead-lined vessels when submitted to high temperatures owing to the tendency of the lead lining to creep and bulge. This is due to the fact that the lead does not contract on cooling to the same extent as it expanded on heating.

By this invention the lead lining is secured to the iron by means of a large number of bolts passing through the iron and the lead, and securely fastened by means of nuts. The head of the bolt is protected from the action of the solution by being itself covered with lead, which is burned on to the main covering. Where preferable, washers may be placed under the bolt heads in order to give a greater binding surface. The bolts should be placed at intervals of 9 to 24 inches, according to the thickness of the lining and the temperature to which the vessel is to be subjected. By means of this invention the durability of the lead lining is much enhanced.—E. J. B.

A Manufacture of "Cellulose" or Wood Pulp from a certain Tree-bark and Wood, and Treatment and Process employed for obtaining such Material. H. J. Simpson and G. de Montmorency Mackirdy, Liverpool, and A. Taylor, Edinburgh. Eng. Pat. 8817, June 18 1887. 6*d.*

The inventors utilise the bark and wood of the Californian red-wood tree for the purpose of preparing paper-pulp by alternate treatment with caustic soda and dilute sulphuric acid. From the bark itself three different grades of cellulose can be obtained: the outer bark yields a coarse pulp; the middle portion may be used as a textile material, whilst the portion nearest the wood yields a finer pulp. The different portions may be separated by mechanical means.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

On Sulphonal. B. Fischer. Pharm. Zeit. **33**, 235.

Professor Kast recommends this as a new soporific. It consists of diethylsulphodimethylmethane, $(CH_3)_2C(SO_2C_2H_5)_2$, first prepared by Baumann. It forms colourless, heavy, prismatic crystals, which fuse at 130·5° C., and dissolve in 18 to 20 parts of hot and about 100 parts of cold water. It is given to adults in doses of 2 grms.—S. H.

Notes on Cosso. E. Listard. Journ. Pharm. Chim. **17**, 507.

The Cosso, which is used as an energetic laxative, contains cosine, tannin, resin, and a volatile oil. Cosine is regarded by Stromeyer as an alkaloid, while the author considers it to be an acid. It combines with alkalis and lead oxide. For the preparation of cosine, cosso mixed with 2 per cent. of lime is extracted with 80 per cent. alcohol, and then with boiling water. The two extracts are mixed, filtered, concentrated, and the residue is treated with glacial acetic acid. A precipitate is formed, which is washed with water, and dried at a gentle heat. It consists of cosine, tannin, and resin. It is treated with sodium bicarbonate, and extracted with chloroform, whereby insoluble sodium cosinate is left behind, the aqueous solution of which is decomposed by acetic acid. After washing with water, the cosine is re-crystallised from 90 per cent. alcohol. It fuses at 142° C., and is soluble in alcohol, ether, chloroform, benzene, carbon bisulphide, and naphtha. It gives a red colouration with ferric chloride, but no precipitate with potassium iodide and Meyer's reagent. The tannin of cosso gives a green precipitate with iron salts, a green colouration with ammonia, and a copious yellow precipitate with lead acetate. The resin of cosso is brown, and has an unpleasant smell and a bitter taste. It is soluble in amylalcohol, chloroform, carbon bisulphide, and oils, insoluble in benzene. It combines with alkalis. 500 grms. of cosso-flowers yield 48 grms. of resin.—S. H.

Cinchona-Bark from the District of the Mapiri River in Bolivia. L. Schäfer. Arch. Pharm. **26**, 303.

In the valleys on the east side of the Cordilleras are now extensive plantations of cinchona, which yield from 2 to 3 kilos. of very valuable bark per tree. Bark taken from *Cinch. Zambamorada* and *Cinch. Zambaverde* grown in this district contained as much as 3·72 and 4·88 per cent. of quinine respectively.—S. H.

Santonine. L. Knapp. Dingl. Polyt. J. **268**, 42—44.

In the process of extraction and purification of santonine, solutions and extracts are obtained which may contain santonine, and therefore require to be tested for the presence of this substance. Linde's reaction consists in mixing a few drops of the solution with concentrated sulphuric acid, whereby a violet colour is obtained varying in depth of tint with the amount of santonine present in the solution. This test can, however, be applied only to colourless solutions. In order to examine coloured solutions, Kossakoffsky recommends to precipitate the colouring-matter with lead acetate and then treat the filtrate with sulphuric acid.—D. B.

PATENTS.

An Improved and entirely New Method for the Admixture of Ferrous Sulphate, or Sulphate of Iron and Potassium Carbonate, or Carbonate of Potassium so that Chemical Action between them is prevented until the Medicines are exposed to each other in the presence of Moisture. T. Thompson, Edinburgh. Eng. Pat. 5419, April 14, 1887. 6*d.*

As ordinarily prepared, both sulphate of iron and carbonate of potassium contain water of crystallisation, and hence, on mixing, carbonate of iron is at once precipitated. The inventor dries and thoroughly incorporates each ingredient with almond oil, petroleum oil, or vaseline, or some resinous substance. The mixture of the two substances is then made up into pills and coated with gelatin, or filled into capsules of gelatin or membrane.—S. G. R.

Improvements in the Treatment of Benzoyl-sulphonic Imide (commonly known as "Saccharine.") A. G. Salamon, London. Eng. Pat. 13,829, October 12, 1887. 6*d.*

In using saccharine for domestic purposes it is necessary, in order to dissolve it, to employ a certain percentage of alkali. The patentee proposes to produce a soluble neutral salt by dissolving saccharine in water with the addition of about three-fifths its weight of sodium bicarbonate and evaporating the mixture to dryness. The residue is then ground and ready for use.—D. B.

Improvements in the Manufacture of Hydrochlorate of Quinine. L. B. Weld, Mass., U.S.A., per P. M. Justice, Middlesex. Eng. Pat. 3949, March 14, 1888. 4*d.*

Sulphate of quinine dissolved in alcohol is boiled with a solution of sodium chloride in excess in an open or closed vessel for about 10 minutes; the proportions are about one part of quinine sulphate to four parts of sodium chloride and 50 parts of alcohol. On concentration the sodium sulphate and chloride separate first, and then the hydrochloride of quinine, which can be readily obtained in the crystalline state.—S. G. R.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Gelatin Emulsion by means of Silver Carbonate. Phot. Wochenbl. **14**, 94.

Stolze proposes the following method:—A solution of 30 parts of silver nitrate is precipitated by 26 parts of crystallised sodium carbonate, and the precipitate, after washing, dissolved in ammonia. This solution is added to a solution of two parts of gelatin in 400 parts of water of 25° C.; 14·5 parts of bromine are mixed with 40 parts of 92 per cent. alcohol, and this solution is gradually added to the silver-gelatin solutin, which is thereby heated considerably. A small portion is then tested with potassium chromate for silver, which is not combined with bromine. The latter must be in slight excess in order to decompose all the ammonium carbonate; 40 parts of hard gelatin are then added to the emulsion.—S. H.

Silver Iodide in the Silver Bromide-Gelatin Emulsion. Phot. Archiv. **29**, 52.

If silver iodide emulsion and silver bromide emulsion be mixed with each other, the sensitiveness of the mixture is diminished. On the other hand, if silver bromide and iodide are produced at the same time in the emulsion the sensitiveness is increased. The best result is obtained if silver bromide is precipitated, while silver iodide already exists in the mixture.—S. H.

XXII.—EXPLOSIVES, MATCHES, Etc.

Twelfth Annual Report of Her Majesty's Inspectors of Explosives (Year 1887).

During the past year only one modification has been made of the general law of 1875 relating to explosives. The present modification constitutes the seventh which has been effected since the Act came into operation twelve years ago, and is the result of the inquiry instituted into the explosion of June 1887, at the chemical works of Messrs. Roberts, Dale, and Co. The inquiry showed that under certain conditions, and unless surrounded with certain other precautions, picric acid and mixtures of picric acid with certain other substances were liable to give rise to very serious explosions. Whereas hitherto picric acid, picrates, and mixtures of picric acid with certain other substances have fallen within the definition of "explosive" contained in the Act only when manufactured or used with a view to producing a practical effect by explosion or a pyrotechnic effect, these substances will henceforth be deemed to be "explosive" within the meaning of the Act for whatever purpose used or manufactured, under the following conditions:—

(1.) Picric acid in process of manufacture and storage only, except when wholly in solution or when manufactured or stored in a place exclusively appropriated to the same, and where the necessary precautions are observed.

(2.) Picrates and explosive mixtures of picric acid with other substances for all the purposes of the Act, except when wholly in solution.

In its general operation the Act continues satisfactory: the loss of life in connexion with the manufacture of explosives was only eight, the average for 10 years being 7·5, whereas before the Act came into operation the average was 37 (from 1871—1874).

Moreover, the number of factories in 1876 was only 55, against 108 factories in 1887.

The one imperfection arises from a somewhat careless administration by the local authorities. During the year, two factories ceased to exist, and three new ones were licensed.

With respect to "quick-firing ammunition," special rules are made, and care is taken that such ammunition shall be made for Imperial service only, and under special superintendence of representatives of the War Office.

The following explosives have been added to the list of authorised explosives:—

Tube safety fuse, colliery safety lighters, roburite, dynamite No. 1, and quick firing ammunition. (This Journal, May 1888.)

During the year five explosives were submitted for examination, viz., roburite, amide powder, a powder submitted by Mr. Borland, carbo-dynamite, and victorite. All were passed except victorite.

In two factories the charges to be worked in incorporating mills have been increased to 80 lbs., and as yet without accident.

Toy firework factories are not included in those considered above; the number at present existing is 13, all of which are in the metropolitan district. In 1880 the number of small firework factories was 29, and since then there has been a gradual falling off; in 1885 it had fallen to 20, since which time no returns have been made. The decrease is due to the fact that the larger manufacturers now make these small wares, to give employment to their workpeople, when nothing more remunerative is in progress.

By the Coal Mines Regulation Act, 1887, loose gunpowder is not allowed to be taken into coal mines; all explosives must be introduced in the form of cartridges in a case containing not more than 5 lbs. This may lead to increased activity in the manufacture of gunpowder cartridges.

With regard to the illegal manufacture of fireworks, this is still carried on to some extent, in the case of the smaller fireworks, "shop goods." This practice can only be stamped out by the local authorities taking the matter energetically in hand. Several cases were brought to light during the year, chiefly by the occurrence of accidents.

In the general improvement in factories, already noted in previous years, there is no falling off, and it would seem that the workpeople themselves are beginning to recognise the value of the Explosives Regulations. In only two cases was it found necessary to take proceedings for irregularities.

With regard to the storage of explosives, the number of magazines is 347, against 354 the previous year. An improved system of construction for magazines is now insisted on; the walls must be not less than 18 ins. thick, and must be built of Portland cement concrete; the roof must be similarly made, or may be slated or tiled, and must be secure against unlawful entry. The magazine must be lined with wood, and the doors must be so arranged as to prevent any possibility of unlawful entrance.

In two cases only were proceedings taken for irregularities in magazines, and in three other cases, where irregularities were found, the explosive was seized. No accidents occurred in magazines by fire or explosion.

Efforts are continued to repress the practices of "breaking bulk" on registered premises, and of exposing fireworks on shop counters, &c. Three accidents occurred on registered premises during the year, one of which, causing four deaths and injuring four persons, was owing to breaking bulk.

Regulations as to the safe packing and marking of explosives are well attended to except by gunmakers, who sometimes use cardboard boxes, which are moreover either improperly marked or not marked at all.

In several cases convictions were obtained for illegal conveyance. The carts used were in some cases not in the charge of a competent person, uncovered boxes of fireworks were conveyed on a trolly, &c.

The importation of foreign dynamite shows a decrease, the total being 707,500 lbs. as against 1,073,800 lbs. in 1886, the amount in each of the years 1882 to 1885 being also over 1,000,000 lbs. The decrease may be partly explained by the growing preference of miners for the gelatinous forms of nitro-glycerine compounds as made at Ardeer, and partly by the formation of the Dynamite Convention (the "Nobel Dynamite Trust Company").

Several cases of illegal importation occurred and were dealt with accordingly; on three occasions the irregularities were caused by passengers from America having in their possession small quantities of dynamite, brought in ignorance of the law.

The work of inspection and search shows, by the lowering of the number of cases where proceedings were instituted, a more general observance of the Act. Out of 51 samples of amorces, however, no less than 10 had to be rejected on account of their containing an excess of explosive material beyond the proportion licensed.

For some years firework-makers seemed to realise the danger arising from the use of sulphur in the presence of a chlorate; in the present year, however, two out of seven samples of Bengal fires had to be rejected on account of this irregularity. The ultimate ignition in such cases is merely a question of time and circumstances. In the presence of moisture, and with an initial temperature of from 80° to 90° F., spontaneous ignition is sure to take place whenever the mixture is placed under conditions favourable to the retention of heat, or where in sufficient bulk. Even with perfectly washed sulphur the danger, although somewhat reduced, is not entirely done away with. The 18 samples of blasting gelatine and gelatine dynamite were all highly satisfactory.

All samples of Cooppal's powder stood the test, whereas in 1886 every one had to be rejected. Dynamite No. 1 was also found highly satisfactory. In this connexion a few remarks may be made on a number of explosives (Judson dynamite, blasting gelatines, &c.) manufactured in America, and samples of which were collected. A striking fact is the entire absence of an inert base for the absorption of the nitro-glycerine, such as is used in Europe. In the case of all explosives comparable to the English dynamite No. 1, *i.e.*, those in which the nitro-glycerine is only mechanically absorbed, the absorbing material is wood pulp or sawdust mixed with a sufficient proportion of a nitrate for its complete combustion when the material is exploded. This has an advantage over Kieselguhr in that the absorbed nitro-glycerine cannot, practically, be expelled by water; a great disadvantage is, however, the increase of bulk. Another striking fact is the absence of the nitrates of barium and potassium; they are replaced by the deliquescent nitrates of soda and ammonia, protection against the action of moist air being afforded by a coating of resin or soft paraffin.

Experiments were made to ascertain the effect on gelatine dynamite of an addition of carbonate of calcium, magnesium, or sodium. Calcium carbonate or magnesium carbonate does not affect the duration of the heat test, whilst sodium carbonate has an uncertain effect, increasing the length of time, which bad samples stand the heat test, and decreasing it in the case of good samples.

The total number of accidents from explosives, as reported during 1887, was 130, causing 43 deaths and injuring 105 persons. The number of inquiries held was seven. The record of accidents in manufacture alone was 63, as against 73 in 1886, and was less than in any year since 1880. The accidents have, however, been of a more fatal character than in any year since 1884, eight deaths having resulted and 18 persons having sustained injury. The most conspicuous explosion during the year was the destruction of a glazing-house at Hounslow, due probably to either the fracture of a portion of the machinery, or matches maliciously placed on the platform of the glazing-house. Another serious explosion was that of a press-house at Kennall Vale, due probably to some blow or friction in taking the press-box to pieces. The inspectors consider the use of press-boxes to be an element of unnecessary risk, and the larger proportion of gunpowder factories now no longer use them.

The accidents in the use of gunpowder are slightly in excess of the average. The total number was 33, causing 18 deaths and injuring 32 persons. The average of accidents for the past 10 years is 28·6; the average number of deaths 15·7, and the average number of persons injured 34.

In the use of dynamite and other nitro-glycerine preparations 17 accidents happened, causing 10 deaths and injuring 21 persons; the average for 10 years is 18·2 accidents, 10·8 deaths, and 21·9 persons injured. A large and very fatal proportion of these accidents is furnished by the improper thawing of dynamite, and direct disregard of the printed instructions.

Firework accidents were more numerous than usual, two persons being killed and ten injured. The increase might have been anticipated from the quantity of fireworks used in the Jubilee celebrations.

Various cases of outrages and malicious attempts are reported, but none were of any great importance.—T. L. B.

Compounds of Caustic Soda and Methyl Alcohol.

C. Göttig. Ber. **21**, 561.

The solid obtained by the evaporation of a solution of sodium hydrate in methyl alcohol placed on the surface of water moves about rapidly in the act of solution. The analysis of this compound has often been attempted, but the results obtained did not agree. The author shows that the composition varies according to its method of preparation.

Perfectly dry caustic soda was dissolved in absolute methyl alcohol, and the solution placed in a flask connected with a reflux condenser and boiled for 1—2 hours, care being taken to exclude all traces of moisture. The excess of methyl alcohol was then distilled off, and the residue allowed to crystallise in a hermetically-sealed vessel. The crystals obtained correspond approximately in composition to the formula $5\ NaHO + 6\ CH_4O$. In a second set of experiments carried out in exactly the same way, methyl alcohol was used, to which a small quantity of water had been added; the compound obtained in this case corresponded fairly well with the formula $NaOH + \frac{1}{2}\ H_2O + CH_4O$.

A third series of experiments with methyl alcohol containing from 10—20 per cent. of water yielded—

$$NaOH + 2\ H_2O + CH_4O,$$

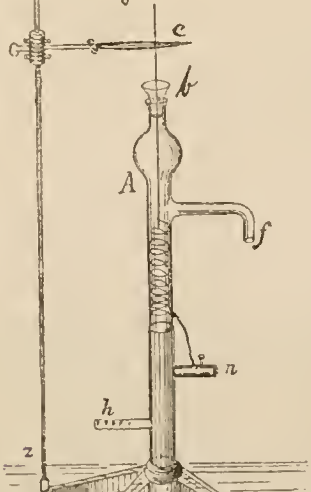
but the results were not very concordant. All the compounds are easily decomposed by carbon dioxide and water. —G. D.

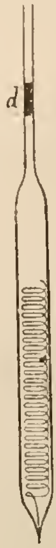
XXIII.—ANALYTICAL CHEMISTRY.

On the Detection of Minute Quantities of Mercury by Electrolysis. C. H. Wolff. Zeits. f. angew. Chem. 1888, 294.

The electrolytic apparatus employed for this purpose consists of an upright tube glass A (Fig. 1), which contains the two electrodes. The positive electrode is in the shape of a spiral of strong platinum wire, which is fused to the sides of the tube and passing through the glass is fastened to the clamp *n*. The negative electrode consists of a spiral of thin iron wire, which is first coated with copper and finally with silver. It is hung inside the platinum electrode, and passing through the stopper *b*, it is fastened to the small clamp *c*, which slides on a vertical metal rod. The latter is connected at *z* with the zinc pole of the battery. The liquid to be tested for mercury is allowed to enter the apparatus at *h*, and its flow is so regulated that it overflows at *f* at the rate of one drop every five seconds. At this stage the electric current is passed through the liquid and mercury soon commences to deposit on the cathode. Before treatment the liquid is acidified with sulphuric acid, and if it contains organic matter (which is mostly the case, as the apparatus is chiefly employed for detecting mercury in urine), the latter is first destroyed by hydrochloric acid and potassium chlorate. The liquid must pass through the apparatus three times before the whole of the mercury is deposited. The cathode is then withdrawn, and after being washed with water, alcohol, and ether, it is fused into a glass tube in the manner shown in Fig. 2. The spiral is then carefully heated, whereby the mercury is volatilised and deposited at *d*. The bottom of the tube is then opened, and after withdrawing the spiral, a small amount of iodine is introduced into the tube. The iodine is volatilised by gentle heat and, ascending into the narrow part of the tube, changes the metallic mercury into the iodide, which can be readily identified by its characteristic properties. The method is extremely delicate; 0·00001 grm. of mercury dissolved in 100 cc. of water give a very distinct ring of the iodide. The negative electrode must be renewed after every test. For further particulars the original article should be consulted.—S. H.

Fig 1.





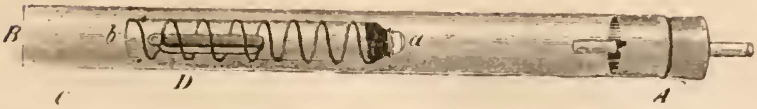
Application of the Polariscope to the Determination of Optically Inactive Substances. Landolt. Sitzungsber der Königl. preussischen Akademie der Wissensch. zu Berlin, 1887, Vol. 48.

It is well known that the presence of optically inactive substances in a solution containing an optically active body often influences the specific rotatory power of the latter to a considerable extent. The author proposes to make use of this property of optically inactive substances for their determination by means of the polariscope. The specific rotatory power of an active substance is determined in presence of the inactive substance, the quantity of the latter being varied so as to obtain a number of specific rotations of the active body which would correspond to certain percentages of the inactive body. Professor Landolt hopes that this method may prove of value for the purpose, even, of the determination of *two* different inactive substances when present in solution together.—J. W. L.

Quantitative Estimation of Ash. L. Reese. Zeits. Anal. Chem. **27**, 133.

The author has constructed the apparatus shown in the figure for the determination of ash in those substances which, like albumen, froth up on heating, and leave a residue of coke which is not readily combustible. The apparatus

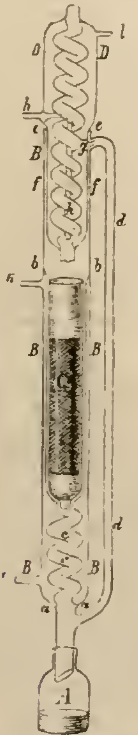
Fig. 8.



consists of a tube A B of infusible glass, into which a narrower and shorter tube *a b* is placed. The tube A B is 40—50 cm. long, the diameter depending upon the quantity of substance employed. To the end of A a water-jet aspirator is attached. The open end *a* of the inner tube *a b* is covered with platinum gauze to retain particles of substance, which may be mechanically carried on by the current of air. *a b* is covered with platinum wire to prevent it adhering to the tube A B. The substance to be burnt is placed in a small porcelain boat, and is weighed with the inner tube. It is replaced in the outer tube, a current of air is aspirated through, and the tube first heated so as to thoroughly dry the substance in the current of hot air. The heating in hot air is continued until all volatile and combustible matter is driven off, air being, if necessary, replaced at the end of the operation by oxygen.—J. B. C.

Fat-extraction Apparatus. O. Foerster. Zeits. Anal. Chem. 27, 173—175.

The apparatus is devised for extracting fat at a low temperature, a method which, the author believes, prevents the solution of extraneous substances.



The portion B in the figure, where the extraction proceeds, is surrounded by a condenser from *a* to *b* to prevent rise of temperature from the water bath, and to condense the solvent before reaching the substance. In connexion with the inner vessel C is a worm attached to the flask A. The vessel C consists of a glass cylinder which contains the substance for extraction, and may be removed from the apparatus for cleaning. Below B a side tube is attached, connected above with the extraction tube at *g*. At this part of the tube D is an arrangement similar to that at B. There is an open condensing worm surrounded by a condenser. The whole of this portion of the apparatus is ground into the lower portion at *e f* and is removable.—J. B. C.

Volumetric Estimation of Sulphuric Acid. A. Gawalowski. Zeits. Anal. Chem. 27, 152—159.

The method is based upon the decomposition of sulphates with excess of $BaCl_2$, and titrating the excess with an alkaline carbonate.

$$K_2SO_4 + 2\,BaCl_2 + Na_2CO_3 =$$
$$2\,KCl + BaSO_4 + BaCO_3 + 2\,NaCl.$$

The most convenient standards for the solution are $\frac{1}{2}$ normal.

The neutral sulphate is dissolved in water. Standard $BaCl_2$ solution is added, and diluted with 30—40 cc. water. The solution is stirred, and allowed to stand $\frac{1}{4}$—$\frac{1}{2}$ hour. A few drops of alcohol are added, and soda solution added until the phenolphthalein, which is used as indicator, changes to a permanent rose colour.—J. B. C.

Volumetric Estimation of Phosphoric Acid. C. Schindler. Zeits Anal. Chem. 27, 142—146.

The method is based upon the formation of a compound of phosphomolybdate of ammonia of definite composition.

The following solutions are requisite :—

1. *Molybdic acid.* To a litre of molybdic acid solution prepared in the usual manner, 30 cc. of a solution of citric acid containing 500 grms. in the litre are added.

2. *Concentrated ammonium nitrate solution* containing 750 grms. NH_4NO_3 in the litre.

3. *Dilute ammonium nitrate solution* containing 100 grms. NH_4NO_3 in the litre and 10 cc. HNO_3.

4. *Magnesia mixture* prepared according to Fresenius.

5. *Lead solution*, 1 cc. of which corresponds approximately to ·04 grm. P_2O_5. This is obtained by dissolving 55 grms. lead acetate in 1 litre water.

6. *Ammonium molybdate solution*, 1 cc. of which corresponds to 1 cc. lead solution, 25 grms. ammonium molybdate are dissolved in 1 litre and standardised against the lead solution.

7. *Tannin solution.* 1 grm. tannin is dissolved in 20—30 cc. water.

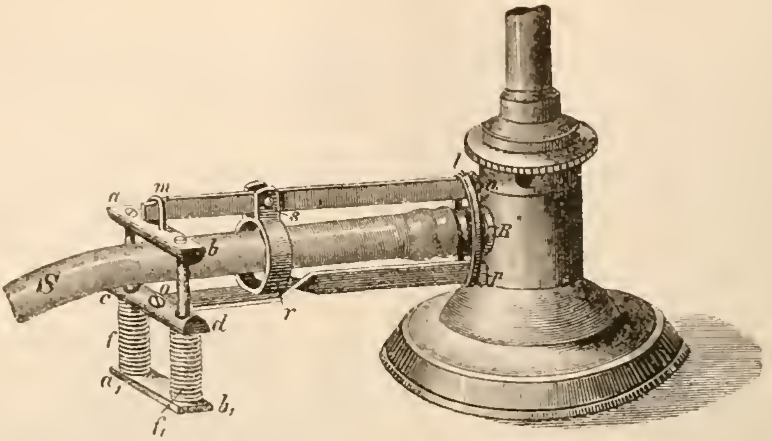
The analysis is conducted as follows :—

50 cc. of nitric acid solution of phosphoric acid containing 0·5 grm. substance are taken and so much of solution 2 added that in every 100 cc. solution after precipitation there are 25 grms. NH_4NO_3. Then solution 6 is added at the rate of 100 cc. for 0·1 grm. P_2O_5.

To the solution of molybdic acid, boiling water is added until the volume amounts to 3—400 cc. Lead solution is added until the molybdic acid is precipitated, and a slight excess of lead solution remains. This is tested with a drop of tannin solution on a white porcelain plate, and, if excess is present, decinormal molybdic acid solution is added until a drop gives a distinct orange colouration with the tannin. The experimental results given by the author are very satisfactory.—J. B. C.

Safety Pinch-cock. v. Klobukow. Zeits. Anal. Chem. **27**, 168—173.

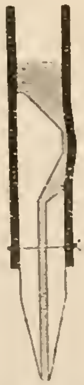
The apparatus consists of a pinch-cock with strong springs f and f^1, and is fitted to the tubing S in contact with the lamp. The pressure is brought to bear on the tubing between the rods *a b* and *c d*. The portion *a b* is connected with a rod *m* moving on a swivel *s* and attached at *l* to a ring. The lower rod *c d* is rigidly attached at *r*. The cock is opened by the pressure of the ring *l p*, which is made of fusible metal, and if the lamp flame burns down the metal melts and releases the pinch-cock.—J. B. C.



Burette Nozzles. O. Binder. Zeits. Anal. Chem **27**, 178.

The shape of the nozzles may be seen from the figure. They are constructed in such a way that a thin stream of liquid is forced not vertically downwards, but bent to one side before running in a vertical direction. In this way bubbles of air are avoided.—J. B. C.

Fig. 17



Estimation of Ferric Oxide in Iron Ores. L. Blum. Zeits. Anal. Chem. **27**, 146—151.

Four—five grms. substance are dissolved, the SO_2 separated, and the solution made up to 500 cc. 50 cc. are drawn off, tartaric acid added in sufficient quantity to prevent precipitation on adding NH_4OH, the solution is diluted and ammonium sulphide added. The sulphide of iron is dissolved in dilute HCl, oxidised, and precipitated with ammonia, and weighed as Fe_2O_3. The author finds that by the above method, which is often adopted for separating iron from alumina in iron ores, too high a result is obtained owing to the precipitation of ferric phosphate with the oxide, the phosphoric acid being present in the ore as magnesium phosphate. To avoid precipitation of the phosphate, the sulphide of iron is precipitated in the hot solution from a very dilute solution, and only half an hour allowed for the sulphide of iron to settle before filtering. In this way precipitation of the magnesium phosphate is avoided.

—J. B. C.

Volumetric Estimation of Molybdic Acid and Lead. C. Schindler. Zeits. Anal. Chem. **27**, 137—142.

If solutions of lead acetate and ammonium molybdate are brought together, a white precipitate of lead molybdate $PbMoO_4$ is formed, which subsides quickly on heating. This precipitate is quite insoluble in dilute acetic acid, and may be used for the quantitative determination of molybdic acid as well as that of lead. This may be done volumetrically, tannin being used as indicator. A drop of tannin solution gives a red colouration with ammonium molybdate, which is visible in a solution of 1 in 400,000, whereas lead molybdate gives no colouration, and lead acetate only a greenish colouration. The following solutions are employed :—

1. A solution of lead acetate. 40—50 grms. lead acetate are dissolved in water with the addition of a little acetic acid, and diluted to a litre. It is standardised with a known weight of pure ammonium molybdate.

2. A solution of ammonium molybdate in which 1 cc. corresponds to the same volume of the lead acetate solution. 20 grms. commercial ammonium molybdate are dissolved in 7—800 cc. water, ammonia added until the faint turbidity disappears.

3. A dilute solution of tannin in water, 0·1 grm. in 30 cc. It is better to renew this solution for each set of experiments. The solution is heated to 58°, allowed to settle for 5—10 minutes, and the liquid decanted and passed through a filter. The precipitate is washed with 50 cc. dilute NH_4NO_3 by decantation, and dissolved in 3 per cent. ammonia solution. The solution, together with that dissolved off the filter, is brought into a ¼-litre flask. 10—20 cc. magnesia mixture added, and made up to the mark and filtered. 50 cc. of the filtrate are taken, acidified with acetic acid, and the liquid made up with boiling water to 3—400 cc. Lead solution is now added from a burette until a small excess of lead goes into solution, and it is titrated back with solution of ammonium molybdate. The author's experimental results are good.—J. B. C.

Estimation of Small Quantities of Arsenic in Fabrics. R. Fresenius and E. Hintz. Zeits. Anal. Chem. **27**, 179—182.

Twenty-five grms. of fabric are cut up, brought into a ½ l. tubulated retort of hard glass and ¼ l. conc. HCl sp. gr. 1·19 added. The neck of the retort is bent in an obtuse angle, and so placed that the portion nearest the bulb is vertical. The neck is connected with a condenser, to which a receiver of 700—800 cc. capacity is attached. The receiver contains 200 cc. water. After digesting for one hour with conc. HCl, 5 cc. of a cold saturated solution of $FeCl_2$ is added, and the liquid distilled. The distillate contains the arsenic as arsenous acid, and it may be precipitated as sulphide.—J. B. C.

Estimation of Silver in Alloys of Silver and Copper. H. Roessler. Dingl Polyt. J. **267**, 570—572.

The method of assay devised by Guy Lussac is recommended in cases where great accuracy is required, providing that the alloy to be assayed is melted and a sample taken from the fused mass. This is necessary, as alloys of silver and copper in solidifying do not remain homogeneous throughout, the inner and outer portions containing different proportions of silver.—D. B.

Determination of Sodium Chloride in Alkaline Water from Coal Mines. L. de Koninck. Chem. Zeit. **12**, 583.

Water from coal mines often contains sodium bicarbonate; after use in boilers only normal carbonate is present, and the percentage of alkali salts is increased by the evaporation. The water also contains organic matter, and is coloured brown, which colouration cannot be removed either by filtration or by settling. A direct estimation of sodium chloride by means of titration with silver solution is therefore out of the question. The author obtains this object in the following manner: 200 cc. of the water to be tested are poured into a flask, which is provided with marks for 200 and 220 cc. The flask is then filled up to the second mark with a solution of calcium nitrate, free from chloride. A precipitate of calcium carbonate is at once formed, and this precipitate carries down with it all the organic colouring matter. 110 cc. are filtered off, and the chloride can now be readily titrated by silver solution in the usual manner. Calcium nitrate may be replaced by other neutral and uncoloured salts, such as the magnesium sulphate and nitrate, zinc sulphate, &c., which give amorphous precipitates with sodium carbonate and are not affected by a dilute potassium chromate solution.—S. H.

Estimation of Carbon in Iron. L. de Koninck. Revue Univ. des Mines, 1888, 332.

Carbon in iron is now chiefly estimated by the McCreath-Ullgren method. This consists in separating carbon by copper-ammonium chloride solution, burning it with a mixture of chromic and sulphuric acid and weighing the amount of carbonic acid formed. If the carbon separated be not washed perfectly free from every trace of the chloride solution, the latter gives rise to the formation of chlorine besides carbonic acid, on oxidising the carbon. The author avoids the escape of any chlorine by adding a little silver sulphate to the carbon, whereby any chlorine formed is at once arrested as silver chloride, which is not attacked by chromic and sulphuric acid. He also prefers to perform the combustion of the carbon in a current of oxygen, and to pass the products of combustion over heated copper oxide and heated lead chromate.—S. H.

A New Method for the Separation of Tin from Antimony and the Estimation of the same in Siliceous Slags and Alloys. H. N. Warren. Chem. News. **57**, 124.

Two grms. of the finely-powdered slag are treated in a platinum dish with a mixture of equal parts of hydrofluoric and hydrochloric acids. The slag is decomposed in a few minutes and whilst the greater portion of the silica is volatilised as silicon fluoride, everything else is dissolved. The solution is filtered, warmed, and saturated with sulphuretted hydrogen. The precipitate is boiled with sodium sulphide and the solution formed precipitated with hydrochloric acid. Tin and antimony sulphide are thus separated from all other compounds. These sulphides are dissolved in aqua regia, and the solution is evaporated to a small bulk in order to drive off the greater portion of the nitric acid. A little hydrochloric acid and excess of potassium ferrocyanide are then added to the solution, which should now have a blue colour. The whole is boiled. Tin is thereby precipitated as ferrocyanide of tin, whereas antimony remains in solution and can be precipitated by sulphuretted hydrogen. The precipitate of tin is dried and ignited, to destroy the organic matter. The residue is reduced in a Rose crucible by hydrogen or coal-gas, dissolved in hydrochloric acid, precipitated as sulphide, and after being oxidised with nitric acid, estimated in the usual manner. The separation of tin and antimony in alloys can be performed by the same process, but the alloy is dissolved in aqua regia.—S. H.

Detection of Nitric Acid in Wines. E. Borgmann. Zeits. Anal. Chem. **27**, 184—187.

The reaction depends upon the blue colouration which diphenylamine gives with nitric acid in presence of conc. H_2SO_4. A solution of 0·01 grm. diphenylamine in 100 cc. pure conc. H_2SO_4 is prepared. This solution is capable of detecting 0·05 m. grm. nitric acid in the litre. Wine, however, does not show the reaction unless it is decolourised with animal charcoal and concentrated by Egger's method (Zeits. Anal. Chem. **24**, 620), 0·5 m. grm. nitric acid may be then detected. The animal charcoal must be free from nitrates which are often present, and it must also be remembered that nitric acid slowly disappears from wines on keeping.—J. B. C.

Detection of Sulphonal. G. Vulpius. Apoth. Zeit. **3**, 247.

If equal quantities of sulphonal and potassium cyanide are ground and mixed in a mortar and then heated in a dry test tube, the tube is quickly filled with dense vapours smelling of mercaptan. (Pyrogallol may be used instead of potassium cyanide.) If the melt is dissolved in hot water and a little ferric chloride solution added, a blood-red colour is produced, viz., the reaction of potassium sulphocyanate with ferric salts.—S. H.

A Simple Method for the Detection of Impurities in the Alcohol of Commerce. L. Godefroy. Compt. Rend. **106**, 1018.

The impurities of alcohol consist of aldehydes and other reducing compounds, and the higher homologues of ethylalcohol (fusel oils). If these bodies be converted into sulphocompounds they can be easily detected by their more or less brown colour. 6 to 7 cc. of the alcohol to be tested are shaken with one drop of absolutely pure benzene, and 6 to 7 cc. of pure strong sulphuric acid are then added. If the alcohol contains any reducing compounds the whole mixture quickly turns at first yellow and ultimately brown. Chemically pure alcohol, treated in a similar manner, shows no alteration at first, but turns slightly pink after 10 minutes. In order to test for higher alcohols, the same mixture is boiled and allowed to stand for a few minutes. Whereas a pure alcohol thus treated exhibits a slightly yellow colour, alcohol mixed with fusel oils presents a brown colouration with a distinctly green fluorescence. If both reducing compounds and higher alcohols be present, the alcohol to be examined must undergo a preliminary treatment with sodium-amalgam before testing for fusel oils. Wine and other alcoholic liquors must be distilled before testing. The first fractions are to be examined for aldehydes, and the higher fractions for fusel oils. A quantitative estimation may be based on the comparison of the colourations produced with a standard colour-scale.—S. H.

Examination of Olive-Oil for Seed-Oil. R. Brullé. Compt. Rend. **106**, 1017.

The author employs for the speedy detection of seed-oil in olive-oil a mixture of strong nitric acid and egg-albumen. 0·1 grm. of the latter, 2 cc. of nitric acid and 10 cc. of the oil to be tested are put into a test tube and gently warmed over a spirit lamp, so that acid and oil have the same temperature. The albumen gradually dissolves in the oil, and whereas pure olive-oil assumes by this treatment a yellow colour with a greenish tint, olive-oil adulterated with only 5 per cent. of seed-oil turns distinctly amber yellow. Large quantities of seed-oil turn the mixture dark-orange. For detecting less than 5 per cent. of seed-oil, Levallois' process of acting with bromine on the saponified fats is the most suitable.—S. H.

Test for Santonine. J. Kossanowsky. Russ. Pharm. Zeits. 27, 161.

The colour-reaction of santonine is only applicable if the solution to be tested is colourless. Coloured solutions must be clarified with basic lead acetate and a few drops of the filtrate are gently heated in a porcelain crucible. Some strong sulphuric acid is then added and a violet colouration of the mixture after further heating points to the presence of santonine. It is also mentioned that in the manufacture of santonine hydrochloric acid may be replaced by sulphuric acid. The calcareous extract of *semen cinæ* is freed from lime by sodium carbonate, the filtrate warmed to 70° C. and decomposed by sulphuric acid. On cooling santonine separates out in large crystals.—S. H.

The Detection of Fahlberg's Saccharine. E. Börnstein. Zeits. Anal. Chem. 27, 165—168.

If the substance is dissolved in strong (25—30 per cent.) caustic potash solution and bromine added drop by drop, until a permanent yellow colouration is obtained, a yellow pasty precipitate separates after a certain time, depending upon the concentration of the solution. This precipitate is crystalline. Heated on platinum foil it froths up, without melting, in a vermicular form and burns, leaving a voluminous residue containing potash. If water is added and heated, bromine is evolved and the residue dissolves slowly. On cooling, yellow crystals separate, having pointed ends. Another property of saccharine is the formation of a substance similar to fluorescein on heating saccharine with resorcinol. The saccharine is heated with a slight excess of resorcinol and a few drops of concentrated H_2SO_4 until it begins to swell up. The flame is then removed until the reaction slackens; the heating is repeated. On diluting with water and adding potash, a strongly green fluorescent solution is obtained. The saccharine is extracted from the substance to be analysed with ether after acidifying with sulphuric or phosphoric acid (supposing the saccharine to be present as potassium salt in solution) and the ether distilled off.—J. B. C.

Detection and Estimation of Magenta in Orchil and Cudbear, with Notes on certain other Adulterations. Chr. Rawson. Journ. Soc. Dyers and Colourists, 1888, 68—70.

Various methods are referred to for detecting the presence of *Magenta* in *Orchil* and *Cudbear*. H. Crossley, J. Soc. Dyers and Colourists, 1885, 23. E. Knecht, *ibid.*, 1885, 23, and Liebmann and Studer, this Journal, 1886, 287.

The author's method is based upon the complete precipitation of the colouring-matter of orchil and cudbear in an aqueous and alcoholic solution by basic lead acetate, followed by an excess of ammonia. Magenta base under the same conditions remains in solution.

One to two grms. of cudbear (or an equivalent amount of orchil liquor) are boiled with 50 cc. of alcohol and afterwards diluted with 100 cc. of water; 15 to 20 cc. of a strong solution of basic lead acetate (sp. gr. 1·25) are then added, followed after stirring by a similar quantity of strong ammonia. The mixture is filtered, and if the amount of magenta is to be estimated, the precipitate is washed with a solution containing one part of ammonia, five parts of alcohol, and 10 parts of water; otherwise washing may be neglected. With pure cudbear the filtrate is quite colourless; if magenta be present it is either colourless or pink, according to the amount of ammonia present in the solution. The liquid must be acidulated with acetic acid when the presence or absence of magenta is at once made apparent. With pure cudbear or orchil the solution remains colourless, whereas if a salt of rosaniline be present, the rose-red tint of magenta is at once developed. To confirm, a piece of worsted-yarn may be dyed in the solution and afterwards tested in the usual way. The author was thus able to detect with certainty one part of magenta in 100,000 parts of cudbear. In order to determine the *amount* of magenta present a standard solution of that dye is prepared so as to contain 1—100th milligrm. per cubic centimeter. It is acidulated with acetic acid so as to be under the same conditions as the solution to be tested. The The latter is made up to a known bulk, say 250 cc. (or, if the magenta present be very small, concentrated to 100 cc. and the whole taken for estimation), and an aliquot part run into a Nessler tube and diluted to 100 cc. The standard solution of magenta is then run from a burette into a second cylinder in such quantity that the depth of colour is equal to that in the first, as in the case of Nesslerising ammonia. The amount of magenta present in the sample of cudbear or orchil examined can then be readily calculated. Instead of the Nessler apparatus, the colorimeter or Lovibond's tintometer is recommended.

Breinl's method (this Journal, 1888, 345—347) was not found wholly satisfactory, since all the cudbear was not precipitated by the basic lead acetate.

The author's method is applicable also to the detection of *Methyl violet* and *Safranine*. The base of the latter is much more soluble in ammonia than those of methyl violet and magenta. On the addition of acetic acid to the ammoniacal filtrate, the solution becomes of a bluish-violet tint if methyl violet be present. Under the same conditions, solutions of safranine and magenta are pink or bluish red. Strong ammonia decolourises methyl violet and magenta, but produces little or no effect upon a solution of safranine. Other known tests may be also applied.

Azo- or hydroxy-azo dyes when present in cudbear may usually be detected by sprinkling a little of the sample on the surface of some concentrated sulphuric acid, a characteristic coloured streak being formed, either green, blue, or violet, according to the colour present. In some cases the colour would, however, be scarcely distinguishable from that given by genuine cudbear.

For the detection of such colouring matters the following mode of procedure was found to give very satisfactory results. From 5 to 10 grms. of worsted-yarn are dyed (for about an hour) with about 10 per cent. of cudbear, either in a neutral bath or with the addition of a few drops of ammonia. A fresh quantity of yarn is then dyed in the same liquor in exactly the same manner. In this way the greater portion of the cudbear is removed from solution. A small quantity of sulphuric acid (3 per cent. on the weight of the yarn) is now added and a third lot of worsted-yarn dyed in the liquor. The azo-red, under the altered conditions of the bath works on to the fibre (with a little cudbear) and may be afterwards identified by well-known means. At the same time it is advisable, although not absolutely necessary, to treat a sample of cudbear, known to be genuine, in exactly the same manner for the sake of comparison. Ground red-woods, such as *sanders-wood* and *bar-wood*, are sometimes added to cudbear; and extracts of the red-wood to orchil liquor. These substances are best detected by means of dye-tests upon cotton, mordanted with salts of alumina. Since the colouring matter of bar-wood, &c., is not easily extracted by water, it was considered preferable to make the tests as follows:—About 2 grms. of the suspected sample of cudbear are boiled ten minutes with 50 cc. of alcohol, and then diluted to 200 cc. with water. A strip of mordanted cotton is boiled in this solution for half-an-hour and allowed to remain in the bath about half-an-hour longer, when it is taken out and well washed. With *genuine* cudbear, the mordanted cotton assumes a faint pink colour, remaining stable after washing. This colour, however, may be almost completely removed by boiling the cotton for a few minutes in alcohol, which treatment does not appreciably affect the colour produced by bar-wood, &c. If, after boiling with alcohol, the cotton is of a decidedly red colour, it may be safely assumed that the sample of cudbear under examination contains one of the red-woods. This may be confirmed by moistening the dyed cotton with a mixture of stannous chloride and hydrochloric acid.

It was subsequently pointed out by the author that *Acid magenta* cannot be detected by the author's method, since that colour is not precipated by basic acetate of lead, and ammonia. But it can easily be detected by such other means as, *e.g.*, dyeing some worsted yarn in a neutral solution, and after exhausting the cudbear as much as possible, to dye a fresh lot of yarn with the addition of sulphuric acid.—W. S.

Influence of Catechol on Fehling's Solution. A. Wohl. Deutschen Zuckerind **13**, 37.

V. Lippmann lately published (Deuts. Zuckerind **12**, 1602) the results of a research on the mother liquors from the crude beetroot sugar, and he detected catechol. Owing to the reducing power of this substance, the question naturally suggested itself whether this might not be one of the sources of error in the estimation of invert sugar by Fehling's method, and the author made a number of determinations with the object of eliciting the truth in this matter. The results of these experiments would show that in the presence of a large excess of sugar in proportion to the amount of catechol, the latter does not appreciably influence the result; that indeed a comparatively large quantity of catechol tends rather to *decrease* the amount of precipitated cuprous oxide. This latter fact the author explains by pointing out the readiness with which catechol takes up oxygen from the air, thus being in a position to act as an oxygen-carrier. The author also points out, however, that the presence of but small quantities of catechol can be possible, if the sugar solution has been cleared by means of lead acetate, the catechol salt being almost insoluble in water. (*See also* this Journal **7**, 128.)—J. W. L.

Quantitative Estimation of Acetone in Methyl Alcohol, Wood Spirit, and Acetone. E. Hintz. Zeits. Anal. Ch. **27**, 182—184.

Commercial methyl alcohol contains 0·2—0·3 per cent. of acetone. The method depends upon the conversion of acetone into iodoform. As the result by this method becomes unreliable when the quantity of acetone reaches 5 per cent. in wood spirit, the author considers it desirable to dilute the alcohol until the quantity of acetone amounts to 1—1·5 per cent. He also makes a correction of 0·002 grm. on the iodoform found, which is due to the presence of iodine salts. The method is otherwise that of G. Krämer (Ber. **13**, 1,000).—J. B. C.

Optical and Areometric Analysis of Liqueurs. H. Schwarz. Dingl. Polyt. J. **267**, 572—575.

The author has extended his method of examining beer described in a previous communication (*ibid.* **266**, 230), to the analysis of liqueurs. As the latter are composed mainly of cane sugar, alcohol, and water, the author proposes to estimate these ingredients quantitatively from the difference between the refraction of the spirituous liquor and that of water, combined with the areometric determination of the specific gravity of the liqueur. In examining samples rich in sugar and alcohol greater accuracy is obtained by diluting the liqueur with a certain volume of water before making the necessary observations. The results are calculated according to the formulæ given for beer.—D. B.

The Vienna gravimetric Method for the Estimation of Tannin. R. Koch. Dingl. Polyt. J. **268**, 329—334.

F. Simond (*ibid.* **268**, 280) lately published the results of some experiments on this method, from which he drew the conclusion that the quantity of bark extracted by a certain quantity of water had no influence on the result. The author's experience of this method being in opposition to any such admission, he has carried out the following experiment.

60 grms. fir bark were extracted by means of the Vienna extraction apparatus and the concentrated solution diluted to 1 litre. It was then again heated in order to re-dissolve any precipitated tannin, and finally allowed to cool to 18° C.

Of this solution:—

(1.) 50 cc. were evaporated on the water-bath to dryness and weighed. The residue = 0·870 grm. = 29·00 per cent.

(2.) 50 cc. were diluted to 150 cc., warmed, allowed to cool to 18°, filtered, and 50 cc. of this evaporated to dryness. Residue weighed 0·274 grm. = 27·40 per cent.

(3.) 50 cc. of the strong solution were evaporated and the dry residue weighed = 0·736 grm. = 24·52 per cent.

(4.) 50 cc. were filtered, then diluted to 150 cc. with water, and 50 cc. of this evaporated to dryness. Residue weighed 0·245 grm. = 24·50 per cent. From these results it would appear that whether 20 grms. or 60 grms. bark are extracted with one litre water, different amounts of soluble tannin are obtained.

The author has subjected both the solid and the pasty Quebracho extract to similar experiments, and with a similar result.

He concludes that for the estimation of the soluble tannin a small quantity only of bark should be treated with a considerable excess of water, while for the estimation of the solids, other than tannin, a comparatively large amount of the bark may be operated upon.—J. W. L.

Analysis of Natural Crude Indigos. C. Rawson and E. Knecht. Jour. Soc. Dyers and Colourists, 1888.

See this Journal, 1888, page 429.—W. S.

New Books.

Soaps and Candles. Edited by James Cameron, F.I.C., Analyst in the Laboratory, Somerset House. London: J. and A. Churchill, 11, New Burlington Street. 1888.

Small 8vo. volume, bound in cloth, containing Preface, Table of Contents, Bibliography, Subject-matter covering 294 pages, and an Alphabetical Index extending from page 295 to 306. From page 289 to 294, tables are given referring to alkalimetric strengths of the alkali materials used in soap-making. The work is illustrated with 54 wood engravings, and is divided into two parts, Part I. being devoted to "Soaps," Part II. to "Candles." Besides the bibliographic list of works consulted, numerous references to the principal Journals of Analytical Chemistry and Chemical Technology are given throughout the book.

Nature's Hygiene. A systematic Manual of Natural Hygiene, containing a detailed account of the Chemistry and Hygiene of Eucalyptus, Pine and Camphor Forests and Industries connected therewith. By C. T. Kingzett, F.I.C., F.C.S. Third edition. London: Baillière, Tindall, and Cox, King William Street, Strand. 1888.

Octavo volume, bound in cloth, containing Prefaces to the three editions, Table of Contents, and 394 pages of Subject-matter, followed by an Alphabetical Index. The work is divided into Parts I. and II.; Part I. being devoted to general principles; and Part II. to the more special consideration of those useful factors in nature's hygiene, which have formed the subject of the author's study. Part II. thus commences with Chap. X. Malarial Fever and its Cause; with an account of the Sanitary properties of the Eucalyptus and its products, &c. Chap. XI. Essential Oils and Perfumes, Terpenes, Camphoric peroxide, Manufacture of Sanitas products, Special study of the Russian Turpentine. Chap. XII. Practical Investigation of the Antiseptic and Disinfectant properties of the products of the atmospheric oxidation of essential oils and the "Sanitas" disinfectants. Further notes on practical disinfection. Chap. XIII. Micro-organisms and soluble ferments, their chemical history and exact relation to disease. A quantitative study of the antiseptic action of the "Sanitas" disinfectants, processes of fermentation, &c. Chap. XIV. Eucalyptus, Pine and Camphor Forests; their extent, distribution, and hygienic effects. Collection of eucalyptus, turpentine, and camphor oils and their distillation. Special study of camphor oil, varnishes, pine wood, wool.

DIE FABRIKATION VON CHLORSAUREM KALI UND ANDEREN CHLORATEN. Von KONRAD WILHELM JURISCH, Ph.D., Privat docent an der Koniglichen Technischen Hochschule zu Berlin. Berlin: R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schonebergerstrasse, 26, S.W. 1888. London: H. Grevel and Co., 33, King Street, Covent Garden.

OCTAVO volume, bound in cloth, and containing Dedication to the author's former principal, E. K. Muspratt, Esq., of Liverpool and Widnes, Table of Contents, 225 pages of Subject-matter, and 2½ pages of Addenda and Corrigenda. With the text are interspersed 63 engravings, and at the end of the work, five sheets of engraved illustrations. The text is arranged in Chapters treating of the following subjects. I. General Introduction. II. Description of the Plant and Apparatus, as well as of the working of the same. III. The Chemistry of the Process, with details of the latter. IV. Technical and Commercial Criticism of this Branch of Manufacture. V. The Magnesia Process. VI. Other Chlorates (chlorates of sodium, barium, and lithium). VII. Statistics of the Chlorate Manufacture.

Trade Report.

(From the Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

THE NETHERLANDS.

Customs Treatment of Vinegar and Pyroligneous Acid for the use of Glass Manufactories.

The *Moniteur Belge* for the 2nd May last contains a notification to the effect that a royal decree of the 8th April grants free entry into Holland to vinegar and pyroligneous acid intended for the use of glass manufactories.

UNITED STATES.

Customs Decisions.

A certain colour called "fast violet," which, upon analysis, was found to be a coal-tar colour, is held to be dutiable at the rate of 35 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 82) for "all coal-tar colours or dyes, by whatever name known," &c.

So-called "mineral sulphur," which is a mechanical mixture composed of 60 per cent. of carbonate of lime, 31 per cent. of sulphur, and about 8 per cent. of magnesia, and which has been "sent through a grinding-mill," is dutiable as an unenumerated manufactured article, under section 2513, Revised Statutes.

So-called "saccharine," a substance of complex chemical composition pertaining to the series of coal-tar derivatives, and used as a substitute for sugar in the diet of diabetic persons, is dutiable as a chemical compound, under T. I., 92.

Empty American bags which are exported with logwood and other foreign dye-woods ground or otherwise prepared in the United States for export, are entitled to free entry on their return, under the provision in T. I., 649.

VICTORIA.

Customs Tariff.

The following is a statement of the rates of import duty now levied under the Customs Tariff of Victoria:—

VICTORIA—*continued.*

No. in Tariff.	Classification of Articles.	Rates of Duty.			
			£	s.	d.
	CLASS I.—ART AND MECHANIC PRODUCTIONS.				
14	Acid, acetic	Per pint or lb.	0	0	3
	Do., muriatic	Cwt.	0	5	0
	Do., nitric				
	Do., sulphuric				
	Alkali, soda, crystals	Ton	2	0	0
	Blacking	20 % *ad val.*			
	CLASS I.—ART AND MECHANIC PRODUCTIONS—*cont.*				
	Drugs:				
	Acid, carbolic	Gallon	0	0	6
	Do., do., pure	Lb.	0	0	6
	Do., oxalic	"	0	0	2
	Do., picric	"	0	0	3
	Aloes	Cwt.	0	12	0
	Ammonia, carbonate of	Lb.	0	0	2
	Do., liquid	"	0	0	2
	Cannabis Indica	"	0	0	1
	Chlorodyne	25 % *ad val.*			
	Cocculus Indicus	Cwt.	0	1	6
	Faba Amara	"	0	1	6
	Gelatine	Lb.	0	0	6
	Glycerine, pure	"	0	0	3
	Do., crude	"	0	0	1
	Grains of paradise or guinea grains	Cwt.	0	2	0
	Morphia	Oz.	0	1	6
	Nitrate of silver	"	0	0	6
	Nux vomica	Cwt.	0	1	6
	Potassium, bromide of	Lb.	0	0	3
	Do., iodide of	"	0	0	10
	Quassia	Ton	2	0	0
	Strychnine	Oz.	0	1	0
	Ink—printing, coloured	Lb.	0	0	6
	Medicines, patent or called patent, not containing spirits, being medicinal preparations or compositions recommended to the public as proprietary medicines, or prepared according to some private formula or secret art, as remedies or specifics for any disease or diseases or affections whatever affecting the human or animal body, or being subject to a stamp duty in the country from whence they are exported	25 % *ad val.*			
	Opium, including all goods, wares, and merchandise mixed or saturated with opium, or with any preparation or solution thereof, or steeped therein respectively	Lb.	1	0	0
	Paints ground in oil	Ton	2	0	0
	Do. mixed ready for use	"	4	0	0
	Powders—washing, baking, and seidlitz	20 % *ad val.*			
	Spirits—methylated	Liquid gal.	0	1	0
23	Perfumery	10 % *ad val.*			
	Vinegar, not being acetic acid or crude vinegar, aromatic, or raspberry	Gallon	0	0	6
24	Stearine	Lb.	0	0	2
	Soap, perfumed and toilet	"	0	0	4
	" other	"	0	0	2
25	Blue	"	0	0	2
	Starch	"	0	0	2
	Varnish, including lithographic	Gallon	0	2	0

FRANCE.

Imports from the United Kingdom.—Values, Duties, &c.

Statement compiled from the French official returns showing the quantities and values of the imports of merchandise into France (*commerce spécial*) from the United Kingdom in the years 1880, 1881, and 1886, with the amounts of the duties levied on the various groups of articles and the percentage of duties levied on the values of each group.

Description of Articles.	1880.	1881.	1886.
Chemical products:			
Quantity in kilos	*	*	11,942,105
Values in francs	*	*	14,433,114
Duties levied in francs	*	*	1,007,432
Percentage of duties levied on values	*	*	7·0
Copper (ore and metal):			
Quantity in kilos	8,419,458	8,906,479	8,499,295
Values in francs	12,965,288	13,905,678	9,574,789
Duties levied in francs	87,895	71,073	16,692
Percentage of duties levied on values	·7	·5	·2
Oil, fined, pure:			
Quantity in kilos	7,314,106	5,616,166	1,956,463
Values in francs	5,580,616	4,200,650	1,411,436
Duties levied in francs	391,383	293,389	122,814
Percentage of duties levied on values	7·0	7·0	8·7
Caoutchouc and gutta-percha, raw:			
Quantity in kilos	715,870	971,718	681,463
Values in francs	4,409,692	6,413,340	4,088,778
Duties levied in francs	23,831	34,663	24,293
Percentage of duties levied on values	·6	·6	·2
Caoutchouc and gutta-percha, manufactured:			
Quantity in kilos	376,129	360,223	397,066
Values in francs	3,318,599	3,233,319	3,701,178
Duties levied in francs	189,517	191,548	226,753
Percentage of duties levied on values	5·7	5·9	6·1
Manures:			
Quantity in kilos	27,961,472	27,201,261	26,928,557
Values in francs	4,198,097	4,080,603	4,055,341
Duties levied in francs	75	51	2,049
Percentage of duties levied on values	..	..	·1
Drugs:			
Quantity in kilos	709,389	571,622	570,417
Values in francs	3,926,162	3,004,245	1,522,743
Duties levied in francs	43,455	38,394	27,929
Percentage of duties levied on values	1·1	1·3	1·8
Colours:			
Quantity in kilos	†	†	751,281
Values in francs	1,564,205	1,659,190	1,353,606
Duties levied in francs	136,506	149,266	178,346
Percentage of duties levied on values	8·7	9·0	13·2

* Cannot be given. † Not stated.

FRANCE—*continued.*

Description of Articles.	1880.	1881.	1886.
Oils, volatile and essences:			
Quantity in kilos	*	22,576	52,131
Values in francs	*	460,535	1,053,058
Duties levied in francs	*	29,145	53,328
Percentage of duties levied on values	*	6·3	5·1
Quicksilver:			
Quantity in kilos	147,620	181,863	156,318
Values in francs	679,052	836,570	781,590
Duties levied in francs	2	..	1
Percentage of duties levied on values	..	..	..
Coal tar dyes:			
Quantity in kilos	..	..	..
Values in francs	459,888	357,885	628,072
Duties levied in francs	..	7,037	54,008
Percentage of duties levied on values	..	2·0	8·6
Starch:			
Quantity in kilos	2,724,954	1,812,981	589,667
Values in francs	1,621,348	1,124,955	383,284
Duties levied in francs	17,383	27,216	27,786
Percentage of duties levied on values	2·9	2·4	7·3

* Cannot be given.

RUSSIAN DUTIES ON CHEMICALS.

An impression having gained currency in the chemical trade that there was an intention on the part of the Russian Government to admit chemicals going from this country to Russia duty free, the secretary of the London Chamber of Commerce wrote to the Board of Trade, inquiring as to the accuracy of the impression. In reply Mr. Thomas Gray says:—"I am directed by the Board of Trade to inform you that they have now received, through the Secretary of State of Foreign Affairs, a despatch from Her Majesty's Embassy at St. Petersburg, to the effect that there is no present intention on the part of the Russian Government to admit chemicals, imported from this country, duty free."

MISCELLANEOUS TRADE NOTICES.

CHEMICAL INDUSTRY IN SWEDEN.

Chem. Zeit. **12**, 493.

Sweden is not at all in a flourishing condition as regards this industry.

Except a few sulphuric acid works, cellulose works, and the mining operations of certain districts, the rest may be left out of consideration. Even the manufacture of sulphuric acid is so badly conducted, or the desire for profits so outrageous, that it is in many cases found worth while to obtain the article from Germany. Hydrochloric acid is not made at all, and the nitric acid almost solely for use in the manufacture of explosives. Though a high duty is imposed on some articles, this is not sufficient to stimulate to a healthy industrial activity. As an instance, the duty on gelatine is about a shilling per pound (50 per cent. of its value), yet large quantities are imported from France. As soon as an attempt at the manufacture of any of these products (gelatine, acetic acid, &c.) is made, competitive works spring up in plenty, and the trade is thereby depressed.

Cellulose works flourish and in this department an export trade is done.

Alkali, bleaching powder, and allied products are imported from England, and potassium chlorate is in some cases obtained from Germany.

The manufacture of pharmaceutical preparations is in an exceedingly bad state, but in many cases the consumption is so small that the manufacture would scarcely pay; then again foreign competition is too great.—T. L. B.

Prizes offered to Chemists.

The French Society of Encouragement has published its annual list of prizes offered for discoveries and improvements relating to arts and manufactures in general. For chemical sciences proper an aggregate of 54,500f. in prizes has been appropriated. As foreigners are allowed to compete, English chemists may feel some interest in a brief mention of the questions proposed this year to investigators. Three prizes of 4,000f. each are to be given for the following discoveries:—The artificial preparation of any useful principle, such as quinine, cane-sugar, &c.; useful application of any metals hitherto unused in industry; any publication useful in chemistry or metallurgy. Eight prizes of 3,000f. for each of the following:—Convenient process for imparting to steel or iron new useful properties through the addition of a foreign substance; industrial manufacture in France of fuming and anhydrous sulphuric acids; glass for chemical operations; manufacture of stoneware; artificial preparation of graphite adapted to pencil making; artificial preparation of compact black diamond; scientific explanation of any industrial process whose theory still remains imperfectly known; experimental investigation of the physical or mechanical properties of any of the usual metals or metallic alloys. Five 2,000f. prizes are offered for each of the following:—Cheap process for ozone; any new convenient tanning material; substituting for sulphuric acid in silk-dyeing some substance that will not injure the fabric; industrial preparation of chlorine from the waste products of the ammonia-soda process; turning the nitrogen of the atmosphere into either nitric acid, ammonia, or cyanogen; sulphuric acid from pyrites made entirely free from arsenic. A 1,500f. prize to anyone having in France secured the greatest improvements in glass blowing, especially applied to chemical and industrial apparatus. And, finally, five 1,000f. prizes for each of the following:—New uses for waste products; new applications for non-metallic elements; new useful alloy; new industrial use for any cheap mineral substance; improvements applied in France to the making and working of seaweed ashes (kelp). Besides, a grand prize of 12,000f., to be given in 1889, is awarded every six years for the discovery most useful to French industry. All models, memoirs, descriptions, and specimens must be forwarded, before January 1889, to the Société d'Encouragement pour l'Industrie Nationale, 44, Rue de Rennes, Paris.—*Chemist and Druggist.*

Chili Borax.

The exportation of calcium borate, containing 25 to 28 per cent. of boracic acid, from Iquique, in Chili, to Hamburg reached nearly 18,000,000 kilos. last year, but owing to the fall of the price in the European markets, no shipments have been made for some months. One of the works situated in the centre of the borax-fields now produces crystallised borax and boracic acid of excellent quality, and the proprietors believe that they will shortly be able to exclude their European competitors from the West Coast of South America. —*Ib.*

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Bulgaria.

Hints to British Traders.

The Austro-Hungarian "Société Commerciale d'Exportation" has opened at Sofia a permanent exhibition of the articles of industry produced in the Empire, and it announces that commercial travellers will from time to time visit the different towns to obtain orders, which can be supplied at once from the depôt at Sofia. It would be advantageous if something similar were organised in the interests of British traders, the more so as the latter are especially prejudiced by the worthless nature of the wares which are palmed off on the unwary as British manufactures—spurious articles to which English labels have been attached at Constantinople. British goods are always in greater favour here than those of other countries, which are best disposed of when bearing British marks. An establishment such as that recommended would enable the local purchaser to discriminate between the genuine and the counterfeit article usually supplied to him, and increase the consumption by tending to reduce the excessive charges which the retail dealer is accustomed to demand.

Essential Oils and Anise.

In 1887, 4,150 lbs. of rose water and essences, worth 55,000*l.*, were exported from Philippepolis, against 7,000 lbs., worth 75,000*l.*, the year before. 15,000*l.* worth of anise were also exported last year, chiefly to France.

Greece.

Petroleum.

The United States Consul at Athens says:—I have already informed the department of a trial importation by the Greek monopoly of 6,200 cases of Russian petroleum. I have satisfaction now in reporting that this trial has not been satisfactory. The Russian oil is not suitable to this market, and is found to be much inferior even to the low grades of American oil which have been sent here. I have information from the directors of the Greek monopoly that no more Russian oil will be imported. A proper regard for their own interests in sending oil of good quality seems to be all that is required of our exporters to enable them to retain the command of this market.

Italy.

Chemicals.

The British Consul at Genoa reports that the imports of chemicals, especially of carbonate of soda, of magnesia, and of nitrate of soda, have somewhat increased. He regrets to learn that in this category Germany continues to supplant us on this market, owing especially to the activity of travellers and agents who personally canvass for orders.

Progress of the Chemical Trade.

Milan is the centre of the Italian chemical industry, a branch which has of late years made very considerable progress. There are now in Milan two works manufacturing sulphuric, nitric and hydrochloric acid, crude and chemically pure, as well as salammoniac and liquid ammonia, while three works at Milan and one at Brescia turn out citrate of magnesia to a total value of about 20,000*l.* per annum. A camphor refinery, the first in Italy, was established last year. Another chemical works refines annually some 700 tons of glycerine, purchasing for this purpose a large proportion of crude glycerine from the Italian stearine works. There is one large quinine manufactory in Milan, which also makes iodide of potassium and other iodides. There is also another works in Milan which makes a speciality of iodides, bromides, bismuth preparations, salicylates, &c., besides producing pharmaceutical articles, as pills, ointments, tinctures, syrups, &c., especially syrup of tamarinds. In Pavia a large manufactory of antiseptic surgical appliances exists, which have a large sale all over Italy. Tartar materials are treated in seven different manufactories, while in Milan there are no less than fifty manufacturers of common and toilet soaps, some of whom carry on a considerable wholesale, and even an export, trade. Oil refineries are found in large numbers, no less than 200 such establishments existing in the province of Lombardy alone. Almond oil and castor oil are pressed in Milan, Busto, Arsizio, and Brescia.

Argol Shipments from Ancona.

Argols for some years formed an article of export from Ancona. They were obtained in the neighbourhood, and also in the Abruzzi and Puglie, and were exported to the chemical works in Great Britain and Germany. Whether because of the raw material being now much sought after by local industries, or because the expenses of refining are excessive in comparison to the value of produce, the fact is that the trade in argols has decidedly decreased.

Japan.

Drugs and Pharmaceutical Preparations.

The British Consul at Tokyo writes to the effect that the Japanese sanitary police have hitherto exercised a very strict control over the import of drugs and pharmaceutical preparations, which have been always carefully analysed at the Government laboratory, in order to ascertain whether they were exactly in accordance with the Pharmacopœia of the country in which they were produced, and if the articles tested were approved they were officially stamped. Articles not so stamped were unsaleable. The Japanese Government has now issued a decree ordering the Pharmacopœia Japonica to be used as the standard in future, and drugs made according to the Pharmacopœia of other States will be provided with a special certificate to that effect.

Messina.

Quinine.

According to the German official reports, quinine is chiefly imported from Germany, which country has completely driven the French manufacturer out of the market.

Drugs and Dyewares.

Aniline dyes, and also artificial alizarin, are a chief article of German import, and come mainly from Cologne, Nuremberg, and Stuttgart. Printing dyes suffer from Italian competition, but the good qualities are supplied only by Germany. Drugs and dyewares come largely from Cologne, Stuttgart, and Nuremberg, as also chemical preparations for pharmaceutical, photographical, and practical purposes.

Soap and Perfumery.

Karlsruhe, Frankfort-on-Maine, and Stuttgart have been competing for some years successfully with France in the import of toilette soaps and perfumery, and their trade is gradually but certainly on the increase.

MADAGASCAR.

Vanilla Cultivation.

The *Bulletin du Musée Commercial*, quoting from the *Progrès de l'Imerina*, with reference to the cultivation of vanilla in Madagascar, says:—

"Vanilla has recently made its appearance on the markets of Madagascar. Mahanoro has produced and exported 1,500 lbs. of it, which, for some reason or other which it would be interesting to know, do not appear in the Customs lists. From the new plantations which have been made there can be reckoned upon, within a period of four or five years, an annual doubling of production. This product appears to be of the best quality, and if this opinion is shared by European purchasers, its cultivation will assume a very considerable importance, and Madagascar will very shortly become one of the chief suppliers of the European market."

MEXICO.

The Drug Trade at Guadalajara.

The wants of the drug trade at Guadalajara are supplied principally by Germany, so far as crude drugs, fine chemicals, essential oils (vetivert, Russian anise, cinnamon, patchouly, sandalwood, &c.), and analyne dyes (the use of which is steadily on the increase) are concerned. Surgical and scientific instruments and glassware are also much bought from Germany, which country is also gradually usurping the trade in mineral water machinery, formerly entirely in French hands. Natural mineral waters are now commencing to be imported, partly from Germany, and partly (Vichy water) from France. But the high duty, 10 cents per kilo., gross weight, operates against any considerable extension of the use of European mineral waters. Heavy chemicals, such as bicarbonate of soda, chlorate of potash, chloride of lime, saltpetre, phosphorus, soda crystals, caustic soda, chromate of potash, &c., as well as a number of patent medicines and toilet articles, are imported from England. Near the town of Sayula, some distance south of Guadalajara, large quantities of an impure soda salt, called tequesquite, are obtained and used in soap-making. The United States provide borax, mercury, excellent carbolic acid, a number of patent medicine and toilet articles (among which latter Lanman and Kemp's Florida water enjoys great popularity), and certain surgical instruments; while from France are imported patent medicines, fine soaps and perfumes, sugar-coated pills, gelatine capsules, surgical bandages, &c. German quinine from the Mannheim and Frankfort factories is pushing out the French article.

Consuming-power Increasing.

Since political troubles have ceased the consuming power of Mexico has undoubtedly increased to a very considerable extent, for on no other supposition can the fact be explained that, although large imports have, since the opening of the Mexican Central Railway, been made *viâ* El Paso (in 1887 they were about 1,000,000*l*. sterling), the importations *viâ* Vera Cruz are not less, but considerably more than they were before the Central Railway was commenced, when Vera Cruz enjoyed a practical monopoly of the whole foreign trade of the Republic.

Drugs and Chemicals.

During 1887 the imports of drugs and chemicals into Vera Cruz were estimated as worth (on the place of production) 90,402*l*., while in 1886 the imports under this head were valued at 75,435*l*. Of this quantity the largest share in 1887 fell to France, viz., 29,245*l*.; next followed Germany, with 22,433*l*.; the United States, with 19,657*l*.; the United Kingdom, with 18,266*l*.; and Spain, with 1,305*l*.

Vexatious Customs Regulations.

The development of the import trade into Mexico is greatly hampered by the system of paying Customs officials a considerable portion of their remuneration in the shape of a share of the fines they levy on goods not duly declared. Foreign shippers rarely escape such fines on their first consignments to any Mexican port. Most of them omit to accompany the goods with an invoice duly certified by the Mexican consul at the port of shipment, or fail to comply with the intricate regulations in regard to consular invoices. The absence of a consular invoice is punished by the infliction of double duties, which is equal to confiscation in all those many cases in which the single duties are equal to 100 per cent. *ad valorem*. Insufficient declaration is punished by a penalty of 10, 20, 25, 50, or 100 per cent., on the simple duties, according to the nature of the "offence."

Vanilla.

In 1887 vanilla was exported from Vera Cruz to the value of 17,536*l*., of which the United States received 13,914*l*., Germany 3,153*l*., and France 289*l*.

Opening for Soap-makers.

Amongst the industries for which the State of Vera Cruz presents an opening is the manufacture of toilet soaps, for which there is an abundant supply of the necessary raw material. The import duty on "fine soap, scented or unscented," is equal to 1*s*. 9*d*. per lb., gross weight (*i.e.*, including packing), which would, of course, constitute a very high degree of protection to native industry if the latter existed. So long as this high duty is maintained, the industry protected by it would, of course, flourish; but the latter would, no doubt, fade if its protecting duty should be abolished, unless, indeed, the abolition of protection were general. So long as it exists in anything like its present degree, no unprotected industry can thrive, as protection raises the cost of production of all commodities, protected or unprotected. But protection is so engrained in the Mexican fiscal system that a fancy-soap factory, if it existed, would have little reason to fear that its protection would be withdrawn.

PORTUGAL.

Chemicals.

The British Minister at Lisbon writes:—The value of the imported chemicals during the last year increased from 84,916*l*. to 90,974*l*.; the most important feature with regard to this class is the increased importation of sulphuric acid, the quantity having risen from 186,728 kilos. in 1886 to 879,689 kilos. in 1887, the corresponding values having been 1,050*l*. and 3,920*l*., as it enters largely into the composition of various manufactures.

ST. JAGO.

Chemicals, Drugs, &c.

According to the British Consul caustic soda and other chemicals come from England, but America supplies drugs and apothecaries' goods, with the exception of a small portion which comes from France.

Trade Journals and Catalogues.

English firms, the Consul continues, have much improved in the way of price currents and catalogues, and there are some excellent advertising journals, in a magazine form, now distributed from England; but in the matter of illustrated and descriptive catalogues America is still in the front, and theirs are generally more explanatory and better got up.

WARSAW.

British Imports.

The British Consul at Warsaw reports that he has ascertained from a reliable commercial source that there was a considerable falling off in the imports from Great Britain in the year 1887. Among other articles there was a falling off in chemicals and aniline dyes. The cause of the reduction in British trade is attributed to the ever-increasing duties.

AUSTRALIA.

According to recent returns there are now in the Colony of Victoria 36 chemical, dye, and oil works, 141 aerated water manufactories, and 34 soap and candle works. In New South Wales, 43 soap and candle works. In Queensland, 19 soap and candle works, 111 cordial factories. In Tasmania, 8 soap and candle works; and in New Zealand, 6 chemical works, 18 soap and candle works, and 112 aerated water works.—*Brit. and Col. Druggist.*

SPAIN.

Mr. Penlington, Vice-Consul at Gijon, in Spain, reports a continued decline in British imports. We are fast losing our chemical trade from Newcastle, our pig iron trade from Glasgow, and the trade in iron and machinery from Liverpool. Germany, on the other hand, is coming to the front in all these articles of commerce, and she is beating France out of the Spanish market even in so-called "articles de Paris." The decline in British trade is traced, at least in part, to the indifference of our manufacturers and unwillingness to adapt their products to special requirements. Last May a contract was made at Gijon with a German house to supply glass bottles at a certain price. Samples and full particulars were sent by the Consulate to an English manufacturer, but he was "busy with the home trade," and while "earnestly hoping to secure some of the Spanish trade," had not up to the date of the report sent either samples or prices. The Germans had in the meantime got in several cargoes.—*Chemist and Druggist.*

STATISTICS.

BOARD OF TRADE RETURNS.

IMPORTS.

——		May 1886.	May 1887.	May 1888.
Drugs, unenumerated..	Value £	50,780	59,653	67,001
Chemical manufactures and products, unenumerated	"	96,020	111,277	140,785
Chemicals and dye-stuffs, unenumerated	"	191,794	152,048	132,725
Oils, not enumerated...	"	78,022	90,855	84,679
Alkali	Cwt.	11,726	3,737	5,097
	Value £	6,983	2,809	4,040
Brimstone	Cwt.	52,158	59,842	85,712
	Value £	12,473	13,229	17,284
Nitrate of soda	Cwt.	185,396	396,684	257,981
	Value £	93,762	209,466	125,812
" of potash......	Cwt.	22,845	30,938	33,288
	Value £	20,342	26,951	28,606
Quicksilver	Lbs.	782,700	315,000	317,724
	Value £	65,165	27,875	30,480
Cinchona bark.........	Cwt.	13,158	13,803	18,806
	Value £	66,769	62,938	77,588
Gum Arabic	Cwt	3,213	2,753	9,248
	Value £	13,587	11,700	36,147
Lac, seed, shell, stick, and dye	Cwt.	12,168	19,739	12,081
	Value £	34,193	51,179	32,143
Bark (for tanners' or dyers' use)..........	Cwt.	37,813	48,066	16,700
	Value £	15,895	24,398	17,005
Aniline	Value £	14,627	24,833	23,061
Alizarine	"	21,841	19,586	26,674
Other coal-tar dyes	"	..	75	1,347
Cochineal..............	Cwt.	544	350	263
	Value £	3,193	2,185	1,689
Cutch and gambier	Tons	2,047	1,513	2,022
	Value £	46,697	35,426	19,304
Indigo	Cwt.	855	3,200	3,963
	Value £	19,023	62,263	66,732
Madder, madder-root, &c.	Cwt	1,451	2,179	1,307
	Value £	1,768	2,353	1,701
Cocoa-nut oil	Cwt.	21,161	9,018	19,940
	Value £	28,203	11,915	25,117
Olive oil	Tuns	2,708	1,921	2,906
	Value £	102,995	70,422	101,572
Palm oil	Cwt.	87,289	71,138	62,440
	Value £	84,207	67,173	61,132
Petroleum oil	Gals.	7,011,247	1,744,682	5,115,813
	Value £	174,540	62,531	134,899
Oil seed................	Tons	1,949	1,127	1,923
	Value £	14,730	26,897	48,124
Turpentine	Cwt.	1,309	3,715	1,591
	Value £	1,490	5,019	2,068

EXPORTS.

——		May 1886.	May 1887.	May 1888.
British and Irish produce:				
Drugs and chemical preparations, unenumerated	Value £	65,121	69,607	88,647
Sundry chemicals -	"	266,133	267,931	338,945
Painters' colours and materials	"	109,025	119,391	131,469
Alkali	Cwt.	644,144	560,834	621,269
	Value £	182,420	157,981	161,219
Bleaching materials .	Cwt.	142,218	125,187	128,489
	Value £	43,116	47,147	49,079
Seed oil............	Tons	7,228	6,613	7,481
	Value £	148,955	134,922	150,443
Pickles, vinegar, sauces, condiments, and confectionery.	Value £	87,836	95,273	113,808
Soap................	Cwt.	27,738	36,766	44,795
	Value £	30,543	36,767	47,114
Foreign and Colonial merchandise:				
Chemicals, unenumerated	Value £	16,010	25,288	27,793
Cinchona bark	Cwt.	10,917	14,086	6,113
	Value £	48,837	47,749	18,139
Cochineal..........	Cwt.	649	353	287
	Value £	4,525	2,418	1,722
Cutch and gambier .	Tons	530	835	1,205
	Value £	13,029	21,378	30,860
Gum Arabic	Cwt.	3,613	2,963	3,017
	Value £	12,574	10,506	12,911
Indigo..............	Cwt.	1,722	3,488	2,516
	Value £	34,857	73,043	46,850
Lac, seed, shell, stick, and dye	Cwt.	6,045	4,595	4,980
	Value £	16,078	13,411	11,952
Cocoa-nut oil	Cwt.	6,593	10,643	10,100
	Value £	8,822	13,906	13,887
Olive oil	Tuns	307	393	290
	Value £	13,185	16,979	11,511
Palm oil	Cwt.	32,708	32,518	62,569
	Value £	32,380	31,719	61,577
Petroleum oil	Gals.	35,744	70,026	19,148
	Value £	1,550	2,552	771
Quicksilver.........	Lbs.	416,734	304,062	893,692
	Value £	32,281	27,196	83,720

BRITISH TRADE WITH SPAIN.

The following table will show the duties imposed on some of the articles in which druggists and chemical manufacturers are interested.

The Spanish Custom House regulations are called "Aranceles," and the articles of importation are classified under 13 different heads. Class 3 comprises substances used in pharmacy, perfumery, and chemical industries, the duties on which are as follows:—

——	Simple Drugs.	Duties for Nations	
		Without Treaty.	With Treaty.
First Group.			
Coco oil, palm, and other solid oils	Per 100 kilo.	1 pes.	1 pes.
All other vegetable oils, except olive oil	„	23 pes.	23 pes.
Act of 1878 and 1879 extra duty	„	20 pes.	20 pes.
Dye woods and bark for tanning	„	10 c.	10 c.
Granza, or madder	„	20 pes.	18·35 pes.
Linseed and other seeds of an oily nature, including coco-nut	„	1 pes.	0·91 pes.
Other products of the vegetable kingdom not otherwise expressed	„	10 pes.	10 pes.
Products of the animal kingdom employed in medicine	„	3 pes.	3 pes.
Second Group.			
Colours, paints, and varnishes, ochres, and natural earths for painting	„	10 c.	10 c.
Indigo and cochineal	Per kilo.	0·10 c.	0·10 c.
Extracts for dyeing purposes	100 kilo.	3 pes.	3 pes.
Varnishes	„	24 pes.	18 pes.
Colours in powder or earth	„	7·50	4·80
Prepared colours and paint	„	25·60	24·00
Colours derived from coal tar and other artificial colours	1 kilo.	0·75	0·75
Third Group.			
Chemical and pharmaceutical products	..	..	..
Muriatic acid	100 kilo.	1 pes.	1 pes.
Nitric acid	„	4 pes.	4 pes.
Sulphuric acid	„	1·50	1·50
Alkaloids and their salts	Kilogram	30 pes.	27·50 pes.
Alum	100 kilo.	1·50	1·15
Sulphur	„	25 c.	25 c.
Natural and artificial barilla (impure carbonates of soda)	„	1·00	80 c.
Alkaline carbonates, caustic alkalis, and ammoniacal salts	„	1 pes.	1 pes.
Chloride of lime	„	1·30	1·30
Chloride of potassium	..	..	..
Sulphate of soda, chloride, carbonate and sulphate of magnesia	„	50 c.	50 c.
Chloride of sodium (common salt)	„	3·25	0 51 c.
Glues and albumens	„	12 pes.	12 pes.
Phosphorus	1 kilo.	35 c.	35 c.
Nitrato of potassium (saltpetre)	100 kilo.	1·50	1·50
Nitrate of soda	„	0·25	0·25
Third Group—*cont.*			
Oxide of lead	100 kilo.	2 pes.	2 pes.
Sulphate of iron	„	1·50	1·50
Pills, capsules, lozenges, and the like	1 kilo.	2 pes.	1·85
Pharmaceutical products not specified	„	1 pes.	0·90
Chemical products not specified	„	10 c.	10 c.
Fourth Group.			
Starch	Per 100 kilo.	10 pes.	9·15
Fæculas for industrial use, dextrin, and glucose	„	1 pes.	1 pes.
Common soaps	„	18·75	15·[illegible]0
Paraffin, stearin, wax, and spermaceti in bulk	„	16·50	16·50
The aforesaid worked up	„	50 pes.	33·90
Perfumery and essences	1 kilo.	2 pes.	1·73

According to Art. 6, an allowance of 30 per cent. will be made for tare from the gross weight of phosphorus in tin boxes. If these boxes be contained in others of wood, the allowance for tare will be 50 per cent.

According to Art. 6, 25 per cent. of the gross weight of perfumery will be allowed for the pots and wrappers.

By Royal Decree of 22nd July 1884, it is declared that the tare of 25 per cent., which is specified in Art. 6 of the Customs Regulations, is only to be allowed for perfumery contained in bottles, pots, and boxes, ready for sale.—*British and Colonial Druggist.*

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

7411. A. Horn, London. Saccharometers. May 19.

7555. E. Passburg, London. Vacuum drying apparatus. Complete Specification. May 22.

7559. A. Knoop, London. Receptacles for liquid carbonic acid and for other fluids under pressure. Complete Specification. May 23.

7667. B. Finch, Manchester. Liquid fuel furnace fires. May 25.

7674. H. Lane, London. Improvements in the method of and in means for measuring air, gas, and other fluids. May 25.

7768. S. Spencer and J. S. Lord, Manchester. Method and apparatus for forcing and drawing chemical or other liquids. May 28.

8003. J. Langstaffe and H. D. Peckover. Apparatus for purifying and softening water and preventing incrustation. Complete Specification. June 1.

8053. G. Fletcher.—Partly communicated by G. Brocklehurst, Barbadoes. Evaporating pans. June 1.

8064. F. W. Scott, jun.—From A. Freitag, Holland. Tubular vacuum pans. June 1.

8078. J. Watt, Liverpool. Apparatus for causing or increasing circulation in water or other liquids during ebullition, and for removing sediment therefrom. June 4.

8119. C. L. Hett, London. Centrifugal pumps. Complete Specification. June 4.

8127. F. Vyrazil, London. Evaporating, distilling, or condensing apparatus. Complete Specification. June 4.

8290. J. Y. Johnson.—From La Société Française des Alcools purs, France. Apparatus for separating liquids having different boiling points. June 6.

8479. R. Gagné, London. Flexible tubes for fluids under pressure. June 9.

8561. The Gas Patents Syndicate, Limited.—From J. B. Archer, United States. An improvement in kilns for firing bricks and the like. June 11.

8621. H. Petersen, London. Improvements in centrifugal separators. Complete Specification. June 12.

8628. W. Oliphant, London. Feed-water heating and filtering apparatus. Complete Specification. June 12.

8725. W. Parker and R. Turner, London. Means for economising fuel and consuming smoke in furnaces. June 14.

• COMPLETE SPECIFICATIONS ACCEPTED.

1887.

7726. R. W. Deacon.—From W. Maxwell. Centrifugal drying machines. June 2.

9422. P. Everitt. Improved filters. June 9.

9698. P. Everitt. Improved filters. June 9.

10,957. L. Mond. Apparatus for treating solids by gases and for other purposes. June 16.

10,976. J. B. Hannay. Furnaces or heating apparatus. June 9.

17,193. T. Pursall and W. Lister. Smoke consuming and fuel economising apparatus for boiler muffles, &c. May 26.

1888.

6212. C. Tellier. Apparatus for producing cold by means of waste heat. June 2.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

7400. S. H. Lion.—From J. Flannery, New York. Improvements in the process and apparatus for making illuminating and heating gas from water in combination with carbonaceous substances. May 18.

7667. L. Wacks, London. The utilisation of small coal or pit slack. May 25.

7691. S. Chandler, sen., S. Chandler, jun., and J. Chandler, London. Improvements in washing and scrubbing gas, and apparatus therefor. May 25.

8100. J. Bowing and E. W. Beckingsale, London. Improvements in the manufacture of artificial fuel. June 4.

8325. J. Love, London. Improvements in apparatus for carburetting gas or air. June 7.

8492. De Stearine Kaarsen Fabriek "Apollo" of Schiedam, London. An improved preparation for treating candle wicks. Complete Specification. June 9.

8559. The Gas Patents Syndicate, Limited.—From J. B. Archer, United States. Apparatus for the manufacture of gas. June 11.

8560. The Gas Patents Syndicate, Limited.—From. J. B. Archer, United States. An improvement in fuel gas burners. June 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

10,684. E. Grahn. Improved process for treating gas-liquor and other ammoniacal liquors. June 2.

11,195. O. Imray.—From C. A. von Welsbach. Incandescence bodies for illuminating purposes, and treatment of mantles produced therefrom. June 16.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATION.

7379. J. C. Hamilton, Glasgow. Improvements in retorts for distilling shale and other nitrogenous materials. May 18.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

7511. J. Dawson and R. Hirsch, Kirkheaton. Preparation of amidodimethylaniline chloride. May 22.

7997. H. H. Lake.—From K. Oehler, Germany. Improvements in or relating to the manufacture of colouring matters. May 31.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5896. A. Kern. Manufacture of sulpho, nitrosulpho, nitrososulpho, and amidosulpho acids, and their application to the production of new colouring matters. May 26.

10,554. J. A. Walton. A liquid blue. May 26.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATION.

8434. A. J. Boult.—From N. Warschauer, Vienna. Improvements in the manufacture of waterproof linen. June 8.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

7733. R. F. Watson, Glasgow. A yarn stretching and dyeing machine. May 26.

7735. F. Moore, London. Improvements in apparatus for mordanting, dyeing, and washing wool, cloth, yarn, and other materials. May 26.

7846. C. J. Alexander.—From W. S. Alexander, Canada. Improvements in apparatus for dyeing wool tops and other fibrous materials. May 29.

8054. E. Casper and J. Debnam, London. Improvements in dyeing. June 1.

8250. W. E. Heys.—From Marchal, Falck, et Cie., France. Improvements in and connected with the production of a permanent aniline black upon cotton yarns and threads. June 6.

8530. T. Holliday, London. Improvements in the method of production of fabrics dyed black, composed partly of animal and partly of vegetable fibres. June 11.

COMPLETE SPECIFICATION ACCEPTED.

1888.

2093. F. Lee, J. Bradshaw, and F. Lee. Method and apparatus for dyeing wool, cotton, and other fibres. June 2.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

7507. E. W. Parnell and J. Simpson, Liverpool. Improvements in the production of sulphuretted hydrogen in combination with the manufacture of alkali by the ammonia process. May 22.

7754. F. Trickett and J. Noad, London. Improvements in the production of soda crystals, and of chlorides and oxides of various metals. Complete Specification. May 26.

8208. H. Leffmann, London. Improvements in the manufacture of carbonic acid and magnesia. Complete Specification. June 5.

8351. G. S. Page, Westminster. Improvements in the process and apparatus used for obtaining anhydrous liquid ammonia. June 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

9760. A. Walker. Manufacture of sulphates of soda and potash, and apparatus therefor. June 16.

10,093. C. J. Hayer. Process and apparatus for obtaining pure alumina compounds from bauxit, &c. June 16.

10,144. S. Hallsworth and R. Bailes. Manufacture of copperas, and of ferric sulphate or sesqui-per-sulphate of iron. June 16.

10,153 J. Fleming. Improvements in connexion with the calcining of sulphurous ores. May 26.

10,222. S. Hallsworth and R. Bailes. Manufacture of ferric sulphate, or sesqui-sulphate of iron. July 16.

10,684. E. Grahn. *See* Class II.

10,759. H W. Deacon.—From C. Arnois. Manufacture of carbonic acid gas. June 9.

10,818. J. Hanson The utilisation of alkali waste for the manufacture of sulphuric acid. June 16.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

7814. W. H. Turner, Tunstal. Placing ware in glist and enamelling kilns. 29 May.

8129. W. J. Parry and J. T. Welch, London. Improvements in the utilisation of slate, slate waste, black grit, or other similar or like waste materials, and in the manufacture of glass and other articles therefrom. Complete Specification. June 4.

8333. F. L. Jeyes and F. Short, London. Improvement in the mode of ornamenting glass ware. June 7.

8518. A. E. Letalle and F. Billing, Birmingham. Photographic stained glass. June 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

10,085. C. Toft. Decorating pottery and porcelain by an imitation of metal mountings used for stained glass. May 26.

10,268. J. B. Payne and R. Davison. A new portable or fixed gas kiln for burning and enamelling glass, china, enamels, tiles, and ceramic wares. May 26.

10,858. J. Gill. Apparatus for the manufacture of pottery, pressing bricks, &c. June 16.

16,355. J. Y. Johnson.—From M. Aubriot. Producing cloisonné decorations in enamelling glass, &c. May 26.

1888.

5620. R. W. Willis and A. J. Willis. Composition for the manufacture of enamelled earthenware. June 2.

6837. H. C. Braun.—From J. Derry. Plastic compound for modelling forms for moulding and casting. June 9.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

7456. J. S. Rigby, Liverpool. *See* Class XVI.

7618. W. Ross, Inverness. A new and improved form of brick for building purposes, to be called "the Culloden partition brick." May 24.

7646. M. H. Heys and W. E. Heys, London. An improved manufacture of plaster or cement, May 24.

7664. H. S. Fearon, London. Improvements in the construction of fire-proof flooring. May 25.

7747. G. J. Snelus J. C. Swan, and H. Smith, London. An improvement in the manufacture or preparation of cement. Complete Specification. May 26.

7781. J. C. J. Smith, London. Improved apparatus to be used in the manufacture of cement. May 28.

7798. G. E. Belmor, London. Improvements in and relating to apparatus for the treatment of bituminous rock and like substances, to adapt the same for paving and other purposes. Complete Specification. May 28.

7905. J. Dougall and T. D. Harries, Aberystwith. An improved artificial stone. May 30.

7915. A. Fleiner, H. Hauenschild, and A. Bauermeister, London. Improvements in the manufacture of artificial Portland cement, and in apparatus therefor. May 30.

7925. H. T. Holloway and H. Holloway. Improvements in block floors or pavements. May 30.

7976. W. G. Margetts, London. An improvement in the manufacture of Portland cement. May 31.

8485. R. Mannesmann, London. An improvement in fire-proof columns. June 9.

8693. C. Baker, London. Improvements in arrangements for drying slurry for the manufacture of cement. June 13.

8723. M. C. Ashwin, Birmingham. Improvements in the manufacture of bricks. June 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

9694. F. W. S. Stokes. Continuous manufacture and burning of cement. May 26.

10,443. C. P. Tabary. A new metallic cement and processes for its manufacture. May 26.

10,764. F. W. S. Stokes. Method and apparatus for drying slurry, and subsequent cooling of the burnt cement. June 9.

11,509. H. Warrington and W. W. Howlett. Bricks and other blocks for building purposes. June 16.

1888.

2393. G. J. Snelus, J. C. Swan, and H. Smith. Manufacture of cement. June 16.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

7408. A. J. Boult.—From G. Manet and C. Manet, France. Improvements in or relating to electrical cartridges for firing the charge of blast holes and the like. May 18.

7409. J. M. Durafort and V. E. J. Durafort, London. Improvements in the manufacture of articles cast in moulds with a covering of a hard metal. May 18.

7525. E. Lones, R. Davies, J. Davies, and B. A. Webb, London. Improvements in coating metal plates or sheets with tin or other metals. May 22.

7610. R. H. Armit, London. Improvements in the manufacture of ordnance. May 23.

7685. W. G. Forster, London. Improvements in the manufacture of aluminium. May 25.

7689. G. H. Greatbatch and T. Crake, London. Improvements in igniting the fuses of blasting charges, and in apparatus therefor. May 25.

7703. H. J. Warrington, Hanley. Improvements in apparatus for igniting fuses for blasting, and other purposes. May 26.

7773. R. R. Gubbins, London. Improvements in manufacturing wrought iron. Complete Specification. May 28.

7867. W. Crookes, London. Improvements in the treatment of auriferous ores, and in the revivification of the materials used in such treatment. Complete Specification. May 29.

7990. J. E. Bennett, Manchester. Improvements in the treatment of metallic chlorides for extraction of metals therefrom. May 30.

7995. H. H. Lake.—From E. Hardmeyer, H. W. Hatch, and J. C. Jackson, United States. An improved method of converting iron into steel. Complete Specification. May 31.

8012. G. Siddell, Sheffield. An improved mechanical appliance for rotating ingots or large forgings of iron or steel while under the hydraulic forging press or steam hammer. June 1.

8030. F. A. Purvis.—From W. H. Trimble, New Zealand. Improvements in machinery for amalgamating and separating gold and other precious metals. June 1.

8095. B. H. Thwaite, Liverpool. Methods of producing solid steel castings, and apparatus therefor. June 4.

8157. W. G. Dickson and J. Clark, London. Improvements in treating the ores of copper and certain other metals for the reduction of metals therefrom, and in furnaces and apparatus used in connexion therewith. June 4.

8177. J. McCulloch, N. McCulloch, and J. Short, Glasgow. Improvements in obtaining silica and clay or alumina. June 5.

8223. A. H. Reed.—From G. Conkling, United States. A machine for eliminating iron from ores and other materials. Complete Specification. June 5.

8233. S. Pitt.—From T. F. Rowland, W. E. Hill, and A. McLachlan, United States. Improvements in cylinder welding apparatus. Complete Specification. June 5.

8234. S. Pitt.—From T. F. Rowland, W. E. Hill, and A. McLachlan, United States. Improvements in welding furnaces. Complete Specification. June 5.

8303. W. F. Donkin.—From R. Donkin, New Zealand. Improvements in the amalgamation of gold and other ores, and in apparatus employed therein. June 6.

8332. W. P. Thompson.—From H. F. Julian, South Africa. Improvements in or relating to the treatment of ores for facilitating the extraction and recovery therefrom of gold and silver, and in apparatus therefor. June 7.

8410. L. A. Groth.—From L. M. D. Pellegrin, France. Improved process for purifying metals. June 8.

8423. G. Siddell, London. Improvements in apparatus or means for turning or rotating ingots in large forgings of iron or steel, or the like, while under the action of a steam hammer or hydraulic forging press. June 8.

8427. J. E. Guild.—From D. R. S. Galbraith, New Zealand. Improvements in the extraction of the precious metals from ores of the same, or from other materials containing precious metal, and in the apparatus employed therein. June 8.

8469. W. Eyre, Sheffield. The manufacture of forged hollow weldless shells. June 9.

8511. C. B. Burdon, and J. Clark, Birmingham. Improvements in treating steel and other metals for the production of homogeneous castings therefrom. June 11.

8658. R. Harris and W. Williams, Bristol. Improvements in coating tin and terne plates, and in machinery or apparatus therefor. June 13.

8668. M. Settle, Manchester. *See* Class XXII.

8746. L. Q. Brin, London. Improvements in plating metals with aluminium, and producing alloys thereof. June 14.

8747. L. Q. Brin, London. An improved process of producing aluminium bronze and other alloys of aluminium. June 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8198. L. W. Adamson and W. P. Hall. Miners' safety lamps. May 26.

9568. N. C. F. Jochumsen.—From J. Hansen. Construction of furnaces for melting iron, steel, &c. June 2.

9782. R. K. Boyle. Treating metals for modifying, hardening, or alloying the same, especially iron or steel. June 9.

10,093. C. J. Bayer. *See* Class VII.

10,387. J. W. Wailes. Improvements in open hearth steel melting and like furnaces. June 2.

10,406. H. J. Allison.—From B. Atha and W. R. Hinsdale. Process and apparatus for forming metallic ingots in a sectional bar. May 26.

10,443. C. P. Tabary. A new metallic cement, and processes for its manufacture. May 26.

10,868. J. Toussaint. Construction of furnaces for refining iron, steel, or other metals. June 9.

13,177. S. Appleby. Improved ingot moulds, and method of casting variously-shaped iron or steel ingots. June 9.

15,884. J. Ashworth. Miners' safety lamps. June 16.

1888.

3793. J. Y. Johnson.—From La Société Anonyme Le Ferro-Nickel. Metallic alloys. June 2.

4938. A. E. Alexander.—From I. E. Craig. Manufacture of polished sheet iron. June 2.

5293. B. D. Martin. Manufacture of chill rolls. June 2.

5564. C. Wolf and H. Friemann. Miners' lamps. June 9.

5859. A. Gutensohn. Process and apparatus for coating iron, steel, and other metal plates with tin or other metal. May 26.

6102. P. Jensen.—From E. H. Russell. Extracting metals from ores or other metallurgical products. May 26.

6381. L. L. Burdon. Manufacture of compound ingots or bars for jewellers and others. June 16.

6382. L. L. Burdon. Manufacture of compound ingots or bars for jewellers and others. June 16.

6460. H. H. Lake.—From F. J. Seymour. Extraction of aluminium or its compounds from ores, &c., and fluxes and apparatus therefor. June 2.

6872. W. P. Thompson.—From W. T. Wells. Process and apparatus for producing a preservative coating on iron and steel surfaces. June 16.

6886. J. W. Bookwalter.—From G. Robert. Conversion of crude or pig iron into malleable iron or steel. June 2.

6951. J. W. Bookwalter. Apparatus for converting crude iron into malleable iron or steel. May 26.

6952. J. W. Bookwalter. Apparatus for converting crude iron into malleable iron or steel. June 16.

7215. W. Burnhsm. Moulding and welding metals. June 15.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

7536. B. Willcox.—From T. P. Whittier, United States. Improvements in galvanic batteries. Complete Specification. May 22.

7619. G. J. Weir, Glasgow. A primary electric battery. May 24.

7826. H. B. Cox, London. Improvements in galvanic generators. Complete Specification. May 29.

7853. W. P. Thompson.—From C. D. P. Gibson, United States. Improvements in or relating to storage batteries. Complete Specification. May 29.

7876. B. Willcox.—From B. A. Abakanowicz and A. d'Arsonval, France. Improvements in electric batteries. May 29.

7977. H. G. Morris and P. G. Salom, London. Improvements in the mode of filling secondary battery plates. Complete Specification. May 31.

8039. A. Le Clercq and A. Vansteenkiste, Liverpool. Improvements in or relating to the transformation or conversion of electric currents. June 1.

8160. E. M. H. Andreoli, London. Production by electricity of chlorine and its oxygenated compounds, and the utilisation thereof. June 4.

8161. C. C. Nichols, on behalf of the London Electric Bleaching Company. Bleaching paper pulp by electricity. Complete Specification. June 4.

8354. M. Leclanché, London. Improvements in the manufacture of depolarisers for primary or secondary batteries. June 7.

8401. E. W. Clifton and V. Robinson, London. Improvements in electric batteries. June 8.

8496. J. Lea and H. R. Hammond, London. Improvements in electro-coating metals with zinc. June 9.

8657. H. Barcroft, Belfast. Improvements in dynamo-electric machines. June 13.

8700. L. M. J. C. C. Renard, London. Improvements in and relating to electric batteries. June 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

7865. F. George. Dynamo-electric and electro-dynamic machines. June 2.

8240. J. R. Hard and T. Wilson. Galvanic batteries. June 9.

9017. W. Cross. Method of heating ores, &c., by electric current for effecting metallurgical, chemical, and other operations, and apparatus therefor. May 26.

1888.

6416. L. Hoppe and G. Hoppe. Galvanic elements. June 2.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

7524. W. P. Kelly, London. A new composition to be used as a lubricant May 22.

7746. G. G. M. Hardingham.—From F. E. Magrini, Italy. Improvements in the manufacture of soap. May 26.

7830. J. Taylor, Leith. An improvement in the manufacture of soaps. May 29.

8262. C. A. Morris, St. Albans. New preparations from vaseline. June 6.

8366. J. Jeyes, London. Improvements in the manufacture of soap. June 7.

8604. C. A. Stitt, Liverpool. Improvements in or connected with the manufacture of soap. June 12.

8740. W. H. Nevill, London. Improvements in the manufacture of soap. June 14.

COMPLETE SPECIFICATION ACCEPTED.

1888.

5971. H. J. Haddan.—From J. W. Evans. Percolators for the extraction of oil by the naphtha process. May 26.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

7398. R. Avenarius, London. Improvements in the treatment of tar oils for use as wood-preserving paints or coatings. May 18.

7607. V. J. Kness, London. Improvements in manufacturing and treating vitrifiable colours or pigments, and in apparatus therefor. May 23.

7687. S. Pitt.—From L. Casella and Co., Germany. The preparation of paint colours from nitrosophenols and their sulphonic acids. May 25.

7708. L. H. Goggs and T. T. Irvine, Liverpool. Improvements in or relating to bronze or other metallic paints. May 26.

7929. T. Garton and W. Barkley, London. An improved black varnish or enamel. Complete Specification. May 30.

8372. J. S. Palmer, Forest Gate. Elastic varnish, printing, and paint composition. June 7.

8738. E. A. de Lisle, London. Manufacture of a vegetable black for decolorising purposes, and apparatus therefor. June 14.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

8221. N. F. E. Rapeaud, London. A new or improved artificial leather. June 5.

8369. E. Gerson, London. Improvements in compounds for chemical tanning, and in the process of tanning without the use of tan bark or tannic acid. Complete Specification. June 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,766. C. Collin, L. Benoist. B. Nicholson, and T. Palmer. Treating hides and skins for preventing the formation or development of injurious germs of animal or vegetable life. June 9.

1888.

2870. E. Tulhill. *See* Class XX.

XV.—AGRICULTURE, MANURES, Etc.

APPLICATION.

8641. The Lezant Syndicate, Limited, London. An improvement in the manufacture of manures from basic slags. June 12.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

7456. J. S. Rigby, Liverpool. Improvements in or relating to the utilization of the lime mud refuse of sugar and other industries for cement and other purposes. May 19.

7640. W. P. Thompson.—From Diebl and Mensik, Austria. New or improved filtering substance for filtering or decolouring liquids, applicable for treating sugar juices, and method of preparing the same. Complete Specification. May 24.

8052. G. F. Redfern.—From W. P. Abell, British Guiana. Improvements in and relating to centrifugal machines for use in the manufacture of sugar. June 1

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

9890. C. Leuchtenberger and B. Moiske. Purification of molasses and other saccharine solutions. June 2.

11,303. O. Bowen and J. Cobeldick. *See* Class XVIII.—B.

10,842. L. E. A. Prangey. Manufacture of sugar, and apparatus therefor. June 9.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

8110. C. D. Abel.—From E. Kiderlen, J. W. von Leenhoff, A. Wernicke, A. Wilhelmi, and A. Kohlhuann, Germany. Improvements in the manufacture of spirit from potatoes and other tubers or fruits containing starch. June 4.

8111. C. D. Abel.—From E. Kiderlen, J. W. von Leenhoff, A. Wernicke, A. Wilhelmi, and A. Kohlmann, Germany. Improved treatment of maltose and other spirits for the removal of impurities therefrom. June 4.

8112. C. D. Abel.—From E. Kiderlen, J. W. von Leenhoff, A. Wernicke, A. Wilhelmi, and A. Kohlmann, Germany. Improved treatment of maltose and other syrups for the separation of albuminous matters and other impurities therefrom. June 4.

8116. E. Wilson, Tadcaster. Drying and curing malt, hops, and other like substances by an improved apparatus. June 4.

8522. A. G. Ferica and A. Eggimann, London. Improvements in or appertaining to the clarifying of beer, wine, and other fermented or fermenting liquids. June 11.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

7475. E. J. T. Digby, London. A new alimentary compound, and means of producing the same. May 19.

7535. B. Willcox.—From H. Salyer, United States. Process of preserving meat and other food articles. Complete Specification. May 22.

8198. J. E. M. Vincent.—From W. K. Withy, Queensland. A saccharine food for cattle, poultry, bees, &c. June 5.

B.—SANITARY CHEMISTRY.

7533. H. E. Newton.—From A. R. Leeds, United States. Improvements relating to the purification of water, factory slop, and sewage. Complete Specification. May 22.

7883. J. H. Barry, London. The purification of sewage, and materials therefor. May 30.

7947. B. Jagger, Leeds. Purification of sewage, and deodoriser of dry closets. May 31.

8130. G. Liscoe, London. Mechanically separating solids from fluids of sewage. June 4.

8261. E. Garside, Rochdale. A process for purifying the water used for wool scouring and other analogous purposes. June 6.

8291. A. G. Haddock and C. H. Harvey, London. Improvements in the treatment of sewage and foul waters. June 6.

8371. W. Edwards, London. Improvements in the prevention of the pollution of rivers and watercourses from manufacturers' polluted waters and waste, and for cleaning and purifying ordinary river waters for the use of manufacturers, and for the recovery of expensive materials used in certain trades, as in paper mills, dyeworks, and others. June 7.

8480. J. G. Galley, London. Improvements in the method of and apparatus for destroying town and other refuse. June 9.

8491. J. Price, London. Improvements in means for expelling liquid from and compressing sewage sludge and other semi-fluid or plastic substances. June 9.

8627. W. Oliphant, London. Improvements in apparatus for liquid purification. Complete Specification. June 12.

8728. J. H. Barry, London. The purification of sewage, and materials therefor. June 14.

C.—DISINFECTANTS.

8017. W. Thomson, Manchester. Improvements in the manufacture of antiseptic substances from waste or bye products. June 1.

8597. J. Hanson, London. An apparatus or device for generating sulphurous acid gas for disinfecting and deodorising. June 12.

COMPLETE SPECIFICATIONS ACCEPTED

A.—CHEMISTRY OF FOODS.

1887.

10,948. W. F. Reid. Process for the preservation of fruit. June 16.

1888.

6478. W. P. Thompson.—From S. Moro. Preventing the decomposition of organic substances. June 2.

B.—SANITARY CHEMISTRY.

1887.

10,904. A. H. Curling and J. Dunbar. Deodorisation and disposal of sewage, and apparatus therefor. June 9.

11,393. O. Bowen and J. Cobeldick. Deodorising, decolorising, and filtering medium. June 9.

C.—DISINFECTANTS.

1887.

10,306. E. H. Hutchinson. Compressing solid and liquid disinfectants, and utilising same when compressed. June 9.

1888.

7177. W. P. Thompson.—From G. C. W. Belcher. Antiseptic or disinfecting compounds. June 16.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

8059. H. H. Lake.—From J. A. Manning, W. M. Peckham, and A. Chambers, United States. Improvements relating to apparatus for treating vegetable substances for the production of paper stock. Complete Specification. June 1.

8161. C. C. Nichols, on behalf of the London Electric Bleaching Company. Bleaching paper pulp by electricity. Complete Specification. June 4.

8361. C. Weisshuhn, London. Improvements relating to the manufacture of wood pulp, and to apparatus for use in such manufacture. June 7.

8494. E. J. V. Davies, London. Improvements in the manufacture of paper and millboard or cardboard. June 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8861. G. H. Mallary. Method of treating esparto grass, &c. for paper-making and other uses. June 9.

8862. G. H. Mallary. Apparatus for reducing esparto grass and other fibrous materials to pulp for paper-making. June 9.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

COMPLETE SPECIFICATION ACCEPTED.

1888.

2870. E. Tuthill. Preparation of an oil or tar from birch tree bark, and application of same for tanning and preserving hides, skins, and furs. May 26.

XXI.—PHOTOGRAPHIC MATERIALS and PROCESSES.

APPLICATIONS.

7486. J. R. McKie, Liverpool. Improved processes of obtaining more brilliant and permanent photographs than by the ordinary method, and the means to be employed in such processes. May 22.

8413. S. H. Fry, Kingston-on-Thames. Improvements in the manufacture of photographic films. June 8.

8618. S. H. Fry, Kingston-on-Thames. Photographic films. June 12.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

7497. H. J. Allison.—From A. S. Fitch, United States. Improvements in explosive compounds. Complete Specification. May 22.

7688. T. Nordenfelt, London. Improvements in time fuzes. May 25.

8016. A. V. Newton.—From A. Nobel, France. Improvements in cartridges. June 1.

8072. J. Nicholas, Ilford. Improvements in the manufacture of explosives. June 4.

8426. L. Plom, London. An improvement in blasting cartridges. June 8.

8503. E. Ducretet, London. Improvements in magneto-electric fuses or exploders. June 9.

8668. M. Settle, Manchester. Improvements in cartridges to be used for blasting in mines and other places where inflammable gas or air is present. June 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8929. H. Güttler. Manufacture of charcoal for explosives, and apparatus therefor. May 26.

10,821. A. Brock and G. J. Mayer. Manufacture of gunpowder. June 16.

1888.

5949. A. Kuhnt and R. Deissler. Explosive compounds. May 26.

6875. A. Favier. Cartridges and detonators for exploding the same. June 16.

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Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

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McDonald, A., l/o Langside; 16, Cochrane Street, Glasgow.

McFarlane, J. F., 139 (not 9, as in June number), Greenhead Street, Glasgow.

McGlashan, J., l/o Runcorn; Woodneuk, Garteosh, near Glasgow.

Mayenfeld, Dr. E. von Salis, l/o Basel; c/o Clayton Anilin Co., Ld., Clayton, Manchester.

Mitting, E. K., l/o Brooklyn; 326—363, North Water Street, Chicago, Ill., U.S.

Peile, Henry, l/o Shotley Bridge; Walsden Chemical Works, near Todmorden.

Pemberton, H., jun., l/o Laramie; 1947, Locust Street, Philadelphia, Pa., U.S.A.

Procter, H. R., l/o Hotspur Street; 38, Percy Park, Tynemouth.

Reid, W. C., l/o Newcastle; 2, Dunkirk Terrace, Corbridge-on-Tyne.

Richmond, H. D., l/o Tottenham; Thornton Lodge, Stonebridge Park, Willesden, N.W.

Ross, A. J. J., l/o Battlefield Cottage; Tayavalla, Falkirk, N.B.

Rowell, W. A., l/o Widnes; 21, Victoria Square, Newcastle-on-Tyne.

Sanderson, T. C., l/o Camberwell; Minas do Corgo, Oporto, Portugal.

Saunders, T. B., l/o Bradford; Upper House, High Town, Liversedge, viâ Normanton.

Siebold, L., l/o Walmersley; 18, Exchange Street, Manchester.

Starling, J. H., l/o The Avenue; 7, Pier Road, Erith, Kent.

Takamine, J., l/o Noshomusho; Fertilizer Works, Fukaqawa, Tokio, Japan.

Twynam, Thos., l/o West Kensington; 7, Marlborough Crescent, Bedford Park, Chiswick, W.

Williams, Rowland, l/o Albert Square; 28, Pall Mall, Manchester.

Williamson, R., l/o Manchester; Cleveland Chemical Works, Middlesbrough.

Wyndham, Dr. Stanley, l/o New York; c/o Mrs. Jamieson, 4, Marloes Road, Kensington, W.

CHANGES OF ADDRESS REQUIRED.

Higgin, A. J., l/o Teneriffe Street, Higher Broughton.

Langbeck, H. W., l/o Bromley-by-Bow, E.

Liddle, W. T., l/o Sunnyside Printworks, Rawtenstall.

Wood, J., l/o Foxhill Bank Printworks, Church.

LIST OF MEMBERS ELECTED, 23rd JULY, 1888.

Broom, Wm., Irvinebank, Herberton, Queensland, analyst and assayer.

Dunlop, A. M., 3, Old Palace Yard, Westminster, S.W., land agent.

Everard, A. G., North Street, Bishop's Stortford, Herts, pharmaceutical chemist.

Fox, Jos. Wesley, 115, Lower Thames Street, London, E.C., salt merchant.

Hanks, Abbot A., 1124 Greenwich Street, San Francisco, Cal., U.S., assayer.

Harvey, Henry C., Raglan House, Brooklands, near Manchester, chemist.

Hope, Jas., The Nickel Co., Kirkintilloch, N.B., metallurgical manager.

Jarmain, George, 9, York Place, Huddersfield, Yorks, public analyst.

Maiden, J. H., Technological Museum, Sydney, New South Wales; and c/o Trubner & Co., Ludgate Hill, E.C. (for Journals), curator.

Philip, Arnold, Royal Indian Engineering College, Cooper's Hill, Staines, analytical chemist.

Storrar, Jas. M., 70, Wellington Street, Glasgow, oil and produce merchant.

Taylor, Jas. Davis, 9, Mincing Lane, London, E.C., merchant.

Tennant, Edward, 35, Grosvenor Square, London, W., merchant.

Vorster, Fritz, Bayenstrasse 71, Coln a Rhein, Germany, manufacturing chemist.

Deaths.

F. A. Gatty, Elmfield Hall, Accrington.

Geo. T. Walker, l/o 138, Bath Street, Glasgow.—July 12th.

PROCEEDINGS OF THE SEVENTH ANNUAL MEETING.

On Wednesday morning, the 4th July, the Annual General Meeting took place in the Bute Hall of the University of Glasgow.

Letters of apology for non-attendance were received from Sir H. E. Roscoe, M.P., Sir Frederick Abel, Sir Chas. Tennant, Mr. David Howard, Mr. J. J. Coleman—Chairman of the Glasgow and Scottish Section—Prof. W. A. Tilden, and Mr. Chas. Hunt.

The President, Professor James Dewar, F.R.S., took the Chair at 11 o'clock and called upon the Secretary to read the Minutes of the last Annual Meeting. After these had been duly confirmed, the Secretary read the Report of the Council.

Report of the Council.

The Council is able to report a continued increase in the membership of the Society. During the year 209 new members have been elected and 116 have been removed by death, resignation, and other causes, showing a net gain of 93. The total number of members is now 2,395.

Among those whose deaths we have to record are Mr. Chas. Moseley, of Manchester; Mr. Rupert Prentice, of Stowmarket; Mr. Andrew Bevan, of Llanelly; Mr. Jas. Taylor, of London; and Mr. Thos. Routledge, of Sunderland; all valued members of the Society.

The papers read before the various Sections during the session, 58 in number, maintain their character for general usefulness. The Council would place on record its best thanks to the authors who have communicated papers to the various Sections. Eight communications were also published in the Journal.

The contract with Messrs. Emmott and Co. having expired on the 31st December last, tenders to print and publish the Society's Journal were invited, and nine firms accepted the invitation. After long and careful comparison it was resolved to accept the tender of Messrs. Eyre and Spottiswoode, and the Council so far has every reason to be satisfied with the manner in which the contract is being carried out.

Allusion was made two years ago to the generous offer of Mr. Raphael Weldon to place at the disposal of the Society the chemical portion of the library of his late father, Mr. Walter Weldon. After mature consideration, it has been preferred to accept only a small portion of the volumes—those which bear closely upon the special departments with which Mr. Weldon was identified.

It is proposed to put in force Bye-law 29 on and after January 1st next, and to send the Journal to such members only as have paid their subscription. This is due to the fact that the number of members in arrear has increased during 1887.

The finances of the Society, as will be seen from the balance sheet, are in a satisfactory state, and show an ample surplus to provide for contingencies. On the 22nd June last the Treasurer reported that the Society had 2,088*l.* 11*s.* 9*d.* invested and 1,761*l.* 12*s.* 9*d.* in the bank, as against 1,039*l.* 10*s.* 4*d.* invested and 1,500*l.* 18*s.* 9*d.* in the bank at the time of the last annual meeting. Under these circumstances it is with great pleasure that the Council has felt able to make some addition to the salaries of the Editor and General Secretary.

In conclusion, the Council would observe that, to fulfil the purposes for which the Society was founded, it is necessary to fully maintain and even increase the number of members. This can be only achieved by that hearty individual support which is derived from a personal conviction of the value of the work in which the Society is engaged.

On the motion of Mr. H. Grimshaw, seconded by Mr. Alexander M. Chance, it was resolved "That the report of the Council be approved and adopted."

The following financial statements prepared by the Honorary Treasurer, who was unable to attend, were then taken as read.

THE TREASURER.—IN ACCOUNT WITH THE SOCIETY OF CHEMICAL INDUSTRY FOR THE YEAR 1887.

Dr.

	£ s. d.	£ s. d.
To Cash on Deposit (31st December, 1886) .	750 0 0	
Balance at Bank, ditto .	134 11 11	
Balance in Treasurer's hands................ ditto .	21 11 0	
	906 2 11	
Less Amount owing to Secretary .... ditto .	1 19 7	
		904 3 4
Annual Subscriptions:—		
2 subscriptions for the year 1885 ..	2 2 0	
18 subscriptions for the year 1886 ..	18 18 0	
6 subscriptions for the year 1887 (£1 1s. each)	6 6 0	
2,114 subscriptions for the year 1887 (£1 5s. each)	2,642 10 0	
Excess payments	0 3 6	
59 subscriptions for the year 1888 (less 13*s.* 1*d.* short paid)	73 1 11	
1 subscription for the year 1889 ...	1 5 0	
Sundry Amounts on a/c of subscriptions for 1886 and 1887 – short paid in 1886	2 0 0	
Sundry odd Amounts on a/c of 1888 subscriptions...........	1 17 0	
2,200		2,748 3 5
Life Composition Fees..........................		135 0 7
Interest on Deposit Account..........................		23 15 5
Interest on Metropolitan Stock		25 11 9
Journal:—		
Advertisements......................	190 17 4	
Sales	188 18 5	
		379 15 9
		£4,216 10 3

Cr.

	£ s. d.	£ s. d.
By Journal Expenses:—		
Publishing	1,250 12 5	
Editorial	574 7 8	
		1,825 0 1
Printing, Sundries, &c.		85 6 6
Sectional Expenses:—		
Birmingham Section............ ...	7 12 9	
Glasgow Section.....................	47 17 4	
Liverpool Section....................	24 6 1	
London Section......................	52 15 1	
Manchester Section..................	51 5 0	
Newcastle Section	24 1 0	
Nottingham Section	11 12 9	
		219 10 0
Secretary's Salary		200 0 0
Honorarium voted to Edward Hughes for assistance rendered to Hon. Treasurer during the year 1886.		21 0 0
Office Expenses:—		
Rent	60 0 0	
Gas..............................	0 7 11	
Fires, Cleaning, Attendance, &c....	9 18 8	
Furniture, Fittings, &c............	3 5 10	
Premium on Fire Insurance	0 2 6	
		73 14 11
Stationery..............................		36 5 3
Auditors' Fee		5 5 0
Purchase of £643 0*s.* 7*d.* Metropolitan 3 % Consolidated Stock		635 0 0
Bank Charges on Scotch and Irish Cheques, &c.....		1 15 1
Wm. Brough—Clerical Assistance in issuing Circulars		1 17 0
Secretary's Petty Cash:—		
Postage, Telegrams, &c............	22 0 0	
Expenses attending Annual Meeting	9 7 4	
Carriage on Parcels................	0 8 9	
Assistance in issuing Circulars.....	0 5 6	
Stationery, Books, Office Requisites, &c.	2 4 7	
Sundries..............................	1 1 0	
Expenses of Council Meetings......	1 9 11	
Gratuities	1 12 0	
Sundry Travelling Expenses	0 6 4	
		38 15 5
Treasurer's Petty Cash:—		
Postage, Post Office Orders, &c.....	13 0 11	
Stationery	0 12 6	
Carriage on Parcels, Sundry Fares, &c.	0 4 9	
		13 18 2
Cash on Deposit (31st December, 1887)..	750 0 0	
Balance at Bank, ditto ..	307 8 7	
Balance in Secretary's hands.............. ditto ..	1 14 3	
		*1,059 2 10
		£4,216 10 3

* In addition to this there is an amount of £1,039 10*s.* 4*d.* Metropolitan 3 % Consolidated Stock, invested in the names of Mr. David Howard and Mr. Edward Rider Cook.

We have compared the above Statement with the Receipts, Counterfoils, Vouchers, and Books of the Society, and certify it as correct.

23, St. Swithin's Lane, London, E.C.,
22nd February, 1888.

THEOBALD BROS. & MIALL,
Fellows of the Chartered Accountants.

STATEMENT OF REVENUE AND EXPENDITURE FOR THE WHOLE OF THE YEAR 1887.

Made up to the 23rd March, 1888.

REVENUE.

		£ s. d.	£ s. d.
	Annual Subscriptions for the year 1887:—		
19	Subscriptions received in 1886 (£1 1s. each)	19 19 0	
57	Subscriptions received in 1886 (£1 5s. each)	71 5 0	
6	Subscriptions received in 1887 (£1 1s. each)	6 6 0	
2,114	Subscriptions received in 1887 (£1 5s. each)	2,612 10 0	
13	Subscriptions received in 1888 (£1 5s. each)	16 5 0	
2,209	Sundry Balances of Subscriptions for 1887—short paid in 1886	2 0 0	
	Excess payments	0 3 6	
			2,758 8 6
	9 Late Composition Fees	(135 0 7)	
	Interest on Deposit Account		23 15 5
	Interest on Metropolitan Stock		25 11 9
	Journal:—		
	Sales—Received ... £180 6 9		
	„ —Owing ... 22 10 0	202 16 9	
	Advertisements—Received ... 129 8 1		
	„ —Owing ... 129 16 8	259 4 9	
			462 1 6
			£3,269 17 2

EXPENDITURE.

	£ s. d.	£ s. d.	£ s. d.
Journal Expenses:—			
Publishing—Paid	1,146 10 1		
„ —Owing	269 16 5		
		1,416 6	
Editorial:—			
Editor's Salary	200 0 0		
„ Expenses—Paid	32 12 5		
„ „ —Owing	19 3 10		
Sub-Editor's Salary	60 0 0		
Abstractors'—Paid	76 5 3		
„ —Owing	111 2 11		
Indexing Journal	30 0 0		
Foreign Journals, &c.	10 17 11		
Patent Lists	19 10 10		
Sundries	7 5 6		
Secretary's expenses attending Publication Committees at Manchester	15 1 9		
		603 0 5	
			2,019 6 11
Sundries, Printing, &c.—Paid		72 12 6	
„ „ —Owing		17 8 6	
			90 1 0
Secretary's Salary			200 0 0
Sectional Expenses			219 10 0
Honorarium to Secretary for extra work—removing Stock from Manchester to London			21 0 0
Honorarium to Edward Hughes for assisting Hon. Treasurer in 1887			12 0 0
Office Expenses			73 11 11
Stationery—Paid		20 2 0	
„ —Owing		17 15 0	
			37 17 0
Solicitors' Charges—Owing			17 17 10
Auditors' Fee—Owing			5 5 0
Bank Charges			1 15 1
Wm. Brough—Clerical assistance in issuing Circulars			1 17 0
Secretary's Petty Cash			38 15 5
Treasurer's Petty Cash			13 18 2
Balance of Revenue over Expenditure			486 18 10
			£3,269 17 2

Memorandum. 63 Subscriptions for 1887 owing not included in above.

Journals in Stock:— Nos., value £

Messrs. T. L. Patterson and T. W. B. Mumford were then appointed scrutineers to examine the Ballot Lists, and while the votes were being counted the President delivered an address.

The President's Address.

This is the first occasion on which the Society of Chemical Industry has visited the industrial metropolis of Scotland. The objects of our Society are so well known that I need hardly say that there could be no more fitting place for its meeting than Glasgow; because within a very short radius of this city we have the most varied chemical manufactures probably that can be met with in the United Kingdom. These manufactures may not be in each individual department so great as they are in some other localities; but for variety, for interest, for the ingenuity which has been exhibited in connexion with their progress during recent years, and, indeed, during a long time past, Scotland deserves enormous credit. That being the case, we have come to Glasgow to be stimulated by observing new works, by hospitable invitations to inspect new industries; and therefore it is desirable that we should not only consider the objects of the Society, but also the immediate purpose of our being here. In the first place, I think the fact that our General Meeting is being held in this magnificent hall is in itself a proof that the aims we have in view are reciprocated by the Principal and the Professors of this ancient and honourable University. It proves that there is no desire on their part to dissociate pure and applied science, and that they are desirous of encouraging the objects of our Society. I am sure you will all agree with me that the Senatus of this University deserves our heartiest thanks for such generous support.

If we consider the variety of inventions which are annually recorded by our Society, and the number and character of the papers read and discussed before it, it will become evident that it would be quite impossible for any one man to deal adequately with the range of our special study. It is sufficient, therefore, for each one who has to discharge the duties of President either to refer to some branch of science, specially within his own knowledge, or to deal with chemistry in its broad and general aspect. I have noticed that however interesting it may be to manufacturers to hear the views of scientific men on particular processes, yet they are never affected to the same extent as by the views of a brother manufacturer. That being so, for me to attempt to go into the details of new industries or new applications of chemistry would be tedious and unprofitable—especially as such matters are dealt with in detail in the records of our various local Sections. It seems to me, therefore, that as we are grouped here for the first time, a reference to something connected with the broader cultivation of chemistry, with its larger issues, and with the transitions that have taken place in our science, may not be inappropriate. After all, the essential aim of our Society may be expressed by saying that we wish to impress on the community at large the fact that industrial supremacy is not an inalienable possession which one generation can hand down to another with perfect security, but that it is, on the contrary, an unstable possession, which can only be maintained and held through scientific intelligence and cultivated industry. If that is our aim, then I say that we must look to what has been done in the past as well as in the present. For there can be no doubt that analogy has operated very powerfully in the history of chemistry, and that those persons who are most alive to the higher interests of progress are always stimulated by the chief currents of thought which have in the past created research in certain departments of our science. Scotland has had a great deal to do with the development of chemistry, and deserves great credit for her work in the past—and, I hope, in the present also, but I am going to deal especially with the past—in advancing a theory and in developing that particular view of chemical action which is now as dominant as any other. At the present time we may say that there are two large schools of chemistry: one school cultivating organic chemistry, in which structural or architectural building up of an atomic character is carried out on a gigantic or manufacturing scale, producing thousands of new bodies every year, and continually increasing in the energy of its work and the variety of its productions. On the other hand we have another school in which physical chemistry is predominant, where the physical relations of chemical action are minutely examined, and where the effect of the physical action of the constituents taking part in chemical changes is being more and more elaborately studied. Now how did this school of chemistry originate? I say that this cultivation of our science originated chiefly in Scotland, and through the intelligence and caution of one of the two great founders of chemical science, namely Black. When Black lectured in this University, he was careful to adopt a view of chemical action which, when we meet with it in the records of his lectures, cannot but strike us as being not only original but as characterised by reserve and by that central nucleus of truth which is bound in the end to succeed. Black's early lectures were not entitled lectures on chemistry, but *Lectures on the Effects of Heat and Mixture*, thus avoiding those theoretical difficulties which he saw had retarded progress in the case of his predecessors. The discoverer of latent heat and the author of one of the finest pieces of inductive reasoning in the English language (I refer to his paper on *Magnesia Alba and on The Relation between the Fixed and Caustic Alkalis*) determined to avoid chemical hypothesis and speculation. It has been sometimes argued that Black discovered latent heat without making experiments. It may be that his definite experiments were made only after he had a strong belief in the truth of his views. Consequently Black has been held to have been more of a metaphysician than an experimentalist; I cannot find any proof of that further than, as is commonly alleged, every Scotchman must be a metaphysician. However that may be, Black's lectures on heat and mixture had a most remarkable effect on his disciples and co-workers, and, strange to say, the influence spread to discussions in another branch of knowledge.

Discussions arose in the Royal Society of Edinburgh with regard to the origin of the world. They undertook large problems in those days, and did not, as we do, labour as specialists in small departments. They fought bitterly, and were divided into two camps on the question of the origin and structure of the crust of the earth; one party advocating water power as the dominant agent, while the other maintained that volcanic action was chief factor in geological phenomena. The Neptunists opposed the Plutonists on the ground that Black himself had shown that the transformation of carbonate of lime from "mild alkali" to "quick alkali" was brought about by the loss of a gaseous acid. How could enormous masses of carbonate of lime have ever been subjected to such heat as that required by the volcanic theory without chemical decomposition? Hutton undertook to explain this by an hypothesis very wide-reaching and suggestive.

The views of Hutton may be succinctly expressed as follows:—

(1.) That heat has acted at some remote period on all rocks.

(2.) That during the action of heat all these rocks (even such as now appear on the surface) lay covered by a superincumbent mass of great weight and strength.

(3.) That in consequence of the combined action of heat and pressure effects were produced different from those of heat on common occasions; in particular, that the carbonate of lime was reduced to a state of fusion more or less complete without any calcination.

The essential and characteristic principle of his theory is thus comprised in the word compression, and by one bold hypothesis founded on this principle he undertakes to meet all the objections to the action of fire, and to account for those circumstances in which minerals are found to differ from the usual products of our furnaces.

Nature, he said, does not work in the same way as you chemists in your paltry laboratories. You cannot imitate those large and complicated reactions which take place at infinite depths in the crust of the earth. There you have immense masses, enormous heat, and above all enormous pressure. It is useless to look for anything similar in the laboratory, and, as a working hypothesis, it is sufficient to conceive that under an enormous pressure of superincumbent matter carbonate of lime does not become caustic as in Black's experiments, but remains carbonate. This argument remained in the hypothetic stage, as Hutton objected to the idea of any attempt at an experimental verification, which is the more remarkable when we remember how readily Black had carried out his own experimental work. Probably the explanation is that feeling ran so high that neither side wished to run the risk of being defeated, and consequently they deferred attempting any experiments until after Hutton's death. If the point was not decided until after Hutton had passed away, his reputation at any rate would not suffer. It was Hall who was the first to attempt the experimental verification of Hutton's theory, and his experiments, considering the time at which they were done and the labour and ingenuity shown in conducting them, are simply epoch-making. He took carbonate of lime, placed it in a closed crucible, subjected it to conditions imitating what Hutton imagined to take place in the crust of the earth, and proved conclusively that the carbonate of lime did not become caustic under such circumstances, but became denser and crystalline in character, being transformed in fact into marble.

The views of Hutton were thereby shown to be rational and true, and that pressure or compression had a most important bearing upon that complicated operation which we call chemical affinity. This is confirmed by the title of the paper itself, which, in imitation of Black's caution, is headed "*An Account of a Series of Experiments showing the Effects of Compression in Modifying the Action of Heat*, by Sir James Hall, F.R.S.E., read 3rd June 1805." Here, then, the views of Black on the effect of modifying agents on chemical affinity are being revealed; and it seems to have at this time become so clear to the minds of Black and his pupils that chemical action was modified by such means, that they formulated a view of those relations which, if I read it, would seem to be the result of modern work:—

"We cannot have a conception of anything opposing a mechanical force but another mechanical force. Hence, we must infer that the corpuscular powers or qualities which ultimately produce the chemical phenomena are not different from the forces which produce and modify local motion, and are really similar to those which produce the fall of heavy bodies and the communication of motion by impulse."

They were therefore saturated with the view that however inexplicable the processes at work in chemical changes, they were not different in kind, but parallel and similar, and must be considered from the same point of view as those physical operations which can be measured and stated with physical accuracy. It is remarkable that Black and his followers should have reached this stage at so early a period in the development of physical chemistry, and I explain it by the fact that the Newtonian philosophy first found a fruitful ground in Scotland. I take this view because Newton's views on various subjects, and indeed his whole philosophy, was ably discussed in the Scottish Universities at an early period. Consequently, the Scotch Universities were saturated with the Newtonian philosophy, and Black becoming acquainted with it, took his theory of chemical action, and his curious mode of expressing the relations of heat and mixture, from Newton's suggestions. He admits himself that practically Newton was the author of the views which he expressed; and the passage which he works upon is to be found in a query attached to the "Opticks," in which Newton, discussing chemical action, asks himself how it is to be considered.

"Now," he says, "the above-mentioned motions"—and he uses the word fermentation as a representation of the action of an acid upon a metal—"are so great and violent as to show that in fermentation the *particles of bodies* which almost rest are put into new motion by a very potent principle, which acts upon them only when they approach one another, and causes them to meet and clash with great violence, and grow hot with the motion, and dash one another into pieces, and vanish into air and vapour and flame (page 355).

"I had rather infer from their cohesion that their particles attract one another by some force, which in immediate contact is exceedingly strong, at small distances performs the chymical operations above mentioned, and reaches not far from the particles with any sensible effect" (page 364).

Then further on: "And therefore, that Nature may be lasting, the changes of corporeal things are to be placed only in the various separations and new associations and motions of these permanent particles; compound bodies being apt to break, not in the midst of solid particles, but where those particles are laid together and only touch at a few points."

From this passage Black worked out and formulated his views of chemical action. Notwithstanding the importance of Black's work and the stimulus given by Sir James Hall's elaborate paper on the effect of compression in modifying chemical action, it was not until Deville, in 1864, became impressed with the importance of the question of chemical stability, that a repetition of Hall's experiments was undertaken. It was Deville's consideration of that remarkable experiment made by Lord Justice Grove, in which it was demonstrated that by dropping white-hot platinum into water, the latter was partially broken up into a mixture of its constituent gases, which led him to his subsequent discoveries. Deville reasoned thus: In order to get this platinum into a condition in which it would have a temperature sufficient to produce such an effect, you use the oxyhydrogen blow-pipe. The oxyhydrogen blowpipe produces this concentration of heat by producing gaseous steam. Starting from the uncombined elements, gaseous steam is produced at a certain temperature, which temperature is conveyed to the platinum, and by the platinum to the water, which is thus decomposed. But how is this possible? It seems at first sight inconceivable that you should take water vapour and bring it to such a temperature that, conveying that temperature by means of a solid body to another specimen of water, it should produce the exact opposite, namely, decomposition into its original constituents.

To work out this problem, Deville took an ingenious course. He said: I may get at the explanation by ascertaining what the temperature of this flame is. For that purpose he threw a mass of platinum into a calorimeter, and having determined the temperature, he said: That temperature is very far short of the temperature which ought to be produced if in the combination of hydrogen and oxygen there was nothing but steam produced. If it instantly passed wholly into steam, the temperature ought to be three times as high, and I must seek the explanation of the deficiency. The explanation was clear. If the total quantity of heat measured was correct, then it was evident that if there was a loss the heat lost must have been doing something such as Black had suggested. It must have been producing a change of state, thereby becoming latent, and the only material in which it could produce that change would be the water itself.

Deville therefore came to the conclusion that the idea of flame which had reigned up to that time was wrong; that the oxyhydrogen flame was not composed solely of intensely heated steam, but of intensely heated steam together with a portion of the uncombined elements; that the proportion of uncombined elements was just as certainly there as the steam itself, and that the one could not exist without the other. That was a very bold view of the constitution of flame; but he at once confirmed it by devising an ingenious method of drawing specimens of gases from the flame in such a way that the gases had not the opportunity of gradational combination. In other words, he devised a simple aspirator, by means of which the gases were instantaneously cooled from the temperature of the flame and were thus prevented from passing through the ordinary phases of combination. By this simple means he showed that when gases are withdrawn from a flame of this kind, they always contain a portion of the uncombined constituents. And so he surveyed the whole field of inorganic chemistry, proving that compounds, such as vapour of water and carbonic acid, the chief products of combustion, and two of the most stable bodies, were essentially unstable under the defined conditions. This led to the great theory of dissociation. Deville saw that this discovery explained the complications of a large number of metallurgical operations involving the use of flame. It modified greatly the prevailing views as to the production of potassium and sodium, and indeed of the stability of compound bodies generally. A complete revolution took place in the science of chemistry, not only with respect to the temperature and composition of flame, but as to the whole question of chemical stability. Debray (a pupil of Deville) proved that in a large class of such dissociation phenomena there is a definite relation between the pressure of the gaseous products and the temperature, that this relation is invariable for the same substance, that it is independent of the mass worked upon, and is only a function of the temperature. He thus completely cleared up a vast number of complicated questions which had struck chemists again and again, such as: Why could carbonate of lime be raised to a full red heat in a closed vessel, and remaining undecomposed, yet be decomposed easily in a current of steam under the same conditions of temperature? All such reactions were but types of a series of anomalies which were once and for ever disposed of by these experiments and the studies of Deville, following strictly on the lines of Black's consideration of the effect of heat and pressure on chemical combination. Therefore the great theory of dissociation due to the exquisite work of Deville may be regarded simply as the natural development of the earlier work and suggestions of Black, Hutton, Hall, and the Scottish school of chemistry.

Now Black's doctrine of latent heat and chemical action produced important results in other branches of our science. We find that as early as 1805 Dalton is predicting that gaseous bodies would be liquefiable provided they were sufficiently compressed and cooled. In fact he was anticipating by more than twenty years the experimental liquefaction of gases by Faraday. Just as Lavoisier felt convinced that the alkaline earths would be proved to be compounds, thus anticipating the discovery of Davy, so Dalton was convinced that the permanent gases would be liquefiable by pressure. The liquefaction of gases by Faraday and their elaborate study by Regnault followed strictly the consideration of the physical side of chemistry. Deville shortly came to the conclusion that there was a strict analogy between what we call chemical decomposition and that simple change of physical state of matter whereby it passes into the solid, fluid, or gaseous condition. The whole of Deville's work rests upon the accuracy of that analogy.

Now we have the modern school of chemistry stepping in with a new light. Thermo-dynamics and the whole relations of heat are developed. Rankine looks into Regnault's work and proves from his data that the quantity of heat which is evolved during this change of state may be calculated, and that it is unnecessary to determine latent heat provided the pressures of the saturated vapours at different temperatures have been measured.

That being the case, it was natural, after having clearly proved the analogy between chemical and physical transitions, to inquire whether or not thermo-dynamics would be equally applicable to strictly chemical phenomena. That is the field which is being cultivated now by many able minds. It was certainly foreshadowed by Rankine, and an immense amount of work on the subject has been done by the founders of modern thermo-dynamics; and altogether it is the most suggestive and far-reaching field of labour now before us

The chemical problem has recently been attacked by an able American physicist, Professor Willard Gibbs. He has very thoroughly discussed the relations of dissociation to chemical change from the thermo-dynamic side, and has discovered a very simple expression which defines the ratio of the number of the simpler molecules existing at any particular time to the number of the more complex molecules which are not yet decomposed in terms of heat and pressure. This wide generalisation Gibbs has discussed in a series of remarkable papers read before the Connecticut Academy. He has proved that the laws of thermo-dynamics are as applicable to chemical action as to simple changes of state. This is practically a return to the notions of the early school of chemistry. Strictly physical data have been all co-related. The decomposition of carbonate of lime into carbonic acid and lime is parallel to that change of state which occurs when water passes into steam. Black used to institute a parallel between the phenomena attending the hydration of lime and that which occurred when steam was condensed to water, both being accompanied by an evolution of heat and a change of state. The one might be called a chemical change, but for him it was analogous to the simpler change of physical state involved in the other. Now the laws governing the one are shown to be applicable to the other—not by analogy only, but by quantitative data proved to be correct. We have now reached a stage at which thermal evolution in chemistry can be predicted and calculated as to its absolute amount just as latent heat can be calculated from the pressure of the vapours of the substances in question.

This is one of the great results achieved by the cultivation of the physical side of chemistry which becomes more important every day, and is being pressed to further and further limits. I need only point to the work of Andrews which has revealed the importance of that temperature which we call the critical temperature; and similar work is being vigorously prosecuted by Amagat, Tait, and others, in which conclusions are being arrived at which are almost astounding—work in which the compression used is so great that mercury gets in some mysterious way through the walls of malleable iron cylinders, where the body acted upon is so compressed that in the gaseous state it is at a higher density than the fluid, and where, by compression alone, the liquid body becomes a solid at ordinary temperatures. But this work is all on the same lines as that which we have been discussing. The results are more striking, simply because the work is carried out by means of instruments of enormous power; but the principles involved are essentially the same.

This brings us to the remarkable experiments on chemical stability made by Joule, in which he employed compression to prove that certain amalgams were decomposed. And this curiously enough carries us back to the work of a professor of this University, namely, the suggestion and mathematical proof by Professor James Thomson (confirmed experimentally by Sir William Thomson) that in the transition of a solid to the liquid condition pressure alters the melting point of the substance. I refer to the discovery that the freezing point of water is lowered by pressure. And this has been proved to be equally true of chemical changes—where a body (like sulphur, for instance) is changing from one allotropic condition to another, the ordinary point of transition is proved to be dependent on pressure. Here we have another kind of change brought about, in which pressure is shown to be a most important factor, more recondite in character, and requiring much more delicate apparatus to investigate it, but strictly parallel to those we have previously considered.

Having referred to the general application of thermo-dynamics to chemical change, I ought to mention another phase of investigation which is gradually working to the same end, and that is the large amount of attention which is now being paid to the question of the velocity of chemical action. This question has recently been pressed upon the attention of chemists by a set of experiments made by van't Hoff. The chief idea is to co-relate concentration with varying gaseous density, so that the reactions of salt solutions are brought into harmony with gaseous reactions. This is the work which van't Hoff has attempted, and very remarkable it is, to consider the concentration of a solution containing a certain quantity of a salt as if the substance was in the gaseous state, and prove that the pressure of the dissolved solid is practically the same as if it had been volatilised into the same volume. Thus, a new view has been opened up which brings into harmony the whole question of solutions of varying concentration and the laws regulating their reactions. The method of time reaction enables us to attack another, namely, the complexity of the number of molecules which undergo change in any specific chemical operation. van't Hoff has attempted to solve this question, and has made very interesting experiments to verify the accuracy of the theory.

I might pursue this subject much further, but time forbids. If I did not refer to the great culture of organic chemistry it might be inferred that I do not appreciate it. That is not so; and indeed I should be the last in applauding the work of a great predecessor in this University to in any way disparage the work of his successors. If we take the successors of Black in the University certainly no man has done better work in the interest of organic chemistry than the great Thomas Thomson. His work on general chemistry, considering the time, is a perfect masterpiece of thought and labour. And further, we are indebted to him as the only English historian of chemistry, if we except the present occupant of the Chair of Chemistry. The whole history of modern chemistry we owe to Thomson; and his work in connexion with the advancement of the atomic theory will always remain a monument to his genius and a credit to this University. And we have not only the work of Thomson, but also the splendid work of Dr. Anderson, the recent occupant of the Chair here. We cannot forget that Anderson practically originated what is now a great and growing industry, namely, the industry of an important group of the coal-tar bases. When we consider his work on the pyridine and quinoline bases, and the variety of the reactions he discovered—work which is so full of theoretical and practical interest—we cannot but admit that this Scotch chemist added very important facts and discoveries to the department of organic chemistry.

With regard to the industrial work which is being done in Scotland, I need only say that with respect to variety in methods of manufacture Glasgow is still prominent, as she has been from the first. At the present day there is no problem which is more likely to modify in every respect chemical changes on the large scale than the question of fuel. More and more are we struck with the idea of this becoming either the petroleum age or the natural gas age. One has only to visit the petroleum regions of America, and see the application of natural gas on a large scale to be convinced that sooner or later the supply of energy will be the most telling agent as regards the successful conduct of all our manufactures. This fact renders it more and more necessary for a small country to economise; and undoubtedly the great development of the paraffin industry in this country, and the closer attention which has in recent years been given to the utilisation of waste products, has been closely identified with the manufactures of Glasgow. I refer chiefly to the vast utilisation of salts of ammonia which has been undertaken by Scotch ironmasters, three of whom are actively engaged in the matter. The Messrs. Baird, of Gartsherrie, have adopted a process by which about one hundred million cubic feet of furnace gases are treated per day, yielding something like seven tons of ammonia, and involving the treatment of about 3,000 tons of air per diem. When we consider the small proportion of valuable material to be separated, and the ingenuity of the apparatus which is the means of extracting it, we cannot say that industrial chemistry is dormant in Glasgow. It is only to be regretted that the waste of this highly valuable and important material has been permitted to go on for so long. It is not my intention now to give more than this one illustration of the energy and enterprise which is characteristic of the manufacturers of this district, especially as I am in the presence of Mr. Mond, who has done so much for the utilisation of ammonia from coal. I trust that on some future occasion he will give us the results of his work on this subject. However, I think I may fairly say that if our Society did nothing more than stimulate such enterprise as I have just cited, it would be doing good service indeed.

I have said that the object of our Society is to bring together abstract and applied science, and I think that the condition of the Society is a proof of the mutual advantages which are thereby derived. We have not only a sub-division of labour throughout the country as regards our organisation, but we get the benefit of the particular knowledge of individual industrial centres. Of course industrial chemistry is necessarily cultivated in certain directions in one locality more than in another, and the fact that our Society is, as it were, omnipresent, enables us to get the best and most original material wherever it is to be found. The Society brings together a large variety of minds. Those chemists who, though as scientific as their brethren, devote their attention exclusively to industrial pursuits, benefit by their contact with the representatives of abstract science, while the latter, I am bound to confess, often get in return more information than they have given. Thus the Society cannot but progress. The fact that it now has over 2,400 members, and is one of the largest — indeed the largest—scientific societies in the kingdom, is a proof that the work it is doing was very much wanted. It is to be hoped that we shall continue to progress in the future as we have in the past. There is no reason why we should not, since the object of our Society is not to make money but to diffuse it, and to do everything which can be done for the progress of applied knowledge. It is a Society which ought certainly to be encouraged and supported. Whatever opinions may be entertained as to the value of the work done in any particular year or at any particular place, all such critical considerations disappear when we sum up the general results of the Society's work.

Although in the case of industrial operations there must always be large personal interest involved, yet such consideration only renders authors of new processes more careful as to the accuracy of the facts and figures brought before the Society. The success of our Society is due to freedom so far from personal jealousies either of members or local sections. The honest endeavour to succeed in industrial rivalry has produced a body of men harmoniously working together for the common welfare.

To give only a few instances of important work done during the past year, and completely described in our Journal, I may mention in the first place the splendid work of Mr. Chance, of Birmingham, on the recovery of sulphur from alkali waste. Anyone who chooses to read that paper will find it full of admirable, methodical, scientific work with regard to the compression, separation, and manipulation of gases. The next paper that I will refer to is one that I had the honour of giving, but which really was given in the name of a distinguished member whom I am proud to see here to-day, namely, M. Pechiney, of Salindres. This work of M. Pechiney and the late Mr. Weldon on the production of chlorine, is another striking example of what I have before referred to, namely, the thorough elaboration of a great industrial process. English manufacturers who have seen it at work have admitted again and again that, if they had had to attempt the problem which M. Pechiney and Mr. Weldon set themselves to solve, they would have hesitated seriously at the construction of the complicated plant required. Yet we find now that the installation has been completed, and the recorded results show that its complexity does not interfere with regular and continuous working.

And this leads me to say that we do not necessarily confine ourselves to the discussion of manufacturing processes which are commercially successful. An industrial process may fail of commercial success for various reasons. No one will deny that vast ingenuity was expended by M. Ballard on his method for separating potassium salts from sea water. Though not a commercial success, M. Ballard's work remains a monument of what can be achieved by genius and determination. But for the introduction of natural supplies from Stassfurt, the process would have been a practicable one; in fact, it is employed by M. Pechiney now. I hope that we, as a Society, shall never fail to recognise whatever is novel, nor be too narrow in our views of what should be admitted to or excluded from the pages of our Journal. I trust that the Society will continue in the course it has hitherto taken, and I feel confident, not only that the new President will discharge his duties in the best interests of the Society, but that the Society will flourish under his presidency.

VOTES OF THANKS.

Professor DITTMAR said he hoped the meeting would heartily join him in a vote of thanks to the President for the excellent lecture he had just given. It would be out of place to review the address at that time, and he would confine himself to congratulating Professor Dewar on the excellent manner in which he had treated his subject, and the justice he had done to the memory of Black, Thompson, and Rankine. He believed that what had been said about the development of the physical branch of chemistry could not have been better put. But, trusting to his old personal friendship with Professor Dewar as a claim for indulgence, he would venture upon offering one critical remark. In dealing with the modern school, Professor Dewar had omitted one name—the name of Clausius—who had, perhaps, done more for the development of the true theory of chemistry which was now taking place than anyone else. If Clausius had contributed nothing more than his brilliant idea of the distribution of temperatures in gases, that alone would be sufficient to immortalise his name.

Seeing his two friends, Professor Dewar and Mr. Mond, sitting together, had suggested to him a question, the solution of which was engaging the minds of many practical chemists. How came it that this country no longer held the prominent position it used to hold in regard to chemical industries? Some people said that the position was explained by the fact that the Germans had, and we had not, the necessary technical schools: that whereas we tried to teach science only in our universities, the Germans taught it not only in their universities but in practical technical schools. There had been too much of that idea in this country. He thought it a great mistake to suppose that the duties of a works chemist or an engineer could be taught directly in schools, and that it was this kind of teaching which had made the German schools so great. First, the most famous of German polytechnic schools were doing very much what the universities did. To regain our former position in industrial chemistry, he thought that two things were necessary. The first remedy had been suggested already by the President, and consisted in affording young men the greatest possible facilities for acquiring a thorough scientific education irrespective of its application. We had already a number of universities, but there were not sufficient of them yet, and there were difficulties in the way of fully utilising those that did exist. For one thing, the laboratory fees were far too high. But what impeded the progress of scientific education more than anything else was the miserable system of examinations which existed. A young German was ready to enter the university at 18. After some preliminary studies there he could devote himself to chemistry, physics, or mathematics, according to his special business, and by the time he was 21 he may have gained a position as investigator. In this country the case was very different. A young man went to the university, and was detained there until the 22nd year of his age before he got his M.A. degree; then he would get the B.Sc., or some other miserable combination of letters, and finally wind up his career there with D.Sc. at the age of 25, when he might begin to do some earnest work in research, but that he was arrived at an age when it was necessary to earn his living, and so he perhaps never got to the length of being a high-class scientist. Another point in which Englishmen would do well to imitate the Germans related to the conduct of their works. In Germany science was brought to bear upon chemical industry to a much higher degree than in England. In this country a great many things were left to rule-of-thumb men and foremen, which in Germany were undertaken by skilled chemists. Mr. Mond had been successful in introducing the ammonia-soda process into this country because he had *himself* applied his great chemical knowledge to the problem before him. English manufacturers did too much by *deputy*. They carried on their works to make money, which was of course quite legitimate. But a German delighted in his trade for the trade's sake, whether he made money or not, though, of course, he liked to take the money if it came. He thought the solution of the problem of how to remedy the present state of things would be to aim at producing as many Dewars and Monds as possible, and all the rest would then take care of itself.

Sir John Neilson Cuthbertson, in seconding the vote of thanks, said the retiring President had largely contributed to the success of the Society during the past year. It was a great advantage to the Society to have men of his eminence among its members, because their presence lifted it out of the sphere of mere business, and placed it on a higher and scientific level. Speaking for the Scottish Section, with which he was himself connected, he could say that they esteemed it a great privilege that the meeting was being held in this city on the present occasion. Looking back over the 30 or 40 years during which he had known the trade of Glasgow, the strides which had taken place in chemical industry appeared remarkable and wonderful. The depression which is sometimes spoken of he regarded as merely comparative. It was to the interest of chemical industry to promote societies such as the one they were members of; and the success of their Society proved, as the President had said, that it was required. With respect to the question of education alluded to by Professor Dittmar, it seemed to him that if this country was falling behind in the manner and to the extent alleged, it was to be accounted for by the very success of chemistry amongst us in the past. Our men of great minds had been engrossed with their own particular affairs, while professional chemists had been attracted to the money-making side of the question, and had not had that amount of time for investigation which was devoted to it by some Germans. He had no doubt that in future, under the influence of that Society, research and education would go hand in hand with practical industry, and that they would thus be able to meet opposition from any part of the world.

The vote of thanks was carried by acclamation.

The President thanked the meeting and his old master, by which name he was always proud to call Professor Dittmar, for the kind manner in which he had been received. He could not deny that but for the admirable tuition he had had at Professor Dittmar's hands he would not have been there that day, and consequently he always received anything he had to say with very great respect. The omission of Clausius's name was quite unintentional, and was certainly not intended as a slight to Germany. It was simply due to the fact that he was dealing with some of those who had identified themselves with the extension of thermo-dynamics to the chemical department strictly so called. No one would dream of saying that as regarded the foundation of thermo-dynamics Mr. Willard Gibbs would occupy a position such as that held by Clausius. Nevertheless, he had dealt with the former because he had set himself that specific problem which came within the scope of his address. It would not be right of him at that time to follow the learned Professor in a broad discussion of technical education. He would only say that he believed that everyone in this country who had had anything to do with science examinations would applaud to the very echo what Professor Dittmar had said respecting them. He had had some experience of examinations in the universities of Scotland as well as in London and Cambridge, and he was convinced that however difficult it might be —and it was admitted to be one of the most difficult operations—to construct a perfect teacher, it was a much more serious task to get a common sense examiner. The result was that there was no continuity in those great centres of examination where there was no professoriate to guide it. He entirely sympathised with Professor Dittmar's view that this was a crying evil, on two grounds, firstly, because pupils were educated merely for examination, which was a bad principle in itself, and, secondly, because as a rule the examiner had not the common sense to know how to examine a pupil at all.

The President then read the report of the scrutineers.

Report of Scrutineers.

"We have examined the Ballot Papers handed to us and have to report that 120 were received, of which three were spoiled, and that all the candidates nominated are duly elected.

"(Signed) T. L. Patterson.
T. W. B. Mumford."

The following is therefore the composition of the Council for 1888—89.

President.

Ludwig Mond.

Vice-Presidents.

Sir I. Lowthian Bell, F.R.S.
R. Forbes Carpenter.
Prof. F. Clowes, D.Sc.
Sir J. Neilson Cuthbertson.
Prof. James Dewar, F.R.S.
Dr. John Evans, F.R.S.
David Howard.
Ivan Levinstein.
E. K. Muspratt.
Sir H. E. Roscoe, M.P., F.R.S.
Prof. W. A. Tilden, F.R.S.
John Williams.

Members of Council.

Alexander M. Chance.
James Duncan.
A. E. Fletcher.
S. H. Johnson.
B. E. R. Newlands.
B. S. Proctor.
F. J. Rowan.
Dr. Edward Schunck, F.R.S.
E. C. C. Stanford.
J. C. Stevenson, M.P.
T. W. Stuart.
Thos. Tyrer.

Treasurer.

E. Rider Cook.

Foreign Secretary.

Dr. Ferdinand Hurter.

The President elect, Mr. Ludwig Mond, on taking the Chair, said that he desired to express his sincere and heartfelt thanks for the great honour which the Society had done him in electing him President, a post which had been held by such a brilliant array of eminent men, starting with the name of Roscoe and ending with that of Dewar. He could assure the meeting that he felt very sensible and very proud of that honour. He trusted that he should have the power to prove worthy of it, and that with the aid of the excellent Council, the names of which the Secretary had just read out—composed of a number of men of great ability and experience, and every one of whom was at all times ready to devote his best energies to the welfare of the Society—he might succeed in handing over to his successor the trust now confided to him in as flourishing and satisfactory a state as he had received it.

On the motion of the Chairman, seconded by Mr. Thos. Tyrer, Messrs. Theobald Bros. and Miall were elected auditors for the ensuing year.

The next Annual Meeting.

Mr. Thos. Tyrer, as Secretary of the London Section, then formerly invited the Society to hold its Annual Meeting for 1889 in London.

On the motion of Mr. E. K. Muspratt, seconded by Mr. T. W. Stuart, it was resolved to cordially accept the invitation of the London Section.

The proceedings concluded with a hearty vote of thanks to the Senate of the University for permitting the Society to use the Bute Hall for the purposes of the meeting.

THE GLASGOW INTERNATIONAL EXHIBITION.

The members then proceeded to the Exhibition by invitation of the Executive Council, and were received by the Ceremonials Committee in one of the large picture galleries, which was specially reserved for this purpose. After examining the numerous works of art displayed the visitors dispersed in order to fully examine the various sections. Principal interest was no doubt centred in the Chemical Section of this fine Exhibition. As in the case of the Chemical Section of the Manchester Exhibition, the Society of Chemical Industry can take credit to itself in counting amongst its members the majority of those who have brought together a most admirable collection of exhibits relating to the manufacture of chemical products. Some of these exhibits contain specimens distinguished by great rarity and singular beauty, and can thus afford abundant satisfaction both to the theoretical and practical mind. It is not intended to give anything like a full report on the exhibits of the Chemical Section of the Glasgow Exhibition, but only to call attention to such features of the more striking and interesting exhibits as appear to warrant it. Great credit is due to those firms which have prepared articles in such a condition of purity and beauty, indeed, such as can only be seen in an Exhibition of this kind, for only operations on the large scale could yield them. Here, then, the student of pure chemical science may receive instruction, for here preparations may be seen which he would vainly attempt to obtain in the laboratory; not unfrequently also absolutely new chemical compounds are discovered in the works laboratory, manufactured in the works, and at once placed in the market.

It might have been thought that the chemistry of the sodium carbonates was exhausted, but in one case, well exemplifying observations just made, we have the remarkable example of a new salt, a new chemical compound discovered in the works laboratory and at once put into the market, and as this is illustrated in the case of the firm with which the President is connected, it may be deserving of first mention. It is the beautifully crystalline *hydrated sesquicarbonate of soda* ("*Concentrated Crystal Soda*") prepared under a recent patent by Messrs. Watts and Richards (this Journal, 1887, 661). Its formula is $Na_2CO_3, NaHCO_3.2H_2O$; it forms fine acicular crystals, and, as a mild alkali, ought to prove a valuable agent for scouring the finer classes of wool. Amongst other products, also illustrating the ammonia-soda process which Mr. Mond first introduced into this country, the show case of BRUNNER, MOND, & CO. contains samples of their pure *Bicarbonate of Soda* made under Mond and Jarmay's patent (this Journal, 1885, 282). It is remarkable, though made on so large a scale, as being a product of almost chemical purity.

MESSRS. BELL BROTHERS, LIMITED, of Middlesbrough, illustrate the conversion of the salt of the brine springs of Clarence and the Middlesbrough district into alkali by the Schloesing ammonia-soda process. They also show samples of pig iron produced in the Clarence blast furnaces.

The attention of the chemist interested in the acids, alkalis, and salts will also be at once arrested in a survey of the exhibit of JAMES MUSPRATT AND SONS by certain magnificent crystals, perfectly clear and somewhat resembling large rhombs of calc-spar, and he will be astonished to learn that these are crystals of *Chlorate of Soda*. Probably such crystals of this salt have never been seen before. They were obtained by the process of Muspratt and Eschellmann (this Journal, 1885, 524).

In the exhibit of MESSRS. J. C. GAMBLE AND SON are also to be seen magnificent crystals of *Chlorate of Soda*, *Sodium Monosulphide*, and *Barium Chlorate*.

MESSRS. GASKELL, DEACON, & CO. exhibit, amongst other things, some magnificent "points" of *Soda Crystals*, their beautiful "*Crystal Carbonate*" ($Na_2CO_3.H_2O$), obtained by Hurter's method, and a fine sample of pure *Calcium Chloride*.

The old firm of CHARLES TENNANT & CO., of ST. ROLLOX, is well represented, and to it attaches a kind of classic interest. The name of Dunlop comes to mind, and his remarkable process for the recovery of manganese peroxide. St. Rollox was the birthplace of the bleaching-powder industry, an industry introduced by the grandfather of the present principal of the firm, Sir Charles Tennant, Bart.

THE WIDNES ALKALI COMPANY, LIMITED, show crystallised *Permanganate of Soda*, *Manganate of Soda*, and finely crystallised *Strontium Hydrate* ($Sr(OH)_2.8H_2O$), exported to the continent for employment in the beetroot sugar industry.

MESSRS. CHANCE BROS., of BIRMINGHAM, have opened an exhibit illustrating the new process for recovering practically all the sulphur from alkali waste. This process is remarkable; it will be remembered (this Journal, 1888, 163), as being one in which the difficulty has been very skilfully overcome of dealing with large volumes of sulphuretted hydrogen gas, the primary product. This is then converted through the media of the vitriol chamber process with special burners on the one hand, and the Claus's kiln on the other, at will, either into a very pure sulphuric acid or into the ordinary commercial forms of sulphur. As an exhibit it presents nothing of merely striking appearance to the eye. The ordinary sightseer would doubtless pass it by; for the chemist and the manufacturer alike, however, it is pregnant with interest, and at the present moment the process which it illustrates is exciting very considerable attention both in this country and on the Continent.

THE EGLINTON CHEMICAL COMPANY, LIMITED.—Splendid crystals of *Ammonium Bichromate*, which, at first sharply defined and angular, at length become rounded. A fine specimen of metallic *Chromium* is also exhibited.

Well-nigh surpassing the preceding is the exhibit of JOHN AND JAMES WHITE, of RUTHERGLEN, showing all the raw materials and products of the chromate industry. Magnificent crystals of *Bichromate of Soda* ("*Patent Pure Bichromate of Soda*"), also the same salt in the form of a crystalline orange cake. The fine crystals of *Ammonium Chlorochromate* shown would interest the chemist.

His attention would be well repaid also by a visit to the stand of MESSRS. STEVENSON, CARLILE, & CO., where (1) are shown samples of the *Chrome Ores*; (2) large samples of *Metallic Chromium*; (3) a fine series of chromates, bichromates, and chromium compounds, amongst which are a beautiful *Bichromate of Strontium*, *Ammonium Bichromate*, in fine red crystals, which form a great contrast to the thick yellow needles of *Ammonium Chromate*.

Finely crystallised specimens are also shown of *Calcium* and *Magnesium Bichromates* and of *Sodium Chromate*.

Messrs. Peter Spence & Sons and The Glasgow Alum and Ammonia Company, Limited, show the clearing effect of adding certain of their alumina preparations to contaminated and coloured waters and allowing them to settle in long glass tubes, besides exhibiting finely crystallised specimens of alums.

The Scottish Shale Oil and Paraffin Industry is well represented by the Young Paraffin Light Company, Limited, in whose case is exhibited the very letter that was originally addressed to the late Dr. James Young, F.R.S., the father of the paraffin industry, then Mr. James Young, by Dr. Lyon Playfair, now the Right Hon. Sir Lyon Playfair, K.C.B., M.P., before the birth of this great industry, telling Young that he was confident there was great value in that bituminous Scottish coal and shale, and urging him to give attention to the subject. Other admirable exponents of the industry are the Broxburn Oil Company, Limited, and the Pumpherston Oil Company, Limited.

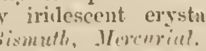
The Russian Oil Industry is represented in Court 24 by Messrs. A. Oehlrich & Co., of Hamburg, Baku, and Riga, and in Court 9 by the exhibit of Crichton's Oil House, of Newcastle-on-Tyne and Baku.

The Iodine Industry is well illustrated by the exhibits of the North British Chemical Company, Limited, and the new Alginate Industry by the Algin Company, Limited, of Clydebank, with which firms the name of E. C. C. Stanford is intimately associated.

Pharmaceutical chemists, dyers, calico printers, sizers, and waterproofers will all be greatly interested in this instructive exhibit, which bears evidence in an eminent degree both of scientific research and commercial enterprise (this Journal, 1885, 518).

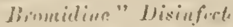
Messrs. John Walker and Co. show beautiful specimens of cube sugar, the product of a recent patent by Messrs. Walker and Patterson. By this method the operator is enabled to complete the several processes of moulding, draining, and liquoring blocks or plates of sugar in one apparatus.

Fine Chemicals receive ample exposition by the exhibits of Messrs. Howards and Sons, where may be seen beautiful specimens of *Cinchonidine Sulphate* and *Hydrochloride*, *Quinidine Sulphate*, *Cocaine*, and very fine crystals of pure *Urethane* (*Ethyl Carbamate*), and Messrs. May and Baker, who show their fine tablets of perfectly transparent and sublimed *Camphor*, beautifully iridescent crystallised *Bismuth*, together with *Bismuth*, *Mercurial*, *Antimony*, and other *Preparations*, and also finely crystallised *Benzoic acid* and *Benzoates*. There are also shown as novelties *Borland's "Bromidine" Disinfectant*, liberating bromine vapours on admixture with water; the new hypnotic, *Sulphonal*—



$$\begin{matrix}CH_3\\CH_3\end{matrix}>C<\begin{matrix}SO_2C_2H_5\\SO_2C_2H_5\end{matrix}$$

and new antineuralgic, *Phenacetine* (*Para-Acetphenetidine*)—



$$C_6H_4<\begin{matrix}OC_2H_5\\NH(CO.CH_3)\end{matrix}$$

A magnificently crystalline block of *pure Spermaceti* exhibited by Messrs. Wm. Walls & Co. must have attracted considerable attention.

As regards exhibits illustrating the Coal-tar and Coal-tar Colour Industries, these are very well represented by the Farbenfabrik von Friedr. Bayer & Co., of Elberfeld, with specimens of their famous *Croceine Scarlets* and *Benzidine colours*, the latter of which go directly on cotton fibre without the intervention of mordants, dyed and printed specimens in illustration of effects, and finally, their new pharmaceutical products, *Phenacetine* and *Sulphonal*, already referred to. The firm of the Society of Chemical Industry of Basel exhibits a collection containing, amongst objects of more special interest, solutions of the wonderfully fluorescent *Diazoresorufin* and "*Fluorescent Blue*." Beautifully crystallised specimens of *Violet B.* and *Pentamethylpararosaniline hydrochloride* are also shown, and a fine specimen of *Chlorbenzaldehyde*, probably used for the preparation of *Gachm's Chlorindigo*.

Besides these the following can scarcely escape the attention of the chemist. The finely crystallised *Tetramethyldiamidothiobenzophenone*, the *Phenyl-α-naphthylamine*, *Auramine Base*, and pure *Sodium dihydroxytartrate*, doubtless used for the preparation of "*Tartrazine*."

Another eminent Swiss firm exhibiting is that of Messrs. L. Durand and Huguenin, also of Basel, represented by their agents for this country, Messrs. Kühn and Schroeder, of Manchester.

In this exhibit are represented the two therapeutical agents of coal-tar origin, *Salol* (anti-rheumatic) and *Antifebrine* (febrifuge). Besides these are shown the special classes of dyes for which the above firm is noted, viz., *Gallocyanine*, *Muscarine*, *Basel blue*, and the *Indophenols*.

The St. Denis Dyestuff and Chemical Company, Limited, of Paris (formerly Poirrier et Cie.), together with a fine display of dyestuffs, exhibit *Antifebrine* and finely-crystallised *Sodium naphthionate*.

An industry which has recently struck firm root and is now flourishing in this country, viz., the Artificial Alizarin Industry, is well illustrated.

The British Alizarin Company, Limited, repeats the fine exhibit, already seen in Manchester and London, with a few additions. Amongst these the pure white and crystallised *Carbazol*, having a delicate blue fluorescence, is interesting, as also the perfectly white specimen of *Chrysene*, and a magnificent specimen of *Acridine Chromate*, crystallised in a mass of agglomerated pale yellow plates.

Messrs. Sadler & Co., Limited, not only exhibit Coal-tar colours and Alizarins, but also their effects upon the goods, dyed and printed, of certain of their customers. Thus, their Alizarin colours on cotton yarns by *Messrs. T. P. Miller & Co.*; on loose wool by *Messrs. Kemp, Blair, & Co., of Galashiels*: printed goods by *Messrs. Inglis and Wakefield* and *Edmund Potter & Co., of Manchester*.

An exhibit that must cause feelings of astonishment is that of Messrs. Hardman & Holdens, of Manchester. Though Alizarin preparations and their effects on textile fabrics are the main feature, the following splendidly crystallised and rare products are shown:—

Monhydroxyanthraquinone ($C_{14}H_8O_3$) in fine yellow crystals. *Acridine hydrochloride* ($C_{13}H_9NHCl$), orange yellow plates; beautiful specimen. A pure specimen of *Purpurin* ($C_{14}H_8O_5$), as a crimson-red crystalline powder. Pure *Alpha-nitro-alizarin* ($C_{14}H_7O_4NO_2$) as an orange-red crystalline mass. *A New Anthra-*

quinone derivative, crystallising in orange-yellow plates, is shown, and also a finely crystallised sample of *Tribromanthracene* in splendid yellow needles. The following specimens are exceedingly beautiful:—*Alizarin Blue* ($C_{17}H_9NO_4$) in fine deep purple needles. *Anthracene* ($C_{14}H_{10}$), a magnificent mass of plates, white, with blue fluorescence. *Phenanthrene* ($C_{14}H_{10}$), splendidly white, but without fluorescence. *Acenaphthene* ($C_{12}H_{10}$), in magnificent white needles, and *Carbazol* surpassing in beauty any other specimen of the kind yet shown in the country; it takes the form of long needle-shaped crystals.

A good collection of *Natural Indigos*, from the various provinces of India and elsewhere, is shown by Messrs. Arthur & Hinshaw, of Glasgow. No less than 47 varieties are exhibited. There is also to be found an interesting collection of *Gums*, and a finely crystallised specimen of *Cream of Tartar* also arrests attention.

The Annual Dinner.

At 7 o'clock the members and their friends to the number of nearly 200 assembled in the banqueting saloon of the Grand Hotel, Charing Cross, for the annual dinner. The retiring President, Prof. James Dewar, F.R.S., took the chair, and was supported by the Hon. Sir. James King, Lord Provost of Glasgow; Mr. Ludwig Mond, President elect; Sir John Neilson Cuthbertson, Mr. E. C. C. Stanford, and Mr. R. R. Tatlock, Vice-chairman of the Glasgow and Scottish Section; Prof. M'Kendrick, Vice-president of the Philosophical Society of Glasgow; M. Pechiney, of Salindres; Mr. A. C. Kirk, President of the Institute of Engineers and Shipbuilders in Scotland; Prof. Jack, Prof. Ferguson, and others.

In giving the toast of "The Queen and Royal Family," the President said he was sure that all present sympathised with Her Majesty in her great grief, and admired that noble character which sustained her in her trouble. As to the other members of the Royal Family, they all knew that the Prince of Wales took a serious interest in science. He said "serious" because those who knew the amount of work he had done in connexion with that projected great institution, the Imperial Institute, were aware that he had thrown himself heartily into the work, and was determined, if possible, to create a scientific institution which should be a fitting remembrance of Her Majesty's reign.

The toast having been drunk with the usual honours,

Sir John Neilson Cuthbertson proposed "Our Guests," coupling with the toast the names of Sir James King (Lord Provost of Glasgow), and M. Pechiney, of Salindres. He said the guests of the evening included representatives of the civic authorities, of the executive of the Exhibition, of the University, to all of whom the Society was grateful for kindness and courtesy already received, and to others who were present they were grateful for favours to come, in the shape of interesting visits to important centres of chemical industry. He was sure that the company would agree with him in saying that they felt honoured in the presence of the Lord Provost, not only as a member of the Society, but as the head of one of the most important chemical establishments in the kingdom, whose name was a household word in Glasgow. The other representative name he would ask them to honour was that of M. Pechiney, who had come a long distance to be present. M. Pechiney was well known as a leading French chemical manufacturer, and as Mr. Weldon's colleague in carrying out one of the most recent successes in chemical science. He sincerely regretted that the Society's visit had brought with it such bad weather, as Glasgow, under such conditions, was not a place to rejoice in; but he trusted matters would mend in that respect before the visit came to an end.

Sir James King said he felt glad that he was not the sole person to respond to the toast, but that in honouring Scotland they had also honoured France, a country which had always been on terms of the greatest amity with Scotland. He felt that he had an arduous task before him, because he found that, leaving out the French department, he had to reply, firstly for the University, secondly for the Exhibition, thirdly for those who were affording facilities for excursions, and fourthly for himself. The University had at all times done everything in her power to facilitate the arrangements of sister universities or of kindred scientific societies. For the Exhibition Executive, he was glad that they had had the opportunity of affording the Society such recognition as it was in their power to give. With regard to those gentlemen who had interesting works to show, and who had afforded the Society an opportunity of visiting them, he felt that he must join with Sir John Cuthbertson in praising them for their public spirit. He had the honour of being a member of the Society, and although he had not yet had the opportunity of doing anything to further it, he wished it success from his inmost heart. He also had the honour of being connected with a firm which, under the double designation of George Macintosh and Co. and the Hurlet and Campsie Alum Company, was, he believed, the oldest existing chemical firm in Glasgow. The business was established in 1784 for the manufacture of cudbear, which was a novelty in Glasgow. It was established by a Highlander who had faith in Highlanders, and all the employés, therefore, were brought from the far north. He believed that none of them could speak English, so that they could betray no secrets They were under military discipline. All, save the married men, had to answer the roll call at eight o'clock every night, and every man who did not come into barracks at that time was fined. That was an amount of identification with the firm one served, which he was afraid would not suit now. The next firm in point of time (though more important in extent) was that of Messrs. Charles Tennant and Co., which began business in Glasgow in 1800, and had always been looked upon as the first in rank. Reverting to his position as chief magistrate, he would like to say a few words comparing the Glasgow of those days with the Glasgow of the present time. First, with respect to the post office, the very shortest time within which a letter to London could be answered was 10 days, but it usually meant 12 days. In those days there were 10 employés in the post office; there were now well nigh 1,000. In those days the revenue derived from the River Clyde was a little over 2,000*l.* a year; it was now over 300,000*l.* a year. The population of Glasgow in those days was a little under 50,000; it was now, as regarded the city proper, about 550,000, and the suburbs, which they considered part of Glasgow proper, amounted to 180,000 more. The rental of Glasgow in those days was 80,000*l.* per annum, and it seemed a large sum; but it was now increased to 3,400,000*l.* As regarded the supply of water in those days, and for almost a generation thereafter, there was no idea of obtaining a supply other than what nature had given in the shape of springs. Within the city there were 30 wells which supplied the people of those days, instead of the 40,000,000 gallons daily which were now brought from Loch Katrine.

M. Pechiney, who spoke in French, expressed his regret that he could not respond in English. He offered his sincere thanks for the hospitality shown him on this his first attendance at the Annual Meeting of the Society, and trusted that he might some day have an opportunity of offering some return for the welcome which had been extended to him.

The President then proposed the toast of the evening, "The Society of Chemical Industry," and in doing so said he desired to couple with it the health of the new President, Mr. Mond. It was needless for him to discuss the benefits which the Society had already disseminated. It was interesting to note, however, that no matter how much diversity of opinion might exist among individual members throughout the kingdom, they could yet coalesce perfectly when they came to deal with scientific subjects. If there was one thing more remarkable than another in the history of this Society, it was that with 2,400 members, with a large number of centres in various parts of the kingdom, it had always been easily and honourably managed, without any serious difference of opinion arising. That, he thought, was a matter of great credit to scientific men. They had all sorts of nationalities and individualities represented in their different centres, yet they were a compact homogeneous body, and under their new President would probably become more so. He thought the election of Mr. Mond a credit to the Society. It showed not only that he was cordially respected individually, but, considering his career in this country, it showed that they were independent of personality, and that they recognised merit from whatever source it came. Mr. Mond was now in a city which he probably knew more about than any other city in the country, since it was there that his original and ingenious process for the recovery of sulphur from alkali waste was worked out and carried on until, with the advance of discovery, new methods replaced it. He had then, as an inventor who is ever fertile should, taken to new fields which were more interesting to himself and much more important to the country. Mr. Mond deserved the credit of a pioneer. He sat down in the midst of an established industry and commenced a rival process, new in itself, which no one else had attempted there, but which under him had grown and extended to such a degree that its success and the novelty of its methods had been of enormous importance to the growth of technical industry in this country. The man who had introduced the ammonia-soda process into Cheshire, within a very short radius of the great centre of the alkali manufacture of this country, and who had continued to develop and extend it annually, was one whom they could not help admiring. But when they found that in addition to this he had devoted his spare time to a great many departments of chemistry, to novel and ingenious processes for the production of chlorine and the recovery of ammonia, they could not but admit that in his case the spirit of research had not been rendered inert by industrial success. Consequently, he felt that in the hands of Mr. Mond the Society was sure to progress. For years he had taken a great part in its ordinary work. As Foreign Secretary, he had not only attended the Council meetings, but had given his best services to the Society in every way.

Mr. Mond, in replying, said he felt under a certain difficulty. He had expected to be called on to reply on behalf of the Society, but Professor Dewar had been so kind as to speak almost exclusively of himself (Mr. Mond), and had said but little of the Society. He desired to thank the Society most heartily for the honour they had done him, and especially for having done it under the circumstances mentioned by Professor Dewar. He had always considered it one of the greatest privileges of this country that it could afford to honour foreigners without the smallest fear of thereby diminishing the fame of its own eminent men. Although he could not consider himself worthy of being so honoured, it nevertheless gave him great pleasure to have a new proof afforded of the impartiality and magnanimity of this great country. He had lived so long amongst Englishmen, and his interests were so bound up with theirs, that, though a foreigner, he was not a stranger among them; and he felt sure that every member of the Society would be convinced that his best endeavours would be given to the development and furtherance of the aims of the Society as connected with this country. In the admirable address which they had listened to in the morning, Professor Dewar had told them that the Society was flourishing and was now the largest scientific society in the kingdom. The report of the Council showed, too, that the financial position of the Society had improved, and was now in a very satisfactory state. In fact, the success of the Society had been greater than its founders, not many years ago, could in their most sanguine expectations have looked for. That success was said to be due to the fact that the Society supplied a want. But how had that come about? The reason was that the chemical manufacturers of this country had become convinced that the rule of thumb had come to an end, that the chemical arts were no longer mysteries, but that they were the application of a science, and that their further progress and development must depend upon exact scientific knowledge and the application of strict scientific methods. That Society was founded to disseminate scientific knowledge amongst its members and to promote the application of strict scientific methods to operations on the large scale. It was from a clear perception of the necessity of giving all possible attention to abstract science, if chemical manufactures were to develop, that they had from an early date laid great stress on having in the Society the largest possible number of men who devoted their lives to abstract science solely; and so, though the Society applied itself principally to the practical application of chemistry on a large scale, they were proud to number among their members most of the scientific chemists in this country. It was only from such men that they could learn to supply their greatest want—the application of strictly scientific principles. He regarded the discourse they had listened to that morning as a brilliant example of what could be done by a man who had devoted his whole life to the problems of pure science to enlighten and throw out valuable suggestions to those who were engaged in the practical application of chemistry. No doubt that discourse would give them food for reflection for many days, which could not fail to be of service to them if properly digested. He felt sure that as long as the veneration for abstract science to which the Society gave distinct expression in the election of its first President continued, and while the members understood what an immense advantage it was for those engaged in applied science to be closely connected with men who stand at the fountain head, and were able to give them those leading ideas which sooner or latter would result in a further development of their calling, the Society would continue in its career of progress and prosperity.

Mr. E. C. C. Stanford then proposed the toast of "The President," and, in doing so, said that when two years ago he had the privilege of acting as the mouthpiece of the Scottish Section in conveying their invitation to the Society to visit Scotland, he had mentioned that Scotland had been spoken of as the finest country in the world—*to emigrate from!* He had ventured then to assert the contrary of that proposition: that it might be found an interesting and agreeable country for the Society to emigrate into and spend a few days in. He hoped that before the present visit was over they would be able to prove the truth of his proposition. He had also pointed out that one of the great advantages of the city of Glasgow was that if one did not like it, it was one of the easiest of places to get away from—provided one had not offended any of its laws, and did not owe its honourable merchants anything. But the Council had taken him so completely at his word that they had gone away before they came there—in other words, they had taken the Society away to Manchester last year instead of bringing it to Glasgow. The Scottish Section, however, freely forgave the disappointment—in the first place because they were there at last (and heartily welcome they were); a year late, but then Scotchmen liked their friends better the later they were; and secondly, because they could see through the innocent design of the Council, who wanted to give them the opportunity of comparing the two great Exhibitions of Manchester and Glasgow. He hoped the cursory glance they had had of the Exhibition had proved it to be not unworthy of that great city. Every arrangement was there made for the comfort of Englishmen. It was said that an Englishman's first act on crossing the border was to sample the wine of the country. In the Exhibition no difficulty would be placed in the way of any persevering man in that direction, from the Methuselah whisky down to the spirit distilled the day before yesterday on purpose to tickle the English palate. On the part of the Exhibition Executive he ought to explain that although they had done their best they had not been able to effect two difficult things—they had not been able either to make a radical change in the climate or to correct the latitude of the city. Consequently their luminous fountain was too far north for the long summer. But the Executive Council were active and intelligent men, and their manager was a most determined character, and if they staid long enough he would make special arrangements with the clerk of the weather, and perhaps even tamper with the axis of the earth. Last, and most of all, the Section forgave them because they had elected an eminent Scotchman for their President. When he added that that Scotchman was one of the most distinguished of living chemists, they would see why forgiveness was changed into gratitude. Professor Dewar was so well known all over the world that it was unnecessary for him to say anything about the man upon whom the mantle of Faraday had fallen; but he would remind them they had got him from Scotland. He had been absorbed into that vortex of intellect,—the city of London. And perhaps it was as well: London always wanted intellect, and Scotland was always ready to furnish it. London's gain was Scotland's loss. But they did not grudge him to London, because they knew London could not do without him, and because they knew, moreover, that wherever Professor Dewar might be he would be a Scotchman first, and everything else afterwards. In the researches he had recently carried out, he was noted for having followed the footsteps of Faraday, and carried the liquefaction of gases to a point probably undreamt of by his great predecessor, working at pressures and temperatures previously unknown. But they felt sure that no pressure, however great, would ever compress him into a cockney, and no temperature, however low, would ever freeze that warm heart which he bore for all his friends, nor ever touch that warmest corner of it which was still reserved for those who lived north of the Tweed. In drinking his health they wished him long life and prosperity, and hoped that his researches would lengthen, widen, and deepen, with increasing age; and last of all, that that fine strong head, and that warm heart, which they knew to be in Dewar, would endure, and endear him to all.

Professor Dewar, in responding, said the last toast could not have been put into better hands than those of Mr. Stanford, who, if he could forget his own position at the present time, he should regard as the latest Scottish alchemist. For Mr. Stanford had not only managed to transmute him from base metal into refined gold, but had even added the very elixir of life. The exaggeration of his qualities into which Mr. Stanford had fallen doubtless arose from the fact that he had been long connected with that part of Scotland which was noted for its erratic characters. Probably his friend could not carry his mind back to twenty-five years ago, when he (the speaker) as a small boy, clad in a kilt, stood admiring him stepping from the steamers in magnificent costume, a perfect national thing. Still, there were extraordinary transitions. Mr. Stanford had abandoned sea-weed and iodine, and the very kilt itself, and now posed before them not only as a modern alchemist but as a serious and substantial member of the Society of Chemical Industry. He felt heartily grateful to him; but the company were in much the same position that he had once found himself in. On the first occasion of his visiting a neighbouring capital, an esteemed friend who entertained him had brought together a number of wits in order to give him an illustration of that variety of talent which was characteristic of the nation. But somehow they resembled the action of the salts in chemistry; they neutralised each other. Many very strange and clever things were said, to his great delight and interest; and after it was all over he asked his host how much of truth there was in the stories he had heard? "My dear Sir," replied the host, "you are "a Scotchman, and with the wit which requires a "surgical operation you cannot appreciate the exact "percentage of truth. But each of those gentlemen "whom you heard understood the others perfectly, "and could make the requisite deduction." His hearers were scientific men, and would know the requisite deduction to be made from the statements that they had just listened to—clever and witty, but seriously exaggerated. The very idea of the mantle of Faraday having fallen on him was so presumptuous that he could not bear to entertain it. He happened to occupy the chair which was conferred on that great man by a distinguished technical chemist, Mr. Fuller, whose name they would perhaps recognise when he associated it with "Fuller's earth." He was not at all sure that Mr. Fuller appreciated the merits of the great Faraday; but he did appreciate the merits of a comfortable sleep—and especially that sleep which came upon one when bored by a scientific lecture. Consequently he felt so grateful to the Royal Institution for that comfort that he had left the Fullerian Trust, and distinctly acknowledged that it was on account of those beneficial lapses into the unknown region that he had enjoyed in the institution. It might interest them to know, too, that his Cambridge chair was founded by a distinguished Fellow of Trinity, who thought that the time had arrived for some chemist to discover a remedy for the gout. He was there—or rather at Cambridge—to find that remedy. That was the will and testament, and he was not yet in a position positively to discharge his duty; but if he was entertained in Glasgow as he had been before, he would be in the right direction for the discovery of that remedy. He trusted that he should never forget his nationality. At the same time every Scotchman recognised those qualities in the southerner that he did not himself possess, and would acknowledge that that intellect and intelligence which Mr. Stanford said Scotland was willing to supply would be useless there but for the receptive power which was found in the South.

Mr. E. K. Muspratt, in proposing the toast of "The Learned Societies," said he knew very little about the learned societies of Glasgow, and had appealed in his difficulty to that great teacher Mephistopheles, who had said, in his interview with the scholar, that where ideas failed words were usually found to take their place. He was also informed in an admirable address by Professor Tyndal to the British Association as to the scientific uses of the imagination; but he thought the imagination was of still more use to any one who had to make an after-dinner speech. However, he had been somewhat relieved of his difficulties by the speeches bearing on the Glasgow University, which had already been made. He presumed that the learned societies of Scotland had followed much the same course as those of England. The first in England, in point of time, was the Royal Society, and he had read recently with great astonishment that it was founded for the promotion and encouragement of *applied science*. If that was the case, it was curious that it should have since developed into a society having very little to do with applied science, but much to do with abstract science. Perhaps, however, that was natural, because when they began their work they must have found that the first thing to do, in order to apply science, was to make science—*i.e.*, to coördinate facts and knowledge. In the course of the development of civilisation and of scientific education, it had been found necessary to differentiate very greatly the learned societies, and so now in every great town there were a number of them devoted to special subjects. The Society of Chemical Industry was one of the latest developments of that differentiation, having been formed only some seven years ago. In Manchester, he believed the same course had been followed as in Glasgow, the first society being the Literary and Philosophic. That Society had done an immense amount of good. It was well known that it was to the Philosophic Society of Manchester that Dalton first enunciated his great Atomic Theory, and that Joule first made known the great Mechanic Theory. They had a similar society in Glasgow, which, he understood, was presided over at one time by the great Thomson, alluded to by the President in his address. They had also had as members Professor Graham and Dr. James Young, who was so well known in connexion with the application of chemistry to the oil industry. He was glad to find coupled with this toast the name of Professor M'Kendrick, who was not only a great physiologist, but was also immediately connected with that science with which they all had most to do and better understood. Professor M'Kendrick had been associated with the President in investigations into the physiological action of quinoline and its bases, but the experiments were interrupted by the outcry against vivisection. But why was that outcry raised in this country, and not in France or Germany? Simply because Englishmen were not thoroughly imbued with the scientific spirit. If English education had been more under the control of scientific men, that agitation would not have occurred. The other Society associated with the toast was that of the Institute of Engineers and Shipbuilders in Scotland. Although there was not a very immediate connexion between that institution and chemistry, he thought that engineers would admit that in the present day is was necessary for them to understand something of chemistry, and that chemistry could do much for engineering; while those who had to apply chemistry practically must needs depend largely on the engineers.

Professor M'Kendrick (Vice-President of the Philosophical Society of Glasgow) responded, and said they were proud of the Philosophical Society of Glasgow, because it was the oldest and most influential scientific society in the West of Scotland, dating from 1802, and because of the eminent names on its roll of members. Such a Society also subserved the great purpose of creating and fostering an interest in science among the merchants of the great centres. During his tenure of office as Secretary of the Society, nothing had pleased him more than to see the interest which thus existed. He was brought into contact with men who showed a remarkable knowledge of various branches of science, but who were themselves unknown to the scientific world. He had thus met one gentleman, a merchant of Glasgow, who had the most profound knowledge of any man he knew of the laws of optics, and who was thoroughly familiar with the use of the microscope in all its details and its latest manifestations. And this knowledge had been acquired in the hours spent at home after business. Of course he had also met with curious examples of men who entertained the most novel ideas. For instance, several thought they had discovered something like perpetual motion: one held that the theory of Fraunhofer's lines was all wrong, and that the general theory of light was quite absurd, all the colours of the spectrum being really combinations of black and white. The Society was at present very prosperous, and was able to carry on scientific work in various departments. It had been thought at first that their chemical section would be injured by the Society of Chemical Industry, but that, happily, had not been the case. When he entered the Bute Hall that morning, he questioned his right to listen to an address on chemical industry, but he soon found that Professor Dewar's subject had an interest for all branches of science, touching, as it did, the speculations of the physiologists, as well as those of the chemist and the physicist. That was an illustration of the saying that science is one. No doubt the time would come when advanced chemists would direct their efforts to the department of physiological chemistry. He thought it discreditable to the country that physiological science was so little cultivated. There was not a single man among them who, by his previous training in chemistry, was able to attack some of the chemico-physiological problems that required to be worked out. As he saw many young chemists there, he would tell them that there was no department of research more likely to confer fame and honour, or to bring that sense of pleasure which came from discovering new truth, than that of physiological chemistry. Chemists had ranged themselves alongside of physicists, and the two branches were now regarded as one. The time would doubtless come when they would also associate themselves with physiologists; when that time arrived there were problems which would require all their knowledge and skill to work out. Professor Dewar would bear him out in saying that *that would be the last part of the realm of organic nature to be conquered by the chemist.*

Mr. A. C. Kirk (who responded as President of the Institute of Engineers and Shipbuilders in Scotland) said he was sure the Society he represented would be proud of the honour done it that night. Chemical industry did require engineering as an assistant in carrying out its methods. He had had five years of chemical engineering, and during that time had done as much real engineering as he would probably have to do all the rest of his life. The two sciences would always be linked more or less together, each requiring the other to assist in carrying out its own work. He would conclude by assuring Mr. Stanford that when he commenced to carry out his proposal to alter the axis of the earth for the benefit of Glasgow, he might rely upon the assistance of all the Glasgow engineers.

Mr. T. Tyrer, in proposing the next toast, "The Local Section," said he could not hope to emulate the example set by Mr. Stanford, but in the plainest and simplest terms he could ask the members, especially those Englishmen who were receiving the generous hospitality and the marked kindness of their Scotch friends, to cordially drink the health of the Local Section. As an officer of the Society, he knew what Sectional work meant, and he took that opportunity of saying that he considered the stability of the Society to depend entirely upon the vitality of its Sections. If the Sectional Committees ceased to exercise ingenuity in obtaining or abstracting papers of value, the Journal must suffer, and the success of the Society diminish. In his opinion the Journal was the Society. It had been commended in high terms by various authorities, past Presidents and others, and by no one more emphatically than their esteemed President and, next only to him, by Mr. Mond, who from the beginning had been associated with the Society as Foreign Secretary, and who from the first had seen that the evidence of the Society must be its Journal. The common sense which characterised all that Mr. Mond did had had its effect on the Journal, and therefore on the reputation of the Society; and that was a fact which augured well for his presidency. The Scottish Section had contributed in no mean degree to the success of the Society's Journal by contributing matter of the very highest character to its pages. The names coupled with the toast were those of the present Chairman and Secretary. But Mr. Coleman could not be there that night, and so his place would be supplied by the Vice-Chairman, Mr. Robert R. Tatlock, who had identified himself with the interests of applied chemistry in a manner which they all recognised and esteemed. Mr. Tatlock had played no small part in the arrangements of that auspicious meeting. The way in which Mr. Henderson had done everything expected of him raised the highest admiration for the Secretary of the Scottish Section, and proved the wisdom of the Committee in appointing him to, and retaining him in, that office which he had so worthily filled.

Mr. R. R. Tatlock said it was a matter of deep regret to him, and doubtless to everyone, that their Local Chairman (Mr. Coleman) could not take that active share in the arrangements that he would have liked. Every member of the Scottish Section well knew that the interest he took in the success of the Society was both wide and deep; and everyone who had followed his classic investigations in connexion with the subject of liquid diffusion must have realised that he had not only sustained the credit of the Section, but had contributed very handsomely to the literature of the Society of Chemical Industry, which was now not only recognised, but was an indispensable factor of the technical literature of Europe and the world. He thanked the assembly on Mr. Coleman's behalf for the hearty way in which they had received the toast, and on his part welcomed his scientific friends to the city of Hume and of Greg; on his part he welcomed his manufacturing friends to the city of Charles Tennant the elder, and of James Young; and in the name of Scottish hospitality he welcomed them all to the ancient city of St. Mungo. The way in which the toast had been received assured him that, far removed as that Section was from the great centres of chemical industry, its efforts were acknowledged and appreciated. If they did not sustain their reputation in the future, it would not be for want of effort on their part.

Mr. G. G. Henderson could only reiterate the words of Mr. Tatlock, and say again that it gave the Scottish Section the greatest pride and pleasure to receive the Society in Glasgow. The Glasgow Section was formed in 1884. At the time doubts were expressed as to whether a Scottish Section could exist; indeed it seemed to be a problem whether there were chemists in Scotland at all, it being supposed that they had all emigrated to England. However, at a small meeting held on the 8th January 1884, it was resolved to request the Council to sanction the formation of the Section, and that consent was given on the 23rd of the same month. Mr. Weldon was then President of the Society, and he wrote a very kind letter to the first secretary, Dr. Dobbie (to whom and to Mr. Stanford all the credit was due) expressing a hope that the Section would succeed and flourish. He thought that, without boasting, he could say that the Section had been successful. At the end of the first year they had rather less than 100 members; now they had considerably over 250 members, and directly through their instrumentality over 200 members had been added to the Society. The Section had contributed 88 papers to the Society's Journal. The Committee were determined to do their best to make the Society so appreciate its visit to Glasgow that it would wish to repeat it soon. One thing the Committee was quite unable to control; the weather of Glasgow was proverbially uncertain, and the Society had so far been afflicted with a bad sample of it. But he hoped they would nevertheless go home pleased with their reception, and satisfied that the sooner they repeated the visit the better would the Glasgow Section like it.

Professor Dewar then proposed the last toast of the evening, "The Officers of the Society." He said that at a time when they were applauding the work done by the Society, they could not possibly forget those who continued year after year that "sad mechanic exercise" (to quote the Poet Laureate) which must necessarily continue if the Society was to be a success. These responsible agents had to maintain continually that integrity of purpose, to exhibit day after day that steady and persistent labour in the interests of the Society which was necessarily required for its advancement. Both the Editor and the Secretary were admirable, honest, straightforward, and not only accomplished but honourable men. They required no police supervision; they did their duty honourably, without the necessity for that supremacy which was always so unfortunate. There was no necessity for coercion; all that was required was continual support. He hoped that under the new reign these gentlemen would not lag. The increase of salary mentioned that morning was only an acknowledgment of what the Council desired to do in the interests of the Society—to acknowledge merit as handsomely as possible. The Council felt that they were indebted to their officers, and desired also to encourage them. He felt sure that the importance and interest which had been added to the Society by this most extraordinary meeting at Glasgow would increase those gentlemen's sense of responsibility, and lead them to sacrifice themselves to their labours more and more. He did not mean to say that there was any ground for complaint; he merely desired to convey that the Council was responsive—the more they got, the more would they return. They desired that the Society should not lag behind; especially that the Journal should be maintained in the forefront of European scientific literature; and they were determined that all they could save in the management of the Society should be expended in behalf of the maintenance of the Journal in the interests of the community they desired to serve.

Mr. Watson Smith (Editor), in responding, paid a high tribute to the wise counsel of the new President with respect to the original arrangement of that part of the Society's Journal devoted to "Journal and Patent Literature." He showed that it was Mr Mond's advice which had led to the adoption of a plan that had been found to work efficiently and satisfactorily, and had, moreover, secured economic results at a time when funds were low and friends were few. He had thus been a friend in the time of need of the Society; and this service was rendered in a perfectly quiet and unostentatious manner through the speaker, who now had the greatest pleasure in bearing testimony to it. Mr. Watson Smith then referred to the valuable assistance received from the large staff of abstractors working under him, and comprising some of the most experienced practical chemists. He pointed out that the more specialists were engaged, and the more the labour was subdivided, so as to give each man congenial occupation, the better each branch of work would be done.

Mr. C. G. Cresswell (General Secretary) cordially agreed with the broad principles laid down by the President. The Society's existence was entirely dependent on its utility to the public, and he personally had the same relation to the Society which the Society had to the world at large. He depended entirely on his utility, and he could only hope that in the future he might be as successful as in the past in meriting the kind commendations of the successive Presidents of the Society. In some respects the position of a Secretary was a difficult one. He was a permanent officer who had to deal each year with a new President. But they always ended in the same way, with kind commendations on the one side and the utmost good feeling on both. The present occasion was no exception to the rule. The President had eulogised him far beyond his merits, and he wished he deserved half of what had been so kindly said of him.

An enthusiastic rendering of *Auld Lang Syne* by the whole of the party brought the evening to a close.

THE EXCURSIONS.

Visit to Nobel's Dynamite Works.

On Thursday morning, on the invitation of the directors of Nobel's Explosives Company (Limited), a very large party left St. Enoch Station by special train for Nobel's Dynamite Factory, near Stevenston, Ayrshire. They were accompanied by Mr. Ludwig Mond, the President, and Professor James Dewar, F.R.S., Ex-president; and, among the other gentlemen who were invited to take part in the excursion were: Mr. R. F. Carpenter, Manchester; Professors Jack, M'Kendrick, and Ferguson, Glasgow; Mr. E. K. Muspratt, Liverpool; Dr. Squire, London; Mr. A. H. Allen, Sheffield; Professor J. Campbell Brown, Liverpool; Dr. G. H. Bailey, Manchester; Mr. Thos. Tyrer, London; Colonel Ellis, R.E., War Office, London; Mr. David Guthrie, Glasgow; Mr. F. W. Paul, Steel Company of Scotland; Mr. F. J. Rowan, C.E., Glasgow; Mr. E. C. C. Stanford and Mr. R. R. Tatlock; Dr. Ivor Lagerwall, St. Petersburg; Mr. A. R. Pechiney, Salindres, France; Mr. John Watson, of Earnock; Mr. G. G. Henderson, and a number of other gentlemen. On arriving at Ardeer the company were met by Mr. Thomas Reid, chairman of Nobel's Explosives Company; Sir Charles Tennant, Bart.; Mr. Hugh Beckett, and Mr. Leonard Gow, directors; Mr. Thomas Johnston, manager; Mr. Francis J. Shand, assistant manager; and Mr M'Roberts, works manager. The company were taken through all the departments of the factory, the chemical portion of which included laboratory; the Kieselguhr mill; nitric acid, refuse acid, and nitrate of lead departments; ammonia mill, and acid-mixing department.

The testing of explosives in a Ballistic mortar was next shown, the strength being measured by the recoil of the mortar, which is slung like a pendulum; and the visitors then proceeded to the "Explosives" portion of the works, where they inspected the nitro cotton drying stoves and factory, air-compressing house and incline winding engine, No. 2 nitro-glycerin department, nitrating house, separating house, final washing and filtering house, dynamite-mixing houses, dynamite-cartridge huts, gelatin mixing house, gelatin-cartridge huts, packing house, magazine, and loading bank, thereafter proceeding by tramway to the site of the experiments.

At the conclusion of the tour of the works the visitors were entertained to luncheon. Mr. Thomas Reid presided, and Sir Chas. Tennant officiated as "croupier." The toasts of "Her Majesty the Queen" and "The other Members of the Royal Family" were loyally pledged, and the chairman expressed the pleasure which the visit of the Society gave himself and his co-directors. He said he hoped that the members had been satisfied with the processes which they had seen, and that they approved of the precautions taken to prevent accident He then alluded to the importance of the operations of the Society of Chemical Industry, remarking that the stimulation of chemical industry was an object of national moment. It was quite obvious to him that if this country was to hold its own against intelligent foreigners it would be by its people meeting them on equal terms. Unless they were as conversant with the application of chemistry as the foreigners were, they would have very little chance of succeeding in the competition. Mr. Ludwig Mond returned thanks on behalf of the Society. Sir Charles Tennant proposed the health of the guests, and M. Pechiney and Professor Jack acknowledged. Professor Dewar then gave "Success to Nobel's Dynamite Company." He said it was really a great day for Scotland when the industry they carried on was inaugurated. It was not only most recondite and interesting, but it was essentially novel. The visitors had just seen the largest dynamite factory in the world, where daily there was produced something like eight tons of explosives. He had known the establishment for 15 or 20 years, during which time it had been practically doubled in extent. He had seen the whole elaboration of the machinery for the manufacture of blasting gelatine, which any chemist would admit was the most marvellous of all the manufactures of explosives. It was wonderful to think of the tons of material made by the solution of nitro-cellulose and nitroglycerin. As to the care that was taken to avoid accident, it seemed to him that if anything did break down it was due not to any want of rigid supervision, but to that always unknown quantity which was introduced into any manufacture of the kind where it was necessary to employ labour that was not skilled. It was difficult to educate such persons, however often the necessity of caution was repeated. The chairman replied.

The following experiments with dynamite and blasting gelatin were afterwards shown:—

Experiments to Demonstrate the Safety of Dynamite and Blasting Gelatin.

1. An iron block, weighing 400 lbs., was allowed to fall from a height of 25 ft. on to a 50-lb. box of dynamite; the box and contents were smashed without explosion.

2. The same experiment was repeated with a 50-lb. box of blasting gelatin.

3. One pound of loose gunpowder was fired inside a 5-lb. packet of dynamite cartridges. The dynamite was fired and scattered around in a burning condition, but did not explode.

4. The cutting in two of a dynamite and a gelatin cartridge was then shown, and the one-half of each cartridge was burned and the other halves were exploded.

Experiments to Demonstrate the Power of Dynamite and Gelatin and their Local Force.

5. The iron block used for smashing the box of dynamite (Experiment 1) was shattered by a little of the dynamite on which it fell.

6. The iron block used for smashing the box of gelatin (Experiment 2) was shattered by some of the gelatin on which it fell.

7. Blowing up tree roots with dynamite and blasting gelatin.

8. Perforation of ⅜-inch boiler plate with sheet tin propelled from a wooden cylinder by a dynamite charge.

9. Explosion of the various compounds made by Nobel's Company in lead cones of uniform dimensions, and comparison of the results with the action of gunpowder.

10. One pound of dynamite exploded 8 ins. above a ⅜-inch boiler plate was found only to slightly bend the latter.

11. Explosion of a single cartridge of dynamite, placed on the top of a ¾-inch boiler plate, burts a small hole in it.

12. Explosion of a single cartridge of dynamite, placed on the top of a ¾-inch boiler plate and covered up with sand, burst a large hole in the plate.

13. Destruction of a wooden raft with 5 lbs. of dynamite placed on it; a second raft distant 10 ft. from the other remained uninjured.

Additional Experiments.

14. Cross of 200 1-inch cartridges placed longitudinally end to end, with 1 in. space between each, exploded simultaneously when a detonator was fired in one of the cartridges.

15. A stockade consisting of railway sleepers was cut down by the explosion of a charge of blasting gelatin confined in a 1-inch gas pipe.

16. A packet containing 5 lbs. of blasting gelatine was thrown into the pond and fired.

The party was then photographed and returned to town, having spent a most enjoyable day.

Prints of the Group photographed at Ardeer may be had on application to T. Patterson, Photographer, Bridgegate, Irvine, N.B., price 3s. 6d. each.

Visit to Forth Bridge and Broxburn Oil Works.

Another party of about 80 members, in charge of Mr. W. J. Chrystal, Honorary Treasurer of the Glasgow and Scottish Section, left the Queen Street Station at 10 a.m. on Thursday for South Queensferry by special train. On arrival they were received, in the unavoidable absence of Mr. Arrol, the engineer in charge, by a number of draughtsmen, who kindly volunteered their services to conduct the party through the works of the Forth Bridge. After inspecting the preparation of the huge plates and tubes for erection in their respective positions, the members went on board a steamer in order to obtain a general view of the bridge itself. At the foot of one of the great piers the steamer hove-to, to enable the visitors to thoroughly inspect the method employed for erecting the cantilevers.

At one o'clock the party proceeded to Broxburn Oil Works by special train. On arrival they were received by a party of the directors, the manager, Mr. W. Henderson, and the chemical staff. They first viewed the extraction of the shale from the pits, and thence proceeded to the distillation retorts and thoroughly examined the processes of purifying the oil. At this point an adjournment took place for lunch, kindly provided by the Company; and after lunch, the refinery, ammonium sulphate recovery process, and separation of paraffin from the oil by pressure, with subsequent purification of the solid paraffin as a preliminary step in the manufacture of candles, were inspected. Soon after 5 o'clock the members returned to Glasgow.

Visit to Thornliebank Printworks.

A party of about 20 members proceeded to Thornliebank station, whence they were conveyed in omnibuses to the Thornliebank Print Works, originally founded by the late Mr. Walter Crum. They were received by Mr. McFarlane, the manager, and conducted through these magnificent works in three parties.

The singeing, bleaching, printing, finishing, and packing departments were visited in turn; and the process of engraving the copper rollers was also witnessed.

At 12.30 the party adjourned to the Village Hall, where a handsome luncheon was served. Mr. McFarlane presided at one table, and Mr. Lonsdale at another. Toasts in honour of the Society were proposed by these gentlemen, and Mr. James Sharp, Mr. Mather, and others, returned thanks on behalf of the Society, not only for the privilege of being permitted to inspect the celebrated works, but also for their reception. They regretted that more members of the Society were not able to be present, but to those who were there it was an occasion to be long held in pleasant remembrance.

The party then proceeded to the Langloan Ironworks, where they were received by the Messrs. Addie and the staff. A "cast" was first shown, and then Addie's process for recovery of ammonia from blast furnace gases was examined. By this means, for each ton of coal used, about 22 lbs. of ammonium sulphate are recovered.

The Summerlee Ironwork was next visited, the party being received by Mr. Neilson and the manager. Here again a "cast" was shown, and then the process in use for recovery of ammonia from the blast furnace gases was exhibited. Refreshments were then provided, and the party returned to town.

A few members also visited Messrs. Thomson's shipbuilding yard, where they had an opportunity of inspecting the "City of New York," recently launched for the Inman and International Line, and now preparing for sea. This is the largest steamer afloat, if we except the "Great Eastern," now awaiting demolition in the immediate neighbourhood.

A few others visited the colossal works of the Singer Sewing Machine Co. at Kilbowie. For modern labour-saving machinery these works are probably unique, and are full of suggestion for those engaged in quite different departments of industry.

One or two members also availed themselves of the opportunity to visit the works of the "Glasgow Cleansing Department," in which connexion it is worthy of note that the Corporation of Glasgow has purchased a large tract of bog land out beyond Paisley, to the right and left of the Caledonian line to Greenock, which land is gradually being reclaimed by aid of the town refuse so as to produce first rate crops of vegetables and grain.

On Friday morning a large party left the Central Station at 9 a.m. for Greenock, to inspect Messrs. Walker's Sugar Refinery. They were received by Mr. T. L. Patterson, the manager, and conducted through each department, where the processes were explained by members of the firm.

At noon they proceeded to Prince's Pier, where they were joined by another large contingent of gentlemen and ladies, and went on board the "Victoria," one of the famous Clyde steamers, specially chartered for the purpose. The "Victoria" then proceeded down the Clyde to Brodick Bay in the Island of Arran, returning by the Kyles of Bute. The weather was most favourable, and the visitors did ample justice to the magnificent repast provided. About 5 o'clock the party returned to Greenock, where the special train met them and brought them back to town.

Communication.

THE MANUFACTURE OF EXPLOSIVES AS CARRIED ON BY NOBEL'S EXPLOSIVES COMPANY.

The Ardeer Factory is situated on the Ayrshire coast, between Saltcoats and Irvine, amidst a somewhat dreary and desolate-looking stretch of sandhills. The works of the Company, with their various buildings, nitric acid, gun-cotton, and nitro-glycerin works, mixing houses, cartridge huts, engineering shops, and other constructive and manufacturing departments, occupy an area of nearly 400 acres. In order to comply with Government regulations the explosives departments are separated by wide sand embankments, and are further protected from the possibility of a general explosion by being situated at considerable distances from each other. They are connected, however, by several miles of tramways, and by piping overhead and underground. The factory is lighted by gas manufactured within the grounds, possesses its own telegraphic and telephonic means of communication, and is in possession of an ample supply of water, which is utilised in the various processes connected with the preparation of the explosives. As the railway companies in Great Britain decline to undertake the conveyance of nitro-glycerin compounds, Nobel's Explosives Company require to provide independent means of distributing their productions, and this is accomplished by means of a small fleet of specially-equipped steamers and sailing vessels, the maintenance of which must add much to the cost of the explosives by the time they are delivered to the miner or contractor. The proximity of the Ardeer Factory to the coast enables the Company to load their vessels direct from the works, and by means of lines of tramways to the water's edge they are able to place the cargo of explosives on board with the requisite care and rapidity.

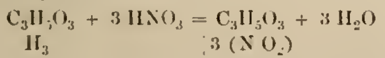
At Ardeer the Company employ from four to five hundred hands, including a large and experienced staff of chemists; and as there is possibly no work in the kingdom where there is so much immediate and ever-present danger, it speaks much for the extraordinary care and precautions which are observed in every department that there have been comparatively few accidents. Everywhere, rules, cautions, and instructions are exhibited for the guidance of the employés, and as a warning to the very few visitors who are admitted within the gates. The comparative immunity from accident which has marked the history of this factory is doubtless due, in a great measure, to the legislative enactments which in this country surround the manufacture and use of explosives, and the care taken by the officials of the Company to carry out every rule to the letter. The comprehensive nature of these regulations may be surmised when we mention that under the Explosives Act of 1875, with subsequent amendments and additions, there are 122 sections, 4 schedules, 209 sub-sections, and 11 Orders in Council, all abounding in rules and regulations of various descriptions, and their alternative penalties. For example, special byelaws and regulations applicable to harbours, estuaries, &c., many of them of a prohibitive character, and others apparently framed with a view to limit as much as possible the use of high explosives, have been passed. So far has one harbour corporation carried its dread of nitro-glycerin compounds as to insist upon all men in the vicinity of a vessel loading and discharging dynamite being clad in special flannel and pocketless garments, and if horses are to be admitted on the same quay, they must appear with the unusual addition of stout boots, having no nails or iron in the soles. The care that is necessary in connexion with the management of an explosives factory, and in conducting the sale of these compounds, may therefore be assumed to be considerable.

The workmen engaged in what are known, for the sake of distinction, as the "danger" departments, are dressed in a red flannel pocketless uniform, and the female workers engaged in the operation of cartridge-making wear a dress of blue serge, while other departments are distinguished by uniforms of grey flannel and of blue jersey, and the foremen superintend operations in a neat patrol uniform. It may also be mentioned that the factory is under the special protection of the Ayrshire county constabulary, several members of which are in the pay of the Company, and are stationed throughout the works. Apart from their other special duties, the policemen prevent the workers from conveying articles of metal or of any dangerous nature into the explosives departments.

The Ardeer Factory bears evidence in every department of the skilful planning and technical ingenuity of Mr. George M'Roberts, F.R.S.E., F.C.S., F.I.C., the works manager, who, after the experience of many years, has succeeding in designing and constructing the special machinery, of a very costly character, in use in several of the departments, which to the casual visitor would seem to be only partially protected by the temporary-looking wooden erections throughout the grounds. This mechanical skill is specially marked in the departments connected with the manufacture of the gelatinous explosives, which we believe occupied many years in designing, constructing, and arranging, and cost a very large sum of money to bring to their present perfect condition.

NITRO-GLYCERIN.

Nitro-glycerin, the explosive compound which enters into all the blasting agents manufactured at Ardeer Factory, was discovered by Sobrero, an Italian chemist, in 1846. It is manufactured by injecting glycerin under pressure into a mixture of nitric and sulphuric acids. It is a dense, oily fluid, of a pale-brown colour, and sweet pungent taste, producing, if tasted, acute headache, nausea, and vomiting. Its specific gravity is 1·6. The chemical reactions in the conversion of glycerin into nitro-glycerin may thus be shown:—



$$\underset{H_3}{C_3H_5O_3} + 3\,HNO_3 = \underset{3\,(NO_2)}{C_3H_5O_3} + 3\,H_2O$$

Previous to the invention of dynamite by Mr. Nobel in 1867, the use of pure nitro-glycerin as a blasting agent had become very extensive, but as no method of packing could insure its safe transmission in a liquid condition, and fearful accidents resulted from its use in mining operations, the employment of nitro-glycerin by itself as an explosive was finally abandoned. When nitro-glycerin is in a frozen or crystallised state it is not so liable to explosion as when in a liquid form.

DYNAMITE.

We have become so accustomed to hear of dynamite and nitro-glycerin in connexion with the terrible outrages which have so often recently startled and horrified the public, that we are apt to forget how useful these compounds are when in proper hands, and to how many good purposes they may be applied. The most destructive agents, under the control of science, serve the most beneficent ends, and whilst on the one hand few are more destructive than those we have mentioned, few on the other hand are more helpful or more essential in mining and engineering undertakings of various kinds. Since dynamite was first brought out by Alfred Nobel in 1867, it has so firmly established itself that it now commands a very extensive sale; yet, neither in transit nor in storage has it caused disastrous accidents, such as those with which the name of gunpowder has been associated. This last fact we mention because so many are prejudiced against the use of dynamite on the ground of its supposed extreme danger. As a matter of fact, no other blasting agent at present known excels it in point of safety, with perhaps the exception of the new gelatinous explosives, to which we shall also refer. A box or packet of dynamite may be thrown from any height, or sustain a violent shock, without explosion. That it is much safer than gunpowder under all conditions of transport has been satisfactorily shown by the evidence brought before a Special Committee of the House of Commons in 1874; by the experiments of Professor Bischof, made before the Sub-Committee of Railway Goods Managers, who had been appointed to report upon the matter; and by the fact that many thousand tons have been conveyed by rail on the Continent, although in this country we learn that the railway companies continue to refuse to grant facilities for its conveyance over their lines, notwithstanding the repeated remonstrances of Her Majesty's Inspectors of Explosives. Dynamite is a plastic substance, of reddish-brown colour, and consists of nitro-glycerin absorbed in porous Kieselguhr, or earth-meal. Many other absorbent materials than Kieselguhr may be used in its preparation; and in the early days of its manufacture, sawdust, charcoal, brick dust, paper, rags, and various other materials were employed. Kieselguhr has, however, been recognised as the substance forming the best and most useful absorbent, and this choice has been further justified by the absence after explosion of the noxious fumes of carbonic oxide, which render charcoal and other materials, although equally absorbent, so hurtful to the health of the miner.

The inert base, Kieselguhr, is the mineral remains of a kind of moss which grew in stagnant waters. The stem consisted chiefly of silica, and when the organic substance of the plant decayed, the silicious portion remained, retaining the shape it had when it formed a part of the plant—that is, a series of cells or diatoms. Beds of Kieselguhr are found in many parts of Germany, and also in this country, where they form the bottoms of peat mosses.

Dynamite, as manufactured at Ardeer Factory, contains 75 parts by weight of nitro-glycerin absorbed in 25 parts by weight of Kieselguhr. In comparison with blasting powder, its use is said to afford a considerable saving in time and labour, serious items in the expense of mining operations. With dynamite, fewer and smaller bore-holes are said to be required, and hence the saving of time, tools, and fuse, and, with an ordinary degree of care, there is a perfect immunity from accidents in stemming bore-holes. And again, the extreme velocity of the explosion makes it as effective in fissured as in sound rock. Blastings with it are therefore shown to be more rapidly performed than with gunpowder — an important matter, especially in sinking wells and in driving tunnels. Boulders, we are informed, may be broken *without boring*, by simply exploding a cartridge or two placed upon them and covered with clay or sand, but when a short bore-hole is made much less dynamite will do the work. The largest roots of trees are easily broken up so as to permit of their removal, by judiciously inserting and exploding small charges in auger holes bored in the wood, and old roots may be removed bodily by a few cartridges exploded in the soil beneath them, or trees may be entirely uprooted. In dock and harbour works, such as in the removal of river bars and harbour obstructions, and in the breaking up of wrecks, half-tide or sunken rocks, this explosive is extremely convenient, and until the introduction of Mr. Nobel's gelatinous compounds, it had almost entirely superseded other blasting agents for these purposes.

In cold weather, dynamite and all nitro-glycerin compounds freeze or harden, even at so low a temperature of 40° Fahr., but on being warmed they resume their normal condition. In a frozen state dynamite burns very slowly, and owing to the danger attending its use when in that state, it should, in the first place, be thawed or softened by means of specially-constructed warming pans. Dynamite in its normal or plastic condition burns freely when set fire to in small quantities, but a large quantity is liable to explode while burning. Special detonators are employed for the exploding of charges of this compound, which, if merely ignited by means of a fuse, will take fire and burn away with unpleasant fumes.

Gelatinous Explosives.

Under the patent rights of their technical director, Mr. Alfred Nobel, Nobel's Explosives Company manufacture several explosive compounds, which, from their distinctive appearance, are known as the gelatinous explosives. These consist chiefly of mixtures, in various proportions, of nitro-glycerin and nitro-cotton—the latter being practically dissolved in the former—a condition in which they are so intimately blended that it is almost impossible, through lapse of time or the action of water, for the nitro-glycerin to exude or the compound to liquefy. This property of being practically unaffected by the action of water has been strikingly exemplified in the case of a sample of blasting gelatin, the strongest of these compounds, which was submitted to the severe test of being *kept in water for nearly seven years*, and on being recently removed was found to be in precisely the same condition as when first placed in the water its strength and susceptibility to detonation being unaltered by its lengthened immersion.

It would be surprising indeed if explosive compounds possessing a quality of such importance should not prove specially serviceable alike in mining and in civil and military engineering. We learn that in the forms of blasting gelatin and gelatin-dynamite they have, to a very large extent, displaced dynamite and other blasting agents and we may conclude that the time is not far distant when the manufacture of dynamite will entirely cease for use in Great Britain, as it already has in Austria, and to a considerable extent in Germany, Norway, and Sweden. Apart from the water-resisting properties of these compounds, the great power of the gelatinous explosives, in comparison with dynamite, has done much to bring about this result. Indeed, they may be looked upon as possessing the maximum of power in the minimum of bulk. It is a maxim now generally recognised by civil engineers, miners, and contractors, that a powerful explosive, at a price proportionate to its power, is a much more economical blasting agent than a nominally low-priced but weak compound, except in special cases where the peculiarity of the rock may demand the latter.

It has been said that the manufacture of dynamite, so far as practical and chemical skill are concerned, present no very great difficulties to the chemist, apart from the extensive outlay necessary for the organisation of a factory in accordance with the Government regulations, and the costly arrangements and care required in connexion with packing, storage, conveyance, and sale in Great Britain; but the same remark certainly does not apply to the production of the gelatinous explosives. From what our own observation has enabled us to gather, and from the result of inquiries, we have ascertained that permission to introduce these latter destructive compounds into Great Britain was only granted after Nobel's Explosives Company had spent many years in perfecting, not only the compounds themselves, but also the method of manufacture, and in inventing and improving machinery for use in the various processes. The manufacture is costly and complicated, and even at this date requires such care and experience as to place the production of the gelatinous explosives beyond the reach of miscreants who may have become possessed of the various apparatus with a view to utilising them for unlawful purposes.

Blasting gelatin is the most powerful of all known explosives, and is a tough, slightly elastic, semi-transparent substance, resembling ordinary gelatin. It contains 93 per cent. of nitro-glycerin, together with 7 per cent. of a special quality of nitro-cotton, and on explosion resolves itself into CO_2, H_2O, and N; there being just enough oxygen to combine with the carbon and hydrogen, so that its composition may be looked upon as chemically perfect for the purpose.

The disruptive force is enormous, being not less than 50 per cent. greater than dynamite, as proved by the Ballistic test.

Blasting gelatin is supplied in cartridges of any required size. In its normal state it is a tough, plastic mass, having a specific gravity of about 1·6. Its plasticity makes it very convenient for charging bore-holes, as by squeezing the cartridges with a *wooden* rod, they can be made to fill the bore-hole completely. In cold weather it hardens, and loses its jelly-like character. In this state it may be used for open blasting; but it is not recommended to use it frozen for charging bore-holes, as its hardness renders it incapable of accommodating itself to the inequalities of the hole, and attempts to force it might result in accident. Moreover, a stronger detonator or an unfrozen priming cartridge is required to explode it when in this condition. Frozen blasting gelatin may be softened for use with perfect safety in the warming pans employed for thawing dynamite. The effect produced by the explosion of frozen blasting gelatin is more violent than that produced by the explosion of the unfrozen material, because the soft elastic blasting gelatin yields to the shock of the explosion, while the frozen material does not.

Blasting gelatin is more insensible to shocks than even dynamite, and hence it is necessary to employ for its explosion a *stronger* detonator than is used with the latter compound. With the view of meeting this requirement, Nobel's Explosives Company now manufacture gelatin detonators of a special strength.

It appears that the German, Austrian, and Italian Governments have recently adopted blasting gelatin for the purposes of submarine mining and coast and harbour defence, and the British Government, having satisfied itself of the proved superiority of this explosive, have also used gelatin for the purposes indicated.

It is interesting to note that blasting gelatin is preferred to all other explosives for use with the pneumatic dynamite gun invented by Captain Zalinski, of the United States army, and adopted by the American and Italian Governments.

Gelatin-dynamite is in appearance more opaque than blasting gelatin, and consists of 80 per cent. of thinly gelatinised nitro-glycerin, with nitrate of potash and wood cellulose added in certain proportions. In practice it is found to be from 30 to 40 per cent. more powerful than No. 1 dynamite.

The slow detonation of gelatin-dynamite renders its action a heaving and rending rather than a violently disruptive one, and for this reason it is more suitable than dynamite or other forms of high explosives for blasting in rock which it is desirable to remove in as large masses as possible, or in mild or soft rock. At the same time its great power enables it to act effectively on hard or on metalliferous rock, so that it may be said to be *par excellence* the ideal blasting agent. The gases or fumes evolved are even less injurious than in the case of dynamite, so that they can have no prejudicial effect on the workmen employed. Gelatin-dynamite is perfectly stable, and does not deteriorate from atmospheric influences, and it is, besides, distinguishable equally with blasting gelatin by its very great degree of non-sensitiveness to detonation or explosion by friction. Like other gelatinous compounds, it is practically insoluble in water, and no precaution need therefore be taken to free the bore-holes from damp or water prior to inserting the charge. This quality renders it specially suitable for subaqueous blasting and for submarine mining. The cartridges made usually of seven-eighths of an inch diameter are plastic, and therefore, when tamped, fit accurately into the bore-hole, and this apparently unimportant fact will represent, in many instances, a gain of about 25 per cent. in potential energy over an explosive—supposing such to exist—of equal strength but rigid form. After most thorough and conclusive tests, gelatin-dynamite has been adopted as the blasting agent in all extensive mining and engineering operations at present being carried on in this country, notably in connexion with the great Manchester waterworks, which are intended to supply water to the city of Manchester from Lake Thirlmere, in Cumberland, and in the construction of the Manchester ship canal. The safety with which it can be employed gives it a claim on the attention of all mine-owners, contractors, engineers, and quarrymen.

Westquarter and Redding Moor Factories.

Nobel's Explosives Company, Limited, have two other factories, both situated in Stirlingshire, about a mile to the west of Polmont station.

Westquarter factory, the larger of the two, is set apart entirely for the manufacture of detonators and electric fuses, and consists of a series of brick buildings with neatly-constructed wooden huts placed at considerable distances apart, and still further isolated by means of the usual earth embankments. The Government regulations, which apply in the case of Ardeer Factory, require, if it were possible, still more stringent observance here, owing to the necessity for delicate manipulation in many of the processes of detonator making and charging. This factory is divided into two departments, in the one of which the various processes involved in the conversion of sheet metal into detonator tubes are carried out, and in the other—the danger department—the tubes are charged, pressed, examined, assorted, and packed.

Detonators consist of metal tubes about 1 inch in length and ¼ inch in diameter, varying somewhat in dimensions according to the strength of charge they are intended to receive. The metal is prepared in thin sheets of the longest possible length, which are then cut into strips of a convenient width, and passed through the various tube-making departments until, after submission to several complicated processes, the strip has been converted into finished tubes of the required length and diameter. When finished, the tubes are removed to the charging department, where, under the careful manipulation of experienced workmen, the requisite quantity of fulminate of mercury and other chemicals is conveyed and pressed into the detonators. The detonators, now finished, are packed in tin boxes, which are then placed in double-wooded cases, so secured as to prevent their contents from being affected by any damage done to the outer case during transit, and also rendering them impervious to damp.

Detonators vary in strength according to the explosive with which they are intended to be used. The treble or No. 3 detonator is in ordinary use for dynamite; but as that explosive is now rapidly being superseded by gelatin-dynamit and other compounds of the gelatinous class, the No. 5 detonator, which is specially adapted for the gelatinous explosives, is in like manner replacing the No. 3 detonator. Nobel's Explosives Company warn their customers that it is only by the employment of their No. 5 detonator that complete detonation of a gelatin compound can be guaranteed, and that intimation doubtless ensures attention to this important fact.

Electric fuses consist of detonators having two insulated wires, tipped with a patent composition, inserted and fixed therein—the open end of the detonators being then hermetically sealed, so as to prevent the possibility of miss-fires from damp or any other cause. The insulated wires are usually 54 inches in length, but we understand that the fuses can be manufactured with wires of any length. They are made of three classes, namely—ordinary mining electric fuses, submarine or special electric fuses, and electric fuses for water cartridge blasting. For the latter purpose many thousands are sold weekly, and as a proof of the progress which has been made in this delicate manufacture, we believe that a defective fuse is almost unknown.

Redding Moor Factory is situated on a rising ground to the south of Westquarter Factory, from which it is about a quarter of a mile distant. This factory is occupied solely in the production of fulminate of mercury, which forms the chief ingredient in the explosive composition used as a charge for detonators; and the buildings, which have been specially designed, are admirably suited for this manufacture. The Union canal passes between the two factories, but by means of an elegant iron bridge, ready communication is maintained, and the operations at Westquarter and Redding Moor Factories are therefore under the same control. In addition to the canal, the close proximity of the North British Railway, which has a goods siding at Westquarter Factory, affords to both factories admirable facilities for the despatch of explosives to all parts of the world.

Fulminate of mercury.—In addition to the use of this explosive for the purpose of charging the detonators manufactured by the Company, it is extensively supplied to the British and Foreign Governments, as well as to private firms, for charging gun-caps, friction tubes, and similar firing apparatus. Fulminate of mercury, which is produced by the action of nitric acid and methylated alcohol on ordinary mercury, is a heavy powder varying in colour from white to a dark-grey. For conveyance, owing to the explosive nature of the powder when dry, it is packed in a moist condition in calico bags and placed in double barrels filled with water. In this condition it may be safely conveyed by rail or steamer.

Nottingham Section.

Chairman: Lewis T. Wright.

Vice-Chairman: Frank Clowes.

Committee:

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J. B. Coleman.
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H. Dodge.
E. Francis.
J. M. C. Paton.
S. J. Pentecost.
C. Spackman.
H. J. Staples.
R. L. Whiteley.

Treasurer: S. V. Holgate.

Hon. Local Secretary:

Jno. R. Ashwell, Midanbury Lodge, Bentinck Road, Nottingham.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

ANALYSIS OF GREASE.

BY L. ARCHBUTT, F.I.C., F.C.S.

In the analysis of grease for railway waggon axles, dirty grease, &c., I have for a long time past used a very simple method, which I have not seen mentioned in any publication, and which has for its object the separation and estimation of fatty acid in the presence of neutral fat or oil. The method consists in dissolving the mixture of fat acid and neutral fat in ether and shaking with a weak alcoholic solution of caustic soda, which extracts all bodies of acid character, and leaves the mineral or other neutral oil dissolved in the ether.

I have verified the method by experiments upon tallow, palm oil, olive oil, and linseed oil. Samples of these were first carefully titrated with normal caustic soda, to estimate approximately the percentage of free fatty acid contained in each. Five grms. of each sample were then dissolved in about 100 cc. of ether, and the solution was shaken in a separator with the following "soda mixture," viz.:—

cc.	
10	Caustic soda (10 per cent. solution).
5	Methylated spirit.
35	Water.
50	

The shaking was cautiously performed so as to avoid emulsifying the mixture, and it was continued for from ½ to 1 minute. After separation had taken place the soda solution was drawn off into another separator, and the ethereal solution of oil was again shaken with another 50 cc. of the "soda mixture," which was drawn off and added to the first, together with two or three aqueous washings of the ether. The mixed alkaline solutions in the second separator were shaken with ether, to remove any traces of neutral oil, and were then tapped off into a third separator, where the liquid was acidified with hydrochloric acid, and the fatty acid which separated was estimated by shaking with ether and evaporating the ethereal solution in the usual manner.

The original ethereal solution of oil was shaken a third time, and in one case a fourth time, with 50 cc. of the weak alcoholic soda, and the fat acid extracted by this treatment was thrown up and estimated separately. The results obtained are recorded in the following table:—

	Tallow.	Palm Oil.	Olive Oil.	Linseed Oil.
Grammes used for volumetric	10·9985	11·2369	50·0	50·0
Normal soda, cc.	1·43	20·20	11·06	6·10
Factor	0·282*	0·273†	0·282*	0·2809‡
Free fatty acid calculated	3·67 per cent.	49·08 per cent.	7·93 per cent.	3·43 per cent.
Grammes used for gravimetric	5·0029	5·0018	5·0000	5·0000
First and second extraction	3·47 per cent.	47·85 per cent.	7·92 per cent.	3·36 per cent.
Third extraction	0·01 ,,	0·04 ,,	0·04 ,,	..
Fourth extraction	..	0·03 ,,	..	..
Free fatty acid weighed	3·48 per cent.	47·92 per cent.	7·96 per cent.	3·36 per cent.

* Equivalent of oleic acid.

† Equivalent of fatty acids from palm oil according to Norman Tate (Allen, II., 213).

‡ Equivalent of fatty acids separated from this sample of linseed oil by saponifying, throwing up the acids as usual, filtering, washing on the filter, and drying by passing the acids through dry filter paper.

When I came to experiment upon colophony I was not so successful. Thus a mixture of 5 grms. of linseed oil and ·25 grm. of pale rosin, when treated as above described, gave a total of ·3775 grm. of mixed fatty and resin acids. Deducting the ·1680 grm. of fatty acids due to the oil, there remained only ·2095 grm. of resin, or only 83·80 per cent. of the total quantity taken.

An experiment was next made with the same pale rosin, without admixture with oil. ·5 grm. was dissolved in ether, and the solution was extracted twice with "soda mixture" as before. The resin acids were separated and weighed, and the original ethereal solution left after soda treatment was evaporated and weighed also. The following was the result:—

Resin acids extracted by soda	83·54
Unextracted matters	16·18
Loss	0·28
	100·00

The unextracted matter was again dissolved in ether, and the solution was shaken twice more with soda. After again evaporating the ether there now remained only 9·44 per cent. of unextracted matter.

Another ·5 grm. of the same pale resin was next dissolved in ether, and the solution was shaken six times with 10 cc. each time of 10 per cent. soda solution, without dilution. After washing the ethereal solution with water and evaporating, there remained 10·8 per cent. of unextracted matter.

Lastly, ·4176 grm. of common brown rosin was dissolved in ether, and the solution was extracted with soda four times, twice with "soda mixture," and twice with 10 cc. of 10 per cent. soda. There still remained 11·8 per cent. of unextracted matter.

These experiments confirm an observation made by Mr. Allen, and recorded in a footnote on page 459 of *Commercial Organic Analysis*, Vol. II., that colophony probably contains ethers or anhydrides which do not react with caustic alkali in the cold.

Subject to the small error thus incident to the process when rosin is present, I have found the following method very convenient for the systematic analysis of greasy products of various kinds :—

<table>
<tr><td colspan="4">Ten grms. of the sample are stirred with ether in a beaker till <i>thoroughly disintegrated.</i> The mixture is then rinsed into a separator and shaken repeatedly with quantities of 10 cc. each of HCl (1·10) till all metals are removed. (Iron and aluminium can only be removed by <i>strong</i> acid. Ether dissolves ferric chloride from its aqueous and <i>dilute</i> acid solution.) The ethereal solution which remains is then washed three or four times with water in quantities of 10 cc. each time.</td></tr>
<tr><td rowspan="3"><i>Acid Extract.</i>—Wash with ether to remove oil mechanically carried over, and add the ether to the main quantity. Run the acid solution into a basin and let the ether spontaneously evaporate; then take to dryness, redissolve, and estimate the <i>Metals</i> in the usual manner.</td><td colspan="3"><i>Ethereal Solution.</i>—Shake with "soda mixture" as described above.</td></tr>
<tr><td rowspan="2"><i>Alkaline Extract.</i>—Wash with ether and add the ether to the main quantity. Then acidify the solution, shake with ether, evaporate the ether and weigh the <i>Fatty Acids</i> (and the greater part of the <i>Resin</i>) which existed as soap in the grease, and perhaps partly in the free state. These can be examined further as desired.</td><td colspan="2"><i>Ethereal Solution.</i>—Evaporate, and weigh the residual oil as control. Then saponify, and shake the alkaline solution with ether.</td></tr>
<tr><td><i>Ethereal Extract.</i>—Consists of <i>Hydrocarbon Oils, Cholesterin</i> and <i>Unsaponifiable Matters, Higher Alcohols, &c.</i></td><td><i>Alkaline Solution.</i>—Acidify, and estimate fatty acids existing in the grease as <i>Neutral Oil or Fat.</i> If the grease contained rosin part of it will be found here.</td></tr>
</table>

If required, the fatty acids obtained from the "alkaline extract" and "alkaline solution" can be mixed together and treated by Gladding's process for the estimation of resin.

The above described method of determining free fatty acid will sometimes be usefully applied to the examination of fats and oils, as it is not only capable of giving a perfectly accurate estimation of the amount of free fatty acid, without a knowledge of its combining weight, but it enables the nature and properties of the fatty acid to be also determined.

JOURNAL AND PATENT[*] LITERATURE.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in and Means or Appliances for Storing Volatile or Inflammable Liquids. J. Stewart and T. Charlton, London. Eng. Pat. 10,512, July 28, 1887. 11*d.*

The tank containing the inflammable liquid is placed within an outer tank, and the space between the two is partly filled with water. One cover may close both tanks, and the space between this cover and the surface of the liquids is occupied by a heavy non-inflammable gas such as carbonic acid. To diminish the surface exposed by the liquid in the inner tank a float may be employed. The specification is accompanied by drawings showing various modifications of the apparatus.—A. R. D.

Improvements in and Appliances or Vessels for Storing or Storing and Transporting Volatile or Inflammable Liquids. J. Stewart and T. Charlton, London. Eng. Pat. 10,513, July 28, 1887. 1*s.* 1*d.*

The leading feature of this patent is the employment of a head of water to confine the vapours disengaged by the volatile liquid under storage. This latter is contained in a reservoir open at the bottom and standing in an outer tank supplied with water. The water thus rises in the inner tank to a height which varies with the quantity of volatile liquid present, the tension of the vapours evolved, and the head of water employed. The use of carbonic acid for the luting purposes described in Eng. Pat. 10,512, of even date, are recommended here also. The specification is accompanied by a number of drawings showing different forms of the apparatus and their application to various purposes.

—A. R. D.

II.—FUEL, GAS, AND LIGHT.

Dowson-Gas and its Application to Gas Motors. Journ. für Gasbeleuchtung und Wasserversorgung, **31**, 460—463.

Dowson-gas is prepared by the patent apparatus of the Dowson Economic Gas and Power Company, London, of which the following is a diagram and description :—

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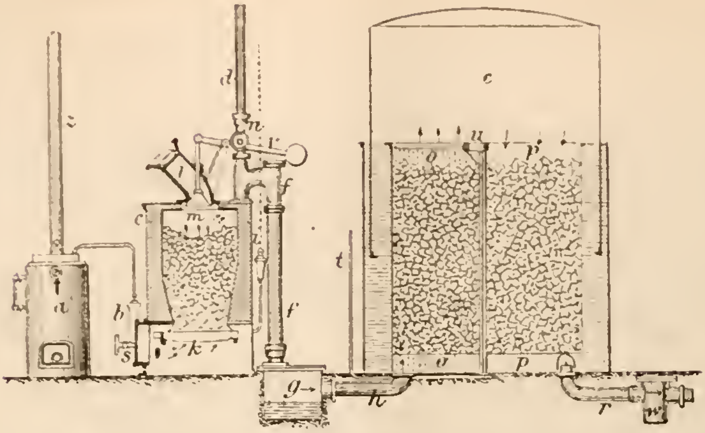
[*] Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows :—

If the price does not exceed 8*d.*	½*d.*
Above 8*d.*, and not exceeding 1*s.* 6*d.*.......	1*d.*
„ 1*s.* 6*d.*, „ „ 2*s.* 4*d.*......	1½*d.*
„ 2*s.* 4*d.*, „ „ 3*s.* 4*d.*......	2*d.*



a is a steam-boiler of very small capacity; the fire-box is perpendicular and provided with a cover, the products of combustion escaping by the tube *z*.

The steam is superheated by passing through a spiral wrought-iron tube which is fixed in the fire-box above the fire. By means of the injector *b* air is blown into the hearth *k* of the generator *c*. The door *s* is closed and made air-tight during working. *m* is the red-hot combustible matter. *l* is a cup and cone arrangement which is closed and made air-tight during work by means of the lever and counterpoise; the fuel is placed in the space above *l* and covered by an air-tight lid. *d* is a tube through which the smoke and the less valuable gases, evolved when the apparatus is first started, escape. When *d* is closed by the cock *n* the gases pass through the tube *f* and the syphon *g* along *h* into the holder *e*. *o o* is a coke scrubber resting on a perforated leaden plate and kept wet by a constant stream of water from the pipe *t u*; the water from the scrubber passes along *h* into the syphon *g* and away by an overflow. *p* is a scrubber of dry coke through which the gas passes on its way to the exit pipe *r*. *w* is a syphon which is, as a rule, placed in the same tank as *g*. In connexion with the gas holder is a valve *i*, which opens when the holder is full and stops the production of gas until the holder sinks again and the valve shuts. The coke in the scrubbers can be used for heating purposes when it can no longer be employed in purifying. One man's time is not completely taken up in watching and attending to the apparatus.

Dowson-gas has the following composition :—

Hydrogen	16 to 18 per cent. by Vol.
Carbon monoxide	22 to 24 „
Hydrocarbons	0 to 4 „
Carbon dioxide	5 to 7 „
Nitrogen	the remainder.

It contains about 43 per cent. of combustible gas each cubic metre, which, when completely burnt, gives on the average 1,600 thermal units; it is therefore very suitable for gas motors, heating purposes, &c., but cannot be employed as an illuminant.

In order to simplify as much as possible the arrangement and management of the generator, the gases evolved must be such that simple purification with water is sufficient, and therefore only such fuel (coke, anthracite) should be used as gives off no tarry constituents and does not cake, otherwise the generator gets choked up.

The followiog are the results of experiments made with this apparatus : —

In the first two hours	53·63 h.p.
In the following four hours	50·86 „
Total	310·7 h.p.-hours.

Fuel consumed in generator	210·5 kilos.
„ „ boiler	27·0 „
Total fuel used	237·5 „

It was also found that the steam used in generating gas and in feeding the boiler (small steam pump) was 0·54 kilos. for 1 h.p.-hour, and that 2·94 cubic metres of gas are required to give 1 h.p.-hour. In these experiments anthracite was used in the generator and the boiler was fired with coke.

W. Schmidt has compared the total cost of a 30-h.p. gas motor, in combination with a Dowson-gas apparatus, with that of a 30-h.p. steam-engine. Assuming that the latter consumes 2·5 kilos of fuel per horse power per hour, giving 300 days of 10 hours each in the year, and that the former consumes 1 kilo. of fuel per horse power per hour, the cost of each would be as follows :—

——	Dowson Apparatus.	Steam-Engine.
	£	£
Total cost of erection	745	649
Cost of working, interest on capital, depreciation, repairs, &c. for one year	210	260

—F. S. K.

PATENT.

An Improved Means for the Production of Water Gas. C. Westphal, Berlin, Germany. Eng. Pat. 4953, April 3, 1888. 8*d*.

Carbonaceous material, such as brown coal or turf, is moistened with water in such proportions as are necessary for the formation of only carbonic oxide and hydrogen. The moist material is distilled in vertical retorts, heated by the combustion of a portion of the gas produced. The heating flues are arranged spirally round the retorts. These latter are closed at the top by the material to be distilled, and at the bottom by standing in a vessel containing water. Internal tubes, reaching downward to the point of gasification, carry off the gas as evolved. The ashes are carried from the lower portions of the retorts by an endless screw, which may also be made to regulate the supply of gas required for the distillation. The air necessary for combustion is heated before mixing with the gas. The retorts are preferably made of a mixture of cast iron and cast steel.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Distillation of Pine Wood in the South. F. S. Clark. School of Mines Quarterly, **9**, 162—177.

The tree mostly sought after is the long-leaved pine. In the North the main products are wood spirit, acetic acid, and charcoal—the harder species of wood being distilled as yielding larger quantities of the two former substances. In the South the distillation was in earlier times neglected, but the pine was much prized for its turpentine and timber value. After tapping for turpentine the trees were generally left standing, having lost their value as timber. The extension of railroads to the Southern States has created a demand for creosote for preserving timber, and has given rise to the establishment of works for the distillation of wood with a view to producing that material. The process differs from the ordinary process of charcoal burning, inasmuch as air is entirely excluded, external heat is applied, and a larger quantity of oily products are obtained, which, in the ordinary way, are lost in self-supporting combustion. The apparatus is specially designed to suit the particular product required. Attempts to make all the products superior in quality result in an average inferiority.

The first condensable products are water and acetic and other acids, afterwards alcohol and phenoloid bodies, and lastly the heavy hydrocarbons used in creosoting processes. Gases are evolved in the following order: carbon dioxide, carbon monoxide, methane, ethane, ethine, and at high temperatures hydrogen due to the decomposition of hydrocarbons. The wood is generally transported down the rivers to the works situated near the coast, the sale of the charcoal compensating for the cost of transit.

The retorts are made of cast or wrought iron or steel, the two latter being especially used for large retorts, and the former preferable for small ones. They are generally cylindrical, between 3 ft. and 7 ft. in diameter, and from 5 ft. to 30 ft. or more in length. Great attention is paid to the construction of the flues, so as to prevent the flames acting directly on the retorts and also to distribute and equalise the heat over all parts, as concentration not only tends to destroy the iron, but decomposes some of the products of distillation. The furnace gases are passed under a protecting brick arch below the retort, which is consequently first heated by radiation, and are then brought back over the retort. Various means are employed for doing this, and the best is the one in which the gases pass out at the sides of the arch into a flue concentric with the retort itself. Baffle plates are so placed that the gases are circulated first over the top of the retort and then underneath, where they are reheated by contact with the upper surface of the protecting arch, and passed to the top again, and so on.

The most resinous pines, preferably with a deep red section, are chosen for giving the largest yield of oily products, the old tapped trees being especially prolific. The fuel for carrying on the process is the gas from the distillation as soon as it will burn, either direct or preferably drawn through scrubbers, and, if necessary, stored in a gasometer, although at the commencement wood or charcoal is used. The temperature for the first 12 hours or so is kept at about 290° C., afterwards gradually increasing and finishing off at about 450° C., with the result that a poor charcoal remains behind, as the following analysis will show:—

	Per Cent.
Moisture	3·41
Ash	0·54
Carbon	63·80
Volatile matter	32·24

The following figures are the average of 16 charges, and represent the yields in ordinary work:—

Weight of Wood.	Light Oil. 0·875—0·950 Sp. Gr.	Pine Oil. 0·950—1·040 Sp. Gr.	Pyroligneous Acid. 1·020 Sp. Gr.	Charcoal.
Lbs. 4,573	Galls. 13·8	Galls. 73·5	Galls. 185	Lbs. 1,511

The following table gives the liquid distillate in portions (approximately sixths) in the order of production:—

Portion.	Oily Products. Sp. Gr.	Acid Products. Sp. Gr.
1st portion	2·68—0·885	14·56—0·000
2nd "	2·68—0·910	11·49—1·0075
3rd "	5·55—0·900	12·26—1·025
4th "	5·93—1·010	11·11—1·030
5th "	6·13—1·016	11·11—1·025
6th "	9·19—1·025	7·28—1·024
Total	32·16	67·81

Yield of Main Products.

	Sp. Gr.	Lbs.	Per Cent.
Acid	1·020	1,572	34·37
Oil	—	729	15·94
Charcoal	—	1,511	33·04
Gas	—	764	16·64

The distillates are allowed to settle, when the oil floats on the acid. It has a sp. gr. 0·97 to 1·03, retains a little acid, and contains also some volatile oil. The flashing point is 50° C. Its main application is for creosoting purposes, and for this it is partly fractionated till the lighter and deleterious bodies, amounting to about 15 to 20 per cent. of the whole, are removed. The crude pyroligneous acid contains about 4 per cent. of hydrated acetic acid, and is used locally as a disinfectant or to make pyrolignite of iron.—A. W.

IV.—COLOURING MATTERS AND DYES.

On Safranines and similar Dye-Stuffs. R. Nietzki and R. Otto. Ber. **21**, 1590.

An amido group can be easily eliminated from phenosafranine by the usual method of treating it with nitrous acid in alcoholic solution. The new body is of a less basic character than safranine; the free base can only be precipitated from solutions of its salts by caustic alkalis, but not by carbonates. Nitric acid precipitates a difficultly soluble crystalline nitrate, which can be easily purified by recrystallisation from hot water. The analyses prove the formula of the body to be $C_{18}H_{13}N_3$. The nitrate, sulphate, and the platinum double salt, were prepared and analysed. The acetyl compound prepared by the action of anhydrous acetic acid and sodium acetate on any of the salts forms difficultly soluble salts with acids. The salts of $C_{18}H_{13}N_3$ dissolve in water with a beautiful red colour and dye wool and silk red, but of a much bluer shade than the safranines. Their alcoholic solution does not show any fluorescence. The base dissolves in concentrated sulphuric acid with a yellowish brown and in concentrated hydrochloric acid with a green colour. On dilution the original red reappears.

Experiments to eliminate the second amido group have hitherto not been successful.

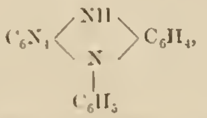
The Base of Phenosafranine.—According to the formula given by Witt this safranine contains a nitrogen atom with five affinities, which are partly combined with the benzene residue, partly with an acid residue. Therefore the free base ought to contain the hydroxy group, and its formula ought to be $C_{18}H_{16}N_4O$. After various experiments to prepare the base the author accomplished this in the following way. To phenosafranine sulphate the theoretical quantity of barium hydroxide was added; a dark red solution resulted which, on addition of alcohol, fluoresced. This solution was evaporated in vacuô at 40° C. After a short time bright yellow crystals appeared, which were difficultly soluble in water, but easily soluble in alcohol. After drying at 100° C. the base was analysed. Its formula is $C_{18}H_{16}N_4O$, but after several recrystallisations from hot water the base loses one molecule of water, its composition being then $C_{18}H_{14}N_4$.

Safranol.—If the hydrochloride of phenosafranine is boiled about three days with an excess of alcoholic potash, two amido groups are replaced by two hydroxy groups. The compound was purified by repeated precipitation from its solution in ammonia by hydrochloric acid and then analysed. Its composition is $C_{18}H_{12}N_2(OH)_2$ and it crystallised in long brass-coloured needles which dissolve in concentrated sulphuric acid with a brown colour. Anhydrous acetic acid forms a diacetyl compound.

Reduction Products of Phenosafranine.—When phenosafranine is treated in an acid solution with zinc dust, stannous chloride, or other reducing agents, a leuco base is formed at first which can be reoxidised to the original product by air. On further reduction, however, a yellow substance is formed, which, when extracted from its alkaline solution with ether, colours the ether yellow and shows a green fluorescence, similar to an ethereal chrysaniline solution. The author has not been successful in isolating this body.

If an aqueous solution of safranine be boiled for several days with zinc dust and hydrochloric acid, a point will be at last reached when the colourless solution cannot be any more changed into colouring substances. To isolate this product the mass is treated with an excess of sodium hydrate until all zinc hydroxide is redissolved and then the base is extracted with ether. The ether is distilled off and brown crystals of a new base are obtained. This was purified by recrystallisation from hot water with the addition of animal charcoal, and finally obtained in long colourless needles melting at 130° C. The base is easily soluble in alcohol, more difficultly in ether, benzene, and hot water. It does not form crystalline salts. Its formula, according to analysis, is $C_{18}H_{19}N_3O$. When melted the body loses about 1 per cent., after heating to 117° C., about 4 per cent. in weight. This is due to a loss of water. Its properties are also changed by melting; it solidifies only at a low temperature to an amorphous body and remelts then below 100° C. Its acid solution can be diazotised and produces red azo-dyes when combined with naphtholsulphonic acids. The base forms with anhydrous acetic acid an acetyl compound, $C_{18}H_{18}N_3OC_2H_3O$, melting at 173° C., and still having basic properties.

The amido group of the base was eliminated by Griess's reaction and a new body of basic properties obtained, soluble in water and dilute alcohol and melting at 117° C. Its formula is $C_{18}H_{18}N_2O$. It forms a well crystallising difficultly soluble platinum salt. It is difficult, the author continues, to come to any conclusion about the constitution of the base. One is tempted to consider it as the mother substance of the leucophenosafranine, the phenylhydrodiphenazine—



$$C_6H_4\left\langle\begin{matrix}NH\\N\end{matrix}\right\rangle C_6H_4,\quad N{-}C_6H_5$$

but this body contains two hydrogen atoms less. Potassium bichromate does not oxidise the body, but forms a chromate. Methyliodide converts it into an iodide soluble in water from which caustic alkalis precipitate a new base.
—A. L.

The Separation of Paratoluidine- Ortho- and Metasulphonic Acids. E. A. Schneider. Zeits. Anal. Chem. 27, 405—406.

The separation depends on the different solubilities of the alkaline salts of these two acids in cold caustic soda or potash. The paratoluidine-metasulphonic acid is nearly insoluble, whereas the ortho compound readily dissolves. The mixture of the acids is dissolved in hot caustic alkali and allowed to cool. The meta-compound is then filtered off.—J. B. C.

Oxalic Acid as a By-product in the Manufacture of Aniline. R. Hirsch. Chem. Zeit. 12, 617.

In the manufacture of nitrobenzene and nitrotoluene by the action on the corresponding hydrocarbon of a mixture of two parts nitric and three parts concentrated sulphuric acid, the latter becomes diluted to about 55° B., and contains in addition to small quantities of nitro-products in solution, about 1 to 1½ per cent. nitric acid.

A quantity of this acid, kept for a couple of months during the winter, was found to have deposited large crystals of oxalic acid. As the waste acid of 55° B. contains about half a per cent. of nitrotoluene, and Leeds' experiments have proved that nitrous acid yields oxalic acid after prolonged action on nitrobenzene, the source of the oxalic acid in this case is obvious. It occurs, in fact, regularly as a by-product in the manufacture of nitrobenzene, and can readily be proved to exist in the waste acid by precipitation with milk of lime. Since the oxalic acid is formed by the action of nitrous (not nitric) acid, in order to obtain the maximum yields of nitro-compounds, the nitric acid used should be as free as possible from the lower acid, and the substances to be nitrated should contain the smallest possible quantity of compounds which are liable to oxidation by nitric acid.—E. E. B.

PATENTS.

Improvements in the Preparation and Application of certain Colouring Matters. P. A. F. Bobœuf, Paris. Eng. Pat. 1947, July 27, 1865. Second Edition. Provisional Protection only. 4*d*.

The colouring matters described in this Provisional Specification are produced by the decomposition of aniline salts with potassium chromate or bichromate, the result being "the production of in the one case a deep blue, and in the other of a deep green colour." The aniline salt used in this case is the hydrochloride. Similar colours are said to be produced from this same salt of aniline, and the yellow or red prussiate of potash. The filtrates and washings from the precipitates are equally useful as liquid dyes. The proportions of the materials used vary according to the shade required.—R. M.

Improvements relating to the Manufacture of Sulpho-, Nitrosulpho-, Nitrososulpho-, and Amidosulpho-Acids, and to their application for the Production of New Colouring Matters. Alfred Kern, Basle. Eng. Pat. 5896, April 22, 1887. 8*d*.

New mono- and disulphonic acids are prepared from mixed tertiary monamines containing at least two aromatic radicles such as methyldiphenylamine and homologues, benzyldiphenylamine, &c. The salts or the solutions of these sulphonic acids are used for the manufacture of the following derivatives of the monamines:—(*a*) nitrososulphonic acids, (*b*) nitrosulphonic acids, (*c*) amidosulphonic acids. From the compounds (*a*) and (*c*) by combination with phenols and their carbonic acids, monamines and their derivatives, aldehydes, phosgene, and carbon sulphodichloride, there are produced sulphonated colouring matters belonging to the following groups:—Gallocyanines, Indamines, Indophenols, Indulines, Meldola's colouring matters, Safranines, Methylene Blues, Azo-colours, Di- and Triphenylmethanes. The sulphonic acids of the mixed amines are prepared by direct sulphonation by means of sulphuric acid of appropriate strength heated to the necessary temperature, the acids being converted into calcium and sodium salts by the usual methods. The sulphonic acids thus produced condense with aldehydes to leuco-sulphonic acids, which yield colouring matters by oxidation. Benzotrichloride gives rise to the direct production of green sulpho-acids. Phosgene yields blue and violet colouring matters of the triphenylmethane sulphonic acid group. Nitrous acid forms nitrososulphonic acids, the latter when heated with phenols, &c. giving blue and violet sulphonated colouring matters of the Gallocyanine and Meldola group. Nitrosulphonic acids are produced by direct nitration, and these act as yellow dyes. By reduction the nitrosulphonic acids yield amidosulphonic acids which can be diazotised and made to combine with phenols and amines or their sulphonic acids, thus furnishing a series of azo-colours. By oxidising the amidosulphonic acids in the presence of monamines or phenols, Indamines and Indophenols are formed from which sulphonated Safranines can be obtained. Lastly, by oxidising the amidosulphonic acids in the presence of sulphuretted hydrogen, sulphonated methylene blues are produced. The compounds claimed in the foregoing part of the specification are manufactured in accordance with processes which are illustrated by the five following examples:—(1.) Formation of sulphonic acids. Illustrated by the sulphonation (by means of sulphuric acid of appropriate strength) of ethylbenzylaniline, methyldiphenylamine, and methylphenylnaphthylamine. (2.) Nitrosulphonic acids. Illustrated by the nitration of the monosulphonic acid of ethylbenzylaniline by means of appropriate mixtures of nitric and sulphuric acids. The dinitrosulphonic acid of ethylbenzylaniline dyes silk and wool of a yellow colour. (3.) Nitrososulphonic acids. The mono- or disulphonic acid of ethylbenzylaniline is treated with the necessary quantity of sodium nitrite when it forms a nitrososulphonic acid. (4.) Amidosulphonic acids. Illustrated by the reduction of the mononitrosulphonic acid of ethylbenzylaniline prepared as under (2) by means of zinc or tin. (5.) Manufacture of colouring matters. Nitrosobenzylethylaniline-monosulphonic acid obtained as under (3) is converted into its sodium salt and the solution of the latter, after being made acid with acetic acid, is boiled with gallic acid. In a short time a bluish violet colouring matter is formed which can be salted out, collected, and dried. A dark blue colouring matter is formed if α-naphthol is used instead of gallic acid. If the α-naphthol is replaced by aniline salt a magenta red colour is produced. An acid methylene blue is obtained by oxidising the amidosulphonic acid of ethylbenzylaniline obtained as under (4) in the presence of a tertiary amine and sulphuretted hydrogen by means of potassium chromate. The production of azo-colours is illustrated by the action of the diazotised amidosulphonic acid obtained as under (4) upon the naphthols, the products being brown dyes. The sulphonic acids of ethylbenzylaniline prepared as under (1) give acid greens on treatment with benzotrichloride and acid violets on treatment with phosgene, the salt of the sulphonic acid for this last purpose being dried, powdered, and suspended in toluene.—R. M.

Manufacture of Yellow, Orange, and Red Azoic Colouring Matters, and Reduction of certain Nitro-Compounds for that purpose. J. Imray, London. From "La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and D. A. Rosenstiehl, Paris." Eng. Pat. 9315, June 30, 1887. 6*d.*

The nitro-compounds referred to are metanitraniline and the nitrotoluidine of m. p. 107°, these substances being reduced in an alkaline solution and then diazotised and combined with phenols, amines, or their sulphonic or carboxylic derivatives. The following examples are given:—(1.) Metanitraniline is dissolved in boiling water, caustic soda added, and then zinc dust in small portions. The yellow reduction product separates out and is collected and diazotised by hydrochloric acid and sodium nitrite in the usual way. The diazo-salt gives with α-naphthol or its monosulphonic acid, with β-naphtholdisulphonic acid, and α-naphthylamine red colouring matters, with β-naphthol and its α-sulphonic acid, with naphthionic acid and with β-naphthylaminesulphonic acid orange colouring matters, and with salicylic acid, phenol, or resorcinol yellow colouring matters. With metaphenylenediamine a colour is produced which dyes cotton yellow. (2.) Nitrotoluidine is treated as above, the polyazoic derivative of the reduction product yielding with α-naphthol-α-sulphonic acid a red colouring matter, with the naphthols brown colours, with β-naphthol-α-sulphonic acid and naphthionic acid orange colours, with phenol and resorcinol yellow dyes. All these colouring matters dye cotton without a mordant.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

On Silk. Th. Weyl. Ber. **21**, 1529.

The author continues his researches on silk (this Journal, **7**, 385) and discusses first the decomposition products of Fibroïn. According to Waltenberger and Städeler fibroïn forms, on boiling with dilute sulphuric acid, leucin and tyrosin. Cramer obtained also glycocol. Schützenberger and Bourgeois obtained, by the action of barium hydrate on silk at 150°—200° C., tyrosin (10 per cent.), a mixture of equal parts of glycocol and alanine (60 per cent.), amidobutyric acid (10 per cent.), and a 4-carbon amido acid of the acrylic series.

250 grms. of purified white silk were boiled for 18 hours with 3 litres of sulphuric acid (1 : 3) with the reversed condenser. The biuret reaction (red to violet colouration with a little copper oxide and an excess of sodium hydrate), distinctly visible during the first 10 hours, had then completely disappeared. Nearly all was dissolved into a yellowish-brown liquid, with the exception of a small quantity of fatty acids and some inorganic matter. The former was partly removed by distillation with steam, partly, together with the inorganic matter, by filtration. The filtrate was neutralised with barium hydrate and boiled down. On cooling, 5·2 per cent. of tyrosin crystallised out. On further evaporation 15 per cent. of a crystalline substance separated out, similar in appearance to leucin. After recrystallisations from alcohol, to which some ammonia had been added, the body was proved to be alanine or amidopropionic acid. It is readily soluble in cold water, ammonia and sodium hydrate, difficultly in 40 per cent. alcohol. If carefully heated it sublimes, turns brown at 237° C., and melts at 255° C. It is α-alanine, as was proved by comparison with the synthetically prepared α-alanine.

The liquid from which the alanine had been separated was treated with alcohol, and 75 per cent. of crystals were precipitated, from which glycocol could be easily isolated.
—A. L.

PATENTS.

An improved Process for Cleansing Wool and other Products, applicable also to the Extraction of Oils and similar purposes, together with an Apparatus for carrying the same into effect. I. Singer and M. W. Judell. Eng. Pat. 13,699, October 10, 1887. 8*d.*

The solvent is bisulphide of carbon. The several macerators are arranged in series so that the solvent may be saturated with the fat, and they are so interconnected by three-way cocks, &c. that any one of them may be disconnected at pleasure. The solvent is removed from the wool or similar material either by steam or by cold or heated air, and the macerators are covered with a flanged lid, provided with a water-seal.—W. L. C.

Improvements in Machines for making Wood-wool. O. Evenstad and O. Senstad, Norway. Eng. Pat. 4296, March 20, 1888. 8*d.*

The apparatus is shown in side elevation in Fig. 1. Shavings produced by the plane a are carried by the endless band b, working on the rollers b' and b'', down the shoot d. They then pass between the rollers f and f', furnished with a number of knives, as shown in Fig. 2. In this way the shavings are cut into fine strips which pass through the shoot g, and are cut into convenient lengths by the oscillating knife i. The wool when cut into lengths drops into the sieve t, where it is freed from dust.—E. J. B.

For Figs. 1 and 2, see pp. 500 and 501.

Fig. 1.

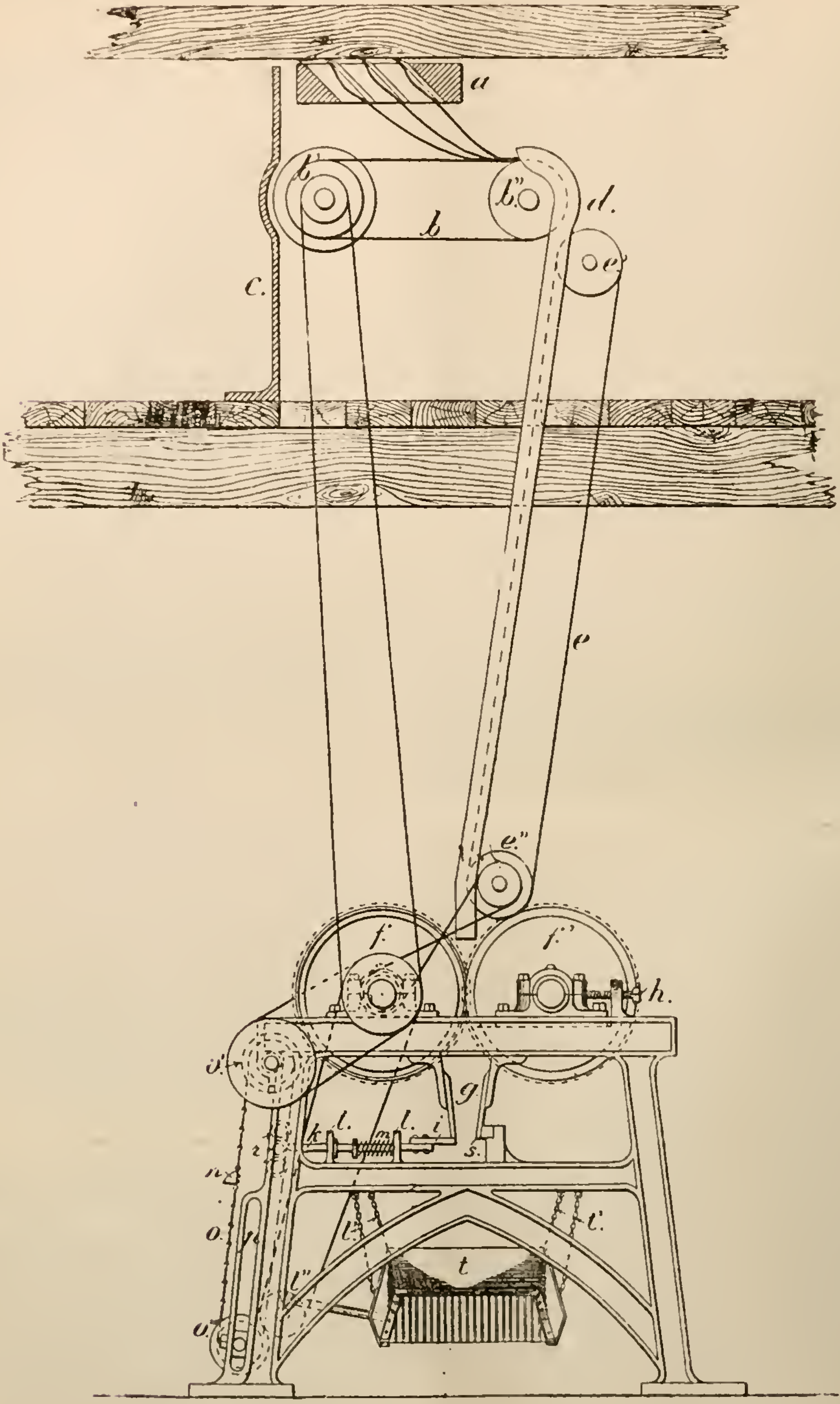
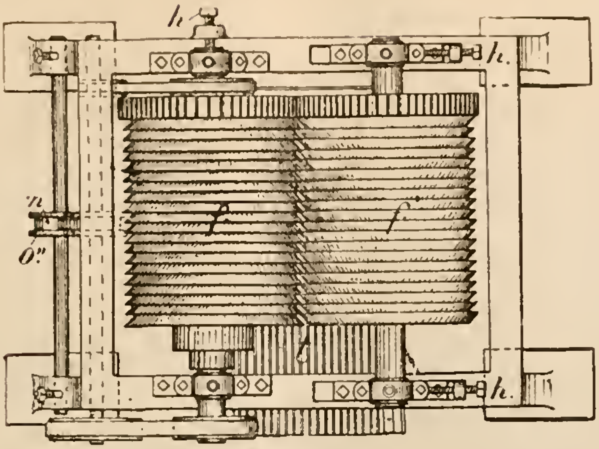


Fig. 2.



Improvements in the Machinery used for Preparing the Fibre of Flax and other similar Fibres for Spinning into Yarns. J. R. Garratt, co. Down, and W. Scott, Belfast. Eng. Pat. 17,652, December 22, 1887. 8*d*.

This invention relates to an arrangement for collecting the dust formed during the passage of the sliver through the drawing frame.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

PATENTS.

Improvements in the Bleaching of Vegetable Tissues. A. J. Boult, London. From F. Rubay, Ghent. Eng. Pat. 1816, February 4, 1887. 6*d*.

For the bleaching of linen, tow, and hemp, with avoidance of exposure on bleaching grounds, a lye is used first composed of carbonate of soda, caustic soda, and potash, followed by a mixture of chloride of lime and soap, and the goods are finally soured in weak sulphuric acid. Another treatment consists of a bath of chloride of lime, soda or potash, together with saccharic acid and acetic or oxalic acid. For dyed fibres, where the colour has not to fade during the process, a bath of chloride of lime, soda, or potash, together with binoxide of barium and nitrate of strontia, soda, or potash is made use of. In the case of jute a mixture of soap and chloride of lime is employed.
—W. E. K.

Improvements in the Production upon Fibres and Fabrics of Colours varying from Black or Brown black to Blue-black and Blue. A. Gilliard, P. Monnet, and J. M. Cartier, Lyons. Eng. Pat. 10113, July 19, 1887. 6*d*.

The colours are produced by direct oxidation upon the fibre of (*a*) a mixture of a salt of a simple amine and a simple diamine; (*b*) hydrochloride of leuco-thionine and leuco-tolyl-thionine (a new product) alone or mixed with a simple amine and diamine; or (*c*) the products of condensation obtained by the action of simple amines on salts of the diamines. For oxidising purposes a mixture of chlorate of soda with vanadate of ammonia dissolved in acidulated water is employed. The cloth or yarn is padded or wrung out in a bath prepared from a mixture of the amines, &c., and oxidising solution, and allowed to lie for 24 hours, when the colour is developed. The oxidation of the mixture of salts of simple diamine and amine gives colours varying from brown-black to deep black, the products of condensation produce blue-black, the oxidation of the leuco-thionines gives a blue more or less purple; and by suitable admixture the shade may be varied as desired. The preparation of the leuco-tolyl-thionine and of the condensation products is described.—W. E. K.

Improvements in Machines employed in Dyeing, Sizing, Washing, and Wringing Hanks. J. Robertshaw, Manchester. Eng. Pat. 10,591, July 30, 1887. 8*d*.

This is an improvement on Patent 12,002, 1885, and consists in a modification of the mechanism for driving the rotary fallers which carry the hanks through the dye-liquor. For details the specification and accompanying drawings must be consulted.—W. E. K.

An Improved Method of and Apparatus for Dyeing Wool, Cotton, and other Fibrous Substances. Fred. Lee and J. Bradshaw, Wakefield, and Frank Lee, Manchester. Eng. Pat. 2093, February 11, 1888. 8*d*.

The material to be dyed is placed in cans with perforated bottoms and covers, and these cans are fixed in holes suitably shaped to receive them in the bottom of a shallow vat, the latter being mounted above a dye liquor cistern or receptacle. By means of a pump the dye-liquor is forced from the lower to the upper receptable and finds its way through the fibrous material in the cans, passing again into the lower vessel. By making the connexion between the upper and lower vats air-tight, a partial vacuum may be produced in the lower cistern, and the circulation of the liquor expedited. Steam-pipes are provided for heating the dye-liquor.—W. E. K.

VII.—ACIDS, ALKALIS, AND SALTS.

Acid Phosphites of the Alkali Metals. L. Amat. Compt. Rend. **106**, 1351—1354.

The author has prepared monosodium phosphite and monopotassium phosphite, similar to the mon-ammonium phosphite previously described by him (*loc. cit.* **105**, 809).

Monosodium phosphite, $NaH_2PO_3 + 2\frac{1}{2} H_2O$, is prepared by adding one equivalent of soda to phosphorous acid, using methyl orange as an indicator. It melts in its water of crystallisation at 42°. This solution evaporated at 100 deposits crystals, which are perhaps the anhydrous salt. *Monopotassium phosphite*, KH_2PO_3, is prepared by similar means. These salts, as well as the *acid phosphites of barium and calcium* prepared by Würtz, prove the bibasicity of phosphorous acid.—J. M. H. M.

PATENTS.

Improvements in or connected with the Manufacture of Alkalis and Compounds of Alkalis. J. Marx, Ehrenstein, Wurtemberg. Eng. Pat. 6417, May 2, 1887. 8*d.*

This invention relates to an improved process for the manufacture of alkalis and alkaline compounds by an electrolytic method. Previous attempts in this direction have failed, owing to the fact, discovered by the patentee, that the products obtained by electrolysis, being soluble and conductive by reason of their solubility, take up part of the electricity, and thereby effect their own decomposition. It is now proposed to avoid this cause of failure by rendering the otherwise soluble products of electrolysis insoluble, or at least soluble with difficulty, at the time of their becoming so concentrated as to be injuriously acted upon. This principle is applied to the manufacture of sodium carbonate from sodium chloride in the following manner:—A solution of sodium chloride is submitted to electrolytic action, whereupon sodium hydrate and chlorine are formed in the first instance. Before the sodium hydrate is redecomposed by the electric current, carbonic acid is introduced into the solution, whereby the sodium hydrate is precipitated in the shape of sodium bicarbonate. The latter is removed, and the mother liquor, brought up to its original concentration by the addition of a fresh quantity of sodium chloride, is again returned to the decomposing vessel. In order to render the process a continuous one, the vessel containing the sodium chloride solution is divided into any number of pairs of compartments, one compartment of each pair containing the anode and the other the cathode. The solution is caused to flow through the several compartments in a reverse direction, that is to say, the solution is conducted around the anodes in a direction the reverse of that in which it is conducted around the cathodes, so that the strongest soda solution is opposite the weakest chlorine solution, and *vice versâ.* The solution leaving the last cathode of the series, runs into a compartment, where it is saturated with carbonic acid, and wherein the sodium hydrate is precipitated as bicarbonate. The mother liquor, brought up to strength with more sodium chloride, is run back again for fresh electrolytic treatment. The chlorine given off may be employed for any useful purpose. If sodium sulphate be subjected to electrolytic action, sodium hydrate and sulphuric acid are produced. The former is treated as previously mentioned, whereas the sulphuric acid is rendered insoluble by suspending round the anode an insoluble carbonate (like carbonate of lime), whereby carbonic acid is produced to saturate the caustic soda with, and gypsum is precipitated.—S. H.

Improvements in the Manufacture of Bicarbonate of Soda, and in Apparatus therefor. C. Wigg, Liverpool. Eng. Pat. 9227, June 29, 1887. 8*d.*

Improvements chiefly in the apparatus for the manufacture of soda by the ammonia process described in the Patent of 1882, No. 3125, and of 1885, No. 4436.

As regards the chemical part of the process, the brine used is purified from ferrous salts by means of crude ammoniacal liquor, whereas the arsenic in the sulphuric acid is precipitated by sulphuretted hydrogen evolved from the carbonating apparatus. The mechanical improvements cannot be explained without reference to previous specifications.—S. H.

Improvements in the Process for Treating Gas Liquor and other Ammoniacal Liquors. E. Grahn, Coblentz, Germany. Eng. Pat. 10,684, August 3, 1887. 6*d.*

Ammonia or the volatile ammoniacal salts in gas-liquor are liberated by means of a current of air or gas, and the air charged with ammoniacal vapours is freed from its ammonia by suitable absorbents. According to the absorbent which is used, solid and dry ammonia compounds or any solutions and mixtures may directly be obtained. The gas-liquor to be worked flows into the upper part of a distilling column of the usual construction. A finely-divided current of air is blown by means of a steam jet into the lowest compartment of the column, and travelling upwards, it takes up the ammonia from the liquor whilst the steam is condensed. The liquid freed from ammonia escapes continuously from the lower part, but before it leaves the apparatus it is brought into intimate contact with milk of lime, in order to liberate the ammonia from the fixed salts. The current of gas charged with ammoniacal vapours is directed into absorbers for the production of ammonium sulphate or chloride. For the manufacture of artificial ammoniacal manure, the current of gas is introduced into chambers furnished with shelves, on which superphosphate, double phosphate or dissolved guano, &c. is spread.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

On the Colourations produced by Iron Compounds in the Glass Melting Furnace. C. O. Weber. Chem. Zeit. **12**, 826.

Numerous experiments of the author, with a view to obtaining yellow (soda-lime) glass by means of iron salts, resulted in a failure, inasmuch as only green glass could be produced. The tints varied from a bluish green to the perfect green of foliage, never with any yellow shade. The tints were more blue if the iron salt contained a volatile acid. Flint-glass, with a high percentage of lead, gave a good yellow colouration with iron salts up to a certain stage, but when the heat was raised to refine the frit, the yellow colour quickly disappeared and gave way to a greyish green, which finally changed into green. Glass of English make of a fine yellow colour is often met with, but it contains very much lead, and is fritted at a very low temperature in furnaces with a reducing flame. If green glass be melted with chromic oxide or barium chromate, peculiar pea-like bodies of metallic appearance are found at the bottom of the melting-pot, especially if the kiln be very hot. They are evidently products of reduction of chromic oxide, and considering that an oxidising flame prevails in the furnace, the formation of products of reduction is well worth noticing. If copper oxide be added to a frit in order to obtain a dark green glass, similar bodies are obtained, which are covered with a layer of metallic copper.—S. H.

Improvements in and relating to the Manufacture of Thin Plates and other Articles of Glass. J. Trassl, Oberwarmensteinach, and H. Lindler, Fichtelberg, Germany. Eng. Pat. 9957, July 15, 1887. 11*d.*

The molten glass is poured directly into the moulds, which are placed in a heated chamber, and, by the use of suitable registers, is allowed to cool more or less slowly, as may be required. In this manner the brittleness of the plates and their liability to break or crack during the grinding is much lessened. The chamber is heated by means of gases from the furnace. It is provided with special arrangements for registers and also with trucks, on which the moulds are placed.—S. G. R.

The Ornamenting and Decorating of Pottery and Porcelain by an Imitation of the Lead or Metal Mountings used for Stained Glass. C. Toft, Stafford. Eng. Pat. 10,085, July 19, 1887. 6*d.*

For the purpose of ornamenting the outer surface of articles of pottery and porcelain, the inventor imitates the ordinary lead or other metal moulding for stained glass by means of a raised glass beading or rounded moulding. The intervening spaces can be either embossed with any suitable pattern or covered in the ordinary way with suitable colours. The beading can also be coloured so as to imitate the colour of the metallic mountings.—S. G. R.

PATENTS.

A New or Improved Process for Producing Cloisonné Designs or Decorations in Enamelling Glass and other Substances. J. Y. Johnson, Lincoln's Inn Fields, Middlesex. From M. Abriot, Paris. 16,355, November 28, 1887. 6*d.*

Cloisonné designs on glass are at present produced by placing the piece of glass upon the drawing or design, and tracing the outlines upon the glass by hand with a pen or brush. The inventor prepares a plate of gutta-percha, caoutchouc, india rubber, gelatin, &c., the reliefs or raised parts on which correspond to the outlines of the design for the cloisonné work. This is then pressed on a pad coated with a fatty flux prepared with gold, silver, or other colour. On applying the stamp to the piece of glass a perfectly sharp impression is obtained, quite equal to that obtained by the hand. Instead of a flat plate of india-rubber a roller with the required design in relief may be employed.
—S. G. R.

A New and Improved Composition for the Manufacture of Enamelled Earthenware Articles. R. W. Willis and A. J. Willis, Islington, Middlesex. Eng. Pat. 5620, April 16, 1888. 4*d.*

Ordinary clay and glass are ground to a fine powder with water, and mixed with magnesia in about equal proportions. If a very hard composition is required, flint, or flint and glass, is used instead of glass.—S. G. R.

X.—METALLURGY, MINING, Etc.

Notes on Lead-smelting in South-Eastern Missouri. J. F. Kemp. School of Mines Quarterly, **9**, 212—219.

The material smelted is a galena dressed from a dolomite containing also pyrites, which carries nickel and cobalt. The ore averages 6 to 15 per cent. PbS. After milling the two products are galena, containing 65 to 75 per cent. Pb, and a mixture of galena and pyrites locally termed "sulphides." The former is now roasted in a Freiberg hearth, till the sulphur is reduced to 5 or 6 per cent.; sand is then added and the mass partly fused and withdrawn. The latter are roasted more easily and quickly, and not mixed with sand. The two materials are then reduced in a cupola, together with roasted matte obtained at a subsequent stage. There are two kinds of smelting:—one for lead and first matte in which puddle cinder is used as the iron flux, and one for concentration of first, second, and third mattes after roasting, in which wasted matte is the flux. The latter is for the nickel and cobalt. The first matte is roasted in a Freiberg hearth for working in the cupola previously mentioned. Besides the ordinary process of refining the lead, it is sometimes fused in a small reverberatory and run into a large zinc desilverisation kettle holding 20 tons, and there poled by a steam jet and cast through a Steitz syphon. This, known as the Anchor brand, is supposed to be good for acid chambers.

The nickel and cobalt are recovered by the reaction in a small cupola between the nickel-cobalt-lead matte and an auriferous and argentiferous speiss, when a nickel-cobalt speiss and a lead containing gold and silver are obtained.
—A. W.

The Extraction of Copper at Agordo. T. Egleston. School of Mines Quarterly, **9**, 124—139 and 256—278.

The ore is iron pyrites containing about 1·6 per cent. of copper with little or no gangue, 2·5 per cent. of arsenic, 3·0 per cent. of zinc as blende, small quantity of tin, and occasionally some galena. It is divided into four sorts. (1.) Poor ore with less than 1·5 per cent. Cu. (2.) Good ore, 1·5 per cent. to 3·0 per cent. (3.) Rich ore, 5·0 per cent. to 8·0 per cent.; and (4.) Ore containing lead. The rich ore constitutes about 2 or 3 per cent. of the whole, and is treated at once in the dry way, while the remaining poor and good ore is roasted for lixiviation. It is pile-roasted, about 300 tons in a pile, lixiviated and the copper precipitated with cast iron. The precipitate is added to the rich ore and furnaced for matte, which latter, containing about 25 per cent. Cu, is stall-roasted five or six times, and then fused in a cupola with quartz and red sandstone for black copper. This is refined by aërial oxidation of the impurities, and rosette copper formed in the usual way. Sometimes the original pyrites is stall-roasted, and advantage is also taken of the process of kernel-roasting to concentrate the larger lumps, which are then mixed with the rich ore for the furnaces. An attempt is made to collect sulphur, but only about 1⅓ per cent. of the quantity present is obtained. It is purified, so-called, by simple fusion and skimming off mechanical impurities, but contains a considerable quantity of arsenic. An improvement has recently been introduced by means of which the waste of iron in reducing the ferric to ferrous sulphate previous to the precipitation of the copper is prevented. The reduction is brought about by an ascending current of SO_2 in a tower, in which it comes into contact with the descending per-salt liquor. By this means a purer precipitate is obtained, the arsenic, previously 0·3 per cent., being now 0·039 per cent., and a great saving in cost is effected.—A. W.

Outlines of a Theory of Steel. F. C. G. Müller. Stahl u. Eisen, **8**, 291.

The author has undertaken the investigation of those substances which have an important influence in determining the properties of steel, and the present article treats chiefly of the black powder which forms the residue from the treatment of slowly-cooled steel with dilute acids. This substance, which has already been the subject of research by Abel and Deering (this Journal, 1885, 284—286), as well as by Osmond and Werth (this Journal, 1886, 193), has a constitution approximating to the formula Fe_3C. It is decomposed by hot strong hydrochloric or sulphuric acid with evolution of carburetted hydrogen, and then leaves a residue of a composition which may be expressed by the formula C_5Fe. Carbon exists evenly alloyed with iron, only in hardened steel, whilst by slow cooling it tends to collect in separate centres, in the form of the compound Fe_3C. The presence of much silicon prevents the formation of this body, and the separated carbon particles take the form of graphite. Certain other elements, such as phosphorus, copper, and especially tungsten, prevent the separation of the carbon, and must have a great hardening effect on the steel.—G. H. B.

Occurrence of Cobalt in Nature. H. Rössler. Dingl. Polyt. J. **267**, 518—520.

The author refers to the occurrence of cobalt in iron and manganese ores, and to its presence in many kinds of non-German iron of commerce. The percentage of cobalt in manganese ores varies from 0·01 in the ore from the Caucasus to 0·7 per cent. in some Spanish ores. At Immsbach on the Donnersberg, in the Pfalz, there is a crevice in porphyry filled with loose iron and manganese oxides, and containing on an average 0 3 per cent. of cobalt and 0·1 per cent. of nickel; red lead, copper, and bismuth oxides are also found there. Cobalt is also found in copper pyrites, and this may be regarded as a fruitful source of cobalt, as certain sulphuric acid and copper works in Germany could extract several thousand kilos. of cobalt per year from their burnt pyrites.—D. A. L.

PATENTS.

Manufacture of Useful Alloys of Aluminium. C. L. Benzon, Sheffield; a communication. Eng Pat. 2753, December 1, 1858. Second edition, 1888. 6*d.*

The alloy is produced by mixing most intimately alumina and carbon with the more electro-positive metal to be alloyed, such as copper or iron, and heating to the requisite temperature. The three substances are used in a most finely divided condition; the carbon, which of preference is animal charcoal, is employed in quantity slightly in excess over that necessary to exactly effect the reduction of the Al_2O_3, or $Al_2O_3 + CuO$ if the latter be substituted for metallic copper. The crucible employed is brasqued, and is similar to those used in the manufacture of cast steel: the charge is heated to the melting point of copper until the whole of the alumina is reduced, when it is increased for one-half hour more to complete the fusion of the alloy. The amount of copper thus employed may be varied at will. Where, however, alloys of exact composition are required, a mixture which will yield a considerable excess of aluminium is first made as above, and is then diluted with copper according to the result of a test analysis. Where iron is substituted for copper, a greater excess of carbon and a higher temperature must be employed; and the reduction from oxide such as hammer slag is found to yield better results than metallic iron gives. The alloys of copper or iron with aluminium may be further admixed with zinc, brass, or German silver. From some of these alloys pure aluminium may be obtained by elimination of the other metals. The copper aluminium alloy is of gold-yellow colour, takes a high polish, and may be cast, rolled, or hammered. The iron aluminium alloy added to cast steel increases its hardness, soundness, and capability of receiving polish.—W. G. M.

Improvements in Condensing and Separating Lead Fume and Apparatus therefor. J. B. Clark, Bristol, and the Panther Lead Company, Limited, London. Eng. Pat. 9706, July 11, 1887. 8*d*.

The furnace gases are led into a flue, whence they pass upwards through a series of vertical pipes to a subsiding chamber and finally to the chimney shaft. In the vertical pipes they pass through coke or wood saturated with water, which is constantly running through each from a pipe above to a reservoir beneath. In this way much of the fume is deposited, and the remainder becomes so saturated with water that it is deposited with greater readiness in the subsidence chamber. Dampers may be used to control the flow of gas through each pipe. An exhaust fan should preferably be employed to regulate the rate of flow, instead of using only the natural draught.—W. G. M.

Improvements in Connexion with the Calcining of Sulphurous Ores. J. Fleming, Rio Tinto, Spain. Eng. Pat. 10,153, July 20, 1887. 11*d*.

The object of this invention is to prevent the loss of valuable material and the destruction of surrounding vegetation by the fumes from calcining heaps. Above the roasting heap or bing, and extending downward over the whole portion (about one-third) which emits the fumes, is suspended an iron hood, lined with tar and painted without with a non-conducting material. The hood is supported by chains from two pairs of shear legs, and the whole is strengthened by iron stays. At one end of the hood is a pipe by which the roaster gases are led to condensing flues to separate arsenious acid, and to the vitriol chambers. Several heaps may be thus connected with the same condensing apparatus. If the gases have excess of air they are passed through calcining furnaces; if insufficient, more can be supplied by regulating dampers in the flues.

—W. G. M.

An Improved Manufacture of Metallic Alloys. J. Y. Johnson, London. From La Société Anonyme Le Ferro-Nickel, Paris. Eng. Pat. 3793, March 12, 1888. 6*d*.

This is an extension of Eng. Pat. 5832 of 1886 (this Journ. 1887, 511). An alloy, containing from 10 to 40 parts of nickel, with from 90 to 60 of copper and 0·175 to 0·05 of aluminium, is prepared as in the earlier specification, and is then mixed with a further quantity of nickel and copper, together with zinc, to form a special German silver, which should have in a high degree tenacity, homogeneity, closeness of texture, and malleability, combined with a low conductivity for heat. An alloy containing—

$$Ni = 18\cdot75,\ Cu = 61\cdot25,\ Zn = 20,\ Al = 0\cdot0219$$

is a mixture containing the maximum of aluminium, which will impart a fair degree of non-conductivity without prejudicing the malleability. This would be made by making an alloy of $Ni = 10 : Cu = 90 : Al = 0\cdot00175$, and adding 12·5 per cent. of this to the necessary quantity of the other ingredients. To economise aluminium, malleable nickel may be used, or a small addition of manganese may be made, in which case a small proportion of potassium ferrocyanide is also employed in making the first alloy.

—W. G. M.

Improvements in the Art of extracting Metals from Ores or Metallurgical Products. P. Jensen, London. From E. H. Russell, Park City, Utah, U.S.A. Eng. Pat. 6102, April 24, 1888. 6*d*.

This is a modification of Russell's Eng. Pat. 5431 of 1884 (this Journ. 1884, 415), in which is protected the addition of a copper salt to the alkaline hyposulphite (thiosulphate) before leaching. In the new process the copper salt (preferably the sulphate) is first mixed with the crushed ore, and thus replaces by cupric hydrate the injurious metallic hydrates which may be present in the charge. When this neutralising action is complete, the usual alkaline hyposulphite leaching solution is added, which reacts with the unaffected copper salt to form cuprous hyposulphite in the manner described in the previous specification. The copper salt may be mixed dry, but is best added in solution. A depth of one to six inches of liquid over the charge, containing one to five pounds of sulphate for each ton of ore, is found to give satisfactory results. The leaching solution may be that of cuprous-sodium-hyposulphite, but inasmuch as the copper necessary for the formation of this compound *in situ* is already present, the simple hyposulphite is preferred.

—W. G. M.

Improvements relating to the Separation or Extraction of Aluminium or Compounds thereof from Ores and other Substances, and to Fluxes and Apparatus therefor. H. H. Lake, London. From F. J. Seymour, Findley, Ohio, U.S.A. Eng. Pat. 6460, May 1, 1888. 8*d*.

Silicated aluminous ores may be heated with zinc oxide, carbon, and a flux to a temperature of 2,500° F. in a suitable furnace. The mixed aluminium and zinc vapours which are evolved oxidise, and the oxides are deposited in a series of subsidising chambers. The bulk of the silica will be left in the furnace or will settle in the first chamber. The mixed oxides are made to yield their aluminium by admixture with fluxes such as borax, or ammonium or sodium nitrates, and with 2 per cent. of carbon, and heating in crucibles to the fusing temperature of Bessemer steel.—W. G. M.

Improvements in or relating to the Conversion of Crude or Pig Iron into Malleable Iron or Steel. J. W. Bookwalter, Springfield, Ohio, U.S.A. From G. Robert, Stenay, Meuse, France. Eng. Pat. 6886, May 9, 1888. 8*d*.

In order to avoid the formation of slag within the metal itself, and the further mixture of the same by agitation, especially at the surface, which is the result of forcing air into or through the molten metal, it is proposed to use horizontal tuyeres, placed somewhat tangentially at the immediate surface of the bath, and on one side of the circular converter. Oxidation will be perfected, but the above-mentioned difficulties will no longer exist, nor will the converter lining be worn away by currents of air passing between it and the fluid metal; a higher temperature than heretofore will result, giving greater fluidity, and, therefore, better circulation and less tendency to entrap slag. By the tangential arrangement of the tuyeres, a horizontal as well as a vertical circular motion will be imparted to the metal, so that fresh portions will be constantly presented for oxidation, whilst the slag accumulates quietly on the opposite side of the vessel. As it is essential that the blast shall enter at the surface, so that it neither penetrates the bath nor is wasted above, the level of the liquid which is reduced by the oxidation of its combustible constituents must be constantly restored, either by a false bottom, by inserting refractory materials, or (preferably) by tilting the converter.—W. G. M.

Improvements in Apparatus for converting Crude Iron into Malleable Iron or Steel. J. W. Bookwalter, Springfield, Ohio, U.S.A. Eng. Pat. 6951, May 9, 1888. 6*d.*

This specification describes a circular converter mounted on trunnions, with a side-blowing arrangement, the blast being delivered at the surface of the metal. Circulation is thus produced throughout the metal bath, but is very sluggish at the centre. In order to bring every portion more rapidly in contact with the blast, the centre is filled in with a core of refractory material, the top of which is sunk but a few inches beneath the surface of the bath; around this a more rapid motion of the liquid takes place.
—W. G. M.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in Secondary Batteries. W. H. Akester, London. Eng. Pat. 7189, May 17, 1887. 8*d.*

The electrode consists of parallel plates or bars of lead, supported in a suitable frame, and separated from each other at the ends by lead distance pieces, so as to leave between each plate or bar of the electrode a space to be filled in with any suitable material not acted on by acid, such as horsehair cloth soaked in a solution of nitrocellulose in amyl acetate. These compound electrodes have attached to each two tapering lugs with projecting screws embedded in them. The lugs are held in closely fitting holes in the cover, by a binding post on one screw and a nut on the other. All parts of the electrode are burned or fused together.—E. T.

Improvements in Apparatus for Separating Iron from other Substances. M. H. Smith, Halifax. Eng. Pat. 10,893, August 9, 1887. 11*d.*

In one form of the apparatus electro-magnets are set radially in parallel lines on the periphery of a revolving horizontal drum; they are also in immediate contact with the inner side of an enclosing cylinder, and are so arranged that the magnets on one side only of the apparatus are excited. At a short but alterable distance from this side, and running the whole length of the cylinder, is a horizontal trough divided into several compartments, provided with a propelling screw and with a hopper at one end. The substance to be treated is fed into the hopper and is gradually urged along the trough by means of the screw; in passing from each compartment to the next it is brought into close proximity with the magnetised drum; thus magnetic particles cling to the ascending side of the cylinder while the remainder falls into a receptacle beneath. Meanwhile the scraps of iron are carried to the top of the drum and to a short distance downward on the other side, but here the commutator is situated, the magnets are no longer excited, and the pieces fall into a trough; any particles still adhering are finally swept off by contact with a brush and the cylinder is left clean for the ascent past a fresh charge. In another form of apparatus the material is fed downwards through a series of magnetised rings to which the magnetic portions are attracted during their descent. In order to bring them within the sphere of the magnetic influence, within the rings are placed rotating cones which may be adjusted so as to leave any desired space between them and the pole-pieces, and which, by centrifugal action, tend also to throw the heavier (iron) portions nearer to the magnets.—W. G. M.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Recovery of Oil from the Refuse of Olive Presses. G. Laquai. Chem. Zeit. **12**, 754—755.

Treatment with water is advocated (Chem. Zeit. **12**, 607) as being preferable to extraction by means of carbon bisulphide or light petroleum.

This view the author combats, asserting that the latter is the better method, inasmuch as the exhaustion is more complete (1 per cent., instead of 20 per cent., of the total oil being left), the process cheaper, the extracted refuse easier of disposal as it may readily be used as fuel in the works, and the product in no way inferior for its legitimate use, viz., soap making. The claim of the oil recovered by means of water to be considered of greater value on account of its applicability for lubrication, and the manufacture of Turkey-red oil is not valid, because of its having been superseded for these purposes by mineral oils and castor oil, respectively.

The author also points out that the proposal to distil the husks with superheated steam in order to obtain an oil for table use is not practicable, on account of the hydrolysis that would occur, yielding fatty acids and glycerol instead of olive oil.—B. B.

Extraction of Olive Oil from Olive Residues. Chem. Zeit. **12**, 617.

The residues obtained after submitting olives to pressure and thus extracting as much of the oil as possible still contain 5—10 per cent. of olive oil. Hitherto these residues have been treated either by extraction with some solvent, such as carbon bisulphide, or, more commonly, by crushing them again with water in edge runners and decanting the oil from the water. The author does not consider either process satisfactory, and proposes to separate the oil by distillation with superheated steam. The apparatus would be very simple, consisting of a superheater, a still provided with a manhole at top and bottom, and a condenser. As the oil decomposes at a high temperature it is preferred to effect the distillation at about 150°—200° C. After the still has been charged with the residues steam is passed in at a temperature of about 250°, and it must be carefully distributed throughout the mass. When the temperature in the still has risen to 100° the vapours which are given off contain comparatively little olive oil, but at from 150° to 200° C. it distils over rapidly. The water which passes over with the oil contains a considerable quantity of ammonia and also some glycerol, given off during the final stages of the distillation.—E. E. B.

German Mineral Oil. C. Engler. Dingl. Polyt. J. **267**, 506—513.

The author compares the German mineral oils obtained from Tegernsee, Alsace, and Hanover with American and Russian oils. The most characteristic physical properties, which are themselves sufficient to indicate the source of an oil, are the specific gravity and the refractive index of various fractions. Some of the results are given in the following table :—

Oil from	Fraction 140°—160°.		Fraction 190°—210°.	
	Sp. Gr.	Ref. Ind.	Sp. Gr.	Ref. Ind.
Tegernsee	0·7465	1·427	0·7840	1·437
Pechelbronn, Alsace	0·7550	1·421	0·7900	1·440
Oelheim, Hanover	0·7830	1·435	0·8155	1·450
Pennsylvania	0·7550	1·422	0·7860	1·439
Baku	0·7820	1·436	0·8195	1·454

Oil from	Fraction 240°—260°.		Fraction 290°—310°.	
	Sp. Gr.	Ref. Ind.	Sp. Gr.	Ref. Ind.
Tegernsee	0·8130	1·451	0·8370	1·465
Pechelbronn, Alsace	0·8155	1·454	0·8320	1·462
Oelheim, Hanover	0·8420	1·468	0·8625	1·480
Pennsylvania	0·8120	1·454	0·8325	1·463
Baku	0·8445	1·467	0·8640	1·475

The cöefficient of expansion for these oils in general decreases as the specific gravity increases, but this is not always the case.

The results of fractional distillation of these oils are set forth in a table, taking into consideration the fractions below 300°; Tegernsee oil yields 67 vols. per cent., Pechelbronn 39 vols. per cent., and Oelheim oil 32 vols. per cent. The latter is therefore the heaviest, but a heavier oil has been found in Wietze, near Celle.—D. A. L.

On Drying Oils. K. Hazura and A Grüssner. Monatsh. Chem. 9, 180.

The authors have devised a method which is applicable to the determination of the constitution of the unsaturated acids of fats and oils.

By subjecting the acid from hemp oil in acetic acid solution to the action of bromine, a solid product and liquid bromine compounds are obtained. The former contains two substances. The one has a melting point of 114°—115°, is readily soluble in alcohol, ether, and glacial acetic acid, and crystallises from alcohol in nacreous plates, having the composition $C_{18}H_{32}O_2Br_4$. The second substance is sparingly soluble in alcohol, ether, and glacial acetic acid, crystallises from alcohol in small microscopic needles, melting at 177°, and has the formula $C_{18}H_{30}O_2Br_6$. By heating these compounds in alcoholic solution with zinc and hydrochloric acid, bromine is liberated with formation of two unsaturated fatty acids of the formulæ $C_{18}H_{32}O_2$ and $C_{18}H_{30}O_2$. The former absorbs four atoms and the latter six atoms of iodine from Hübl's solution. For these acids the author suggests the names of linoleic and linolenic acids. When oxidised with potassium permanganate in alkaline solution, these acids yield sativic and linusic acids.

Sativic Acid, $C_{18}H_{32}O_2(OH)_4$, is insoluble in cold water and ether, dissolves in 1,000 parts boiling water, and is readily soluble in alcohol. It crystallises from water in silky needles melting at 173°. The sodium and potassium derivatives are readily soluble in water; the barium salt is, however, insoluble. When treated with nascent hydrogen iodide it is resolved into stearic acid. Sativic acid must therefore be regarded as a tetrahydroxystearic acid.

Linusic Acid, $C_{18}H_{30}O_2(OH)_6$, is insoluble in cold water and ether, sparingly soluble in hot water and alcohol. It crystallises from water in microscopic rhombic plates melting at 203°. The sodium and potassium salts are readily soluble in water; the barium salt dissolves easily in hot, sparingly in cold water.

By taking into consideration the fact that when linolenic, linoleic, and ricinoleic acids are oxidised, linusic, sativic, and trihydroxystearic acids are produced, and that Saytzeff obtained from oleic and elaïdic acids, dihydroxystearic, and isodihydroxystearic acids, they deduce the following law: ***When oxidised with potassium permanganate in alkaline solution, unsaturated fatty acids take up as many* (OH) *groups as there are free valencies, yielding saturated hydroxy fatty acids containing the same number of carbon atoms in the molecule.*** This law enabled the authors not only to predict the products of the oxidation of unsaturated fatty acids, but also suggested the means of determining the unsaturated acids present in oils and fats. This was done in the following manner :—The fats were saponified, the soaps dissolved in water, neutralised, and then precipitated with lead acetate. The lead salts were extracted with ether and the unsaturated acids separated from the ethereal extract by means of dilute sulphuric acid. The solution was then rendered alkaline and oxidised with potassium permanganate. The composition of the hydroxy fatty acids in the oxidation products was then determined, and the number of carbon atoms and free valencies contained in the unsaturated fatty acids produced therefrom was deduced from the number of carbon atoms and alcoholic hydroxyl groups. In this manner the author has determined the constitution of the liquid fatty acids of various drying oils. The following table gives the results : —

	100 grams of Liquid Fatty Acids from				
—	Linseed Oil.	Hemp Oil.	Nut Oil.	Poppy-seed Oil.	Cotton Oil.
	Yield				
Dihydroxy-stearic acid.	1·2	4·0	2·5	8·5	23·0
Sativic acid ..	6·5	24·0	25·0	18·5	31·5
Linusic and isolinusic acids.......	20·3	2·5	2·0	0·3	..

Dihydroxystearic Acid, $C_{18}H_{34}O_2(OH)_2$, melts at 137°, is insoluble in water and ether, sparingly soluble in cold, easily in hot alcohol, and crystallises from the latter in nacreous plates. The potassium and sodium salts are readily soluble in water, the barium salt is insoluble.

Isolinusic Acid, $C_{18}H_{30}O_2(OH)_6$, melts at 173°—175°, is soluble in alcohol, insoluble in ether. It crystallises from water in microscopic prismatic needles. This acid is isomeric with linusic acid.

As, by the oxidation of the fatty acids of linseed oil, the four hydroxy acids above named are produced, the author describes the mode of conducting the oxidation as applied to this oil :—30 grams of the liquid fatty acids of linseed oil are saponified with 30 cc. of potash, specific gravity 1·25. The soap thus formed is dissolved in two litres of water and treated gradually with two litres of a 1·5 per cent. solution of potassium permanganate. The mixture is then filtered, and the filtrate containing the potassium salts of the resultant oxidation products is acidified with sulphuric acid. The precipitate is collected on a filter and dried in the air. The acid mixture (A) is converted into the barium salt and extracted with boiling water. The insoluble portion is decomposed with hydrochloric acid, filtered, and the acids thus liberated are dried and extracted with cold ether. The ethereal solution contains dihydroxystearic acid besides a small proportion of unoxidised acids. The residue, insoluble in ether, consists of sativic acid. The soluble part of the barium salt from (A) is concentrated by evaporation and decomposed with hydrochloric acid. The acid thus set free mostly consists of linusic acid, being only occasionally contaminated with small quantities of isolinusic acid, the removal of which may be effected by fractional crystallisation from alcohol.

The acid filtrate from (A) called (B) is neutralised with potash. Four litres are then concentrated to a volume measuring 300 cc., re-acidified with sulphuric acid, and the acid thus liberated, called (C), is collected on a filter, dried in the air, and extracted with ether. The insoluble portion is isolinusic acid. The soluble part, azelaic acid, $C_9H_{16}O_4$, a product of the decomposition of linoleic acid. The filtrate from (C) yields, when extracted with ether, a small amount of azelaic acid and other lower fatty acids formed by the oxidation of linoleic acid.

In this manner the author obtained the following numbers for the composition of the acids from drying oils.

Linseed oil contains about 65 per cent. of isolinolenic acid, 15 per cent. of linolenic, and 15 per cent. of linoleic acids.

Hemp oil.—70 per cent. linoleic acid, 15 per cent. linolenic and isolinolenic acid, and 15 per cent. oleic acid.

Nut oil.—80 per cent. linoleic acid, 13 per cent. linolenic and isolinolenic acid, and 7 per cent. oleic acid.

Poppy-seed oil.—30 per cent. oleic acid, 65 per cent. linoleic acid, and 5 per cent. linolenic and isolinolenic acids.

Cotton oil.—40 per cent. oleic acid and 60 per cent. linolenic acid.—D. B.

PATENTS.

Improvements in the Composition of Mercurial Soaps. J. Thomson. Eng. Pat. 7117, May 16, 1887. 6*d*.

In patent No. 9591, July 24, 1886, the proportions of biniodide of mercury to be incorporated with soap vary between $\frac{1}{10000}$th and $\frac{1}{100}$th part. The present patent extends these quantities indefinitely in either direction.

—W. L. C.

Improvements in the Treatment or Preparation of Mineral and other like Oils. C. L. Baillard. Eng. Pat. 8194, June 7, 1887. 6*d*.

Mineral oils (of the type C_nH_{2n+2}) and resin oils are treated with the oxyoleic acid described in Patent No. 449, January 11, 1886, and are then boiled with free steam over an aqueous solution of potassium chlorate, to which hydrochloric or sulphuric acid is added, or of chloride of lime, or of fluor spar suspended in water containing sulphuric acid. The product is essentially soluble in alkalis, and can be used for oiling wool, &c.—W. L. C.

Improvements in Percolators for the Extraction of Oil by the Naphtha Process. H. J. Haddan. Eng. Pat. 5971, April 21, 1888. 8*d*.

This relates to improvements in percolators designed more especially for the extraction of cotton-seed oil by the naphtha process, and is the invention of J. W. Evans, of Cleveland, Ohio. Owing to the fact that cotton-seed meal packs so densely, the percolators are made not more than 7 feet high, but of large internal diameter. The interior space is broken up by a number of radial arms, termed breakers, supported by a centre piece and by hinged brackets attached to the sides; under these breakers and cross-bars is a system of perforated steam-pipes. A drawing is given.—W. L. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

On the Hydrocarbons accompanying Diterebentyl in Resin Oil. A. Renard. Compt. Rend. **106**, 1086.

If resin oil boiling between 300° and 360° be treated with sulphuric acid, the diterebentyl $C_{20}H_{30}$ becomes transformed into polymerides and a soluble sulphonic acid. The polymerides are separated from the unaltered portions of resin oil by distillation, and remain in the residue as a hard brown semi-transparent resinous mass. The distillate is treated with sulphuric acid, at first in the cold, then at 50°—60°, washed with soda, and rectified over sodium, whereby a mixture is obtained boiling at 330°—350°, and containing two hydrocarbons which cannot be separated by fractional distillation. The fraction boiling between 340° and 350° consists principally of diterebentylene, $C_{20}H_{28}$, identical with the substance obtained by heating the dibromide of diterebentyl. The fraction boiling between 330° and 340° contains a new hydrocarbon, which can be obtained in the pure state by one or two treatments with fuming sulphuric acid or fuming nitric acid, by which the diterebentylene is transformed into a soluble derivative. The pure hydrocarbon is then obtained after washing with caustic soda and rectifying over sodium. It is a colourless, non-fluorescent oil, of sp. gr. 0·9362 at 12°, boiling at 330°—335°, and of the composition $C_{20}H_{36}$. It is unalterable in the air, and is not attacked by fuming sulphuric or nitric acids, or by hydrochloric acid or bromine, at ordinary temperatures. It must be considered to be didecene, $C_{20}H_{36}$, a polymeride of decene, $C_{10}H_{18}$, and is homologous with diheptene, $C_{14}H_{24}$, and dioctene, $C_{16}H_{28}$. The resin oils, which constitute about nine-tenths of the product of distillation of resin, consist of a mixture of about 80 per cent. diterebentyl, 10 per cent. diterebentylene, and 10 per cent. didecene.—G. H. B.

PATENTS.

New and Improved Material for colouring Paints, Cements, and other Substances. J. Rust, London. Eng. Pat. 9887, July 14, 1887. 4*d*.

Ferruginous sand or ironfounders' waste is heated to redness in a current of air or steam for a few hours, whereby it becomes brown or red according to the temperature that has been used, and can be employed for colouring paints and cements.—B. B.

A Liquid Blue. J. A. Walton, London. Eng. Pat. 10,554, July 29, 1887. 4*d*.

The blue is for laundry use, and is made by mixing 33 parts of Prussian blue with nine parts of oxalic acid, both finely ground, and adding them to a cold aqueous solution of basic aniline blue (95 grains per gallon). When solution is complete the liquid is diluted until it contains altogether 1,350 parts of water. Eight parts of gum arabic are then dissolved in water and stirred in, the object being to prevent precipitation of the colouring matter.—B. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Improved Method of Tanning. Zeits. f. Electrotechn. **6**, 176.

The use of a current of electricity in tanning by rotating drums diminishes the duration of the process, and an apparatus has been constructed on this principle by Worms and Balé (this Journal, 1888, p. 443).—T. L. B.

XV.—AGRICULTURE, MANURES, Etc.

Calcium Sulphite and its Use in Agriculture. E. Jensch. Chem. Ind. **11**, 169—173.

The experiments of Heiden and Holdefleiss have shown that however carefully ordinary manure is stored, 22 to 23 per cent of the nitrogen is lost unless some substance is added to fix the ammonia. The author recommends calcium sulphite, and gives the results of experiments to prove the value of this material for the above purpose. By mixing the salt with the moist dung ammonium sulphite is formed which rapidly oxidises to the sulphate, while nitrates are also produced. The amido compounds of the dung are either decomposed directly into ammonia or they are changed to such a degree that this alteration can be effected by the aid of alkalis. Calcium sulphite is further useful as a disinfecting agent.—A. W.

PATENTS.

A new Method of Utilising the Waste of Flour and other Mills and Machines or Industries for Treating Agricultural Produce. L. Rappaport, Breslau, Prussia. Eng. Pat. 5270, April 9, 1887. *6d.*

This has for its object the extraction of the oil, grease, wax, or cholesterin which are contained in the waste residuum and siftings from flour, rice, millet, peeling, groat, and grit mills and other kindred industries in which agricultural produce of various sorts is treated.

Such oil, grease, &c. may be extracted either mechanically by pressure, or by means of solvents, such as benzine, naphtha, carbon bisulphide, ether, chloroform, &c. From the solution on distillation are obtained various fatty matters which are afterwards separated by saponification. The waste thus deprived of its oil, &c., and in some cases poisonous properties, may be used for cattle feeding and various other purposes.—J. H.

New or Improved Processes for Converting Natural and other Phosphates into Products assimilable by Vegetables and into Valuable Sub-products. W. L. Wise, London. From E. Solvay, Brussels. Eng. Pat. 6632, May 5, 1887. *6d.*

In order to wholly or partially liberate the phosphoric acid of natural phosphates of lime, and render the same assimilable by plants, the inventor calcines them with silica or alumina. At a low temperature metaphosphate of lime is produced, soluble in citrate of ammonia. At a sufficiently high temperature phosphoric anhydride is volatilised and may be collected and converted into any suitable fertiliser.

The above reaction may be combined with the production of chlorine or hydrochloric acid and a caustic alkali, by adding common salt or potassium chloride to the mixture for calcination. The calcined residue then contains a soluble alkaline phosphate, which, on being causticised with lime, yields precipitated bicalcium phosphate and caustic alkali.
—J. M. H. M.

An Improved Fertiliser. P. C. Jensen, Chicago, U.S.A. Eng. Pat. 3013, February 28, 1888. *6d.*

The inventor utilises the tank water obtained in rendering fats by evaporating it until it becomes hard and brittle on cooling. To overcome the tendency to deliquesce it is mixed with quicklime, in which state it can easily be reduced to a dry powder. Other nitrogenous animal matter can be treated in a similar manner.—J. M. H. M.

XVI.—SUGAR, STARCH, GUM, Etc.

Mannose. E. Fischer and J. Hirschberger. Ber. **21**, 1805.

By the action of nitric acid on mannite, besides levulose, another sugar is produced, to which the authors give the name of mannose. It may be separated by adding an acetic acid solution of phenylhydrazine, with which it forms a difficultly soluble compound. It reduces Fehling's solution, is fermentable, turns the plane of polarisation to the right (less than dextrose), and forms with phenylhydrazine the insoluble compound above mentioned. On heating with an excess of phenylhydrazine it forms an osazone, $C_{18}H_{22}N_4O_4$. Sodium amalgam reduces mannose to mannite. It is turned brown by alkalis, and, on heating with 20 per cent. hydrochloric acid, it forms humin substances. It is a pale yellow syrup, which does not crystallise. Mannose has not been detected in honey or grape juice.—H. T. P.

Crystalline Saccharic Acid (Saccharo-lactonic Acid). O. Sohst and B. Tollens. Ann. **245**, 1—27.

The anhydride of saccharic acid (saccharo-lactonic acid) can be obtained by mixing 100 grms. of starch with 100 grms. of water, adding the mixture to 500 cc. nitric acid (sp.gr. 1·15), and heating in a shallow basin on the water-bath. When a rapid evolution of red fumes begins, the heat is moderated, and the whole evaporated at 60°—70° with stirring, to a syrup. After adding an equal volume of water, it is neutralised while warm with pure powdered potassium carbonate, and an excess of concentrated acetic acid added. The potassium salt which separates is filtered after standing, dried on porous plates, and, after boiling with animal charcoal, purified by recrystallisation: 100 grms. of starch yield 18—20 grms. of the pure salt.

The free acid is obtained by neutralising an aqueous solution of the acid salt with ammonia, and precipitating with silver nitrate. The silver salt is washed, suspended in water, and decomposed with hydrochloric acid, any excess of the latter being removed with silver carbonate. The acid is purified by digesting with animal charcoal, evaporating the filtrate on the water-bath to a thin syrup, and further concentrating by evaporating over sulphuric acid or in the air. On standing, crystals are deposited, and the whole solidifies in a few hours. The crystals are spread on porous plates, and obtained pure by repeatedly recrystallising from water. Saccharic acid loses 1 mol. of water, and is converted into the lactonic acid when liberated from its salts. Saccharo-lactonic acid melts at 130°—132°. It does not reduce Fehling's solution; but when heated at 98°—100° it gradually melts, yielding a brittle, brown, transparent acid gum, which immediately reduces Fehling's solution. This gum is probably the double lactone of metasaccharic acid. Saccharic acid reduces ammoniacal silver solution, and when heated it gives off water and crystalline pyromucic acid sublimes.

Saccharo-lactonic acid has a high specific dextro-rotatory power, which diminishes when the solution is kept for some time. When saccharic acid is liberated from its salts, it has a very low rotatory power. These facts show that when the lactonic acid is dissolved it is partially converted into saccharic acid.

Acid potassium saccharate, $C_6H_9O_8K$, is sparingly soluble in cold, but far more readily soluble in hot water. It crystallises in shining needles, and shows an acid reaction.

Acid ammonium saccharate, $C_6H_9O_8NH_4$, crystallises in small needles, which are somewhat more readily soluble than the potassium salt. It is dextro-rotatory.

The *magnesium*, *silver*, and *barium* salts are crystalline. When 5 grms. of the potassium salt are heated at 150° for three hours with 15 grms. of concentrated hydrochloric acid, a considerable quantity of carbon dioxide is evolved. The product is dissolved in dilute sodium carbonate, filtered from a brown insoluble substance, warmed with animal charcoal, and precipitated with hydrochloric acid. The precipitate, after crystallising from hot water, yields 5·5 grms. of pure dehydromucic acid, which is identical with the acid obtained from mucic acid.

Diphenylene oxide was isolated from the brown insoluble residue referred to above.—F. S. K.

Substitute for Gum Arabic. E. B. Stuart. Western Drugg. 10, 119.

On account of the high price of gum arabic, an artificial product has been brought into the market in America. It is almost colourless, but has otherwise the appearance of the natural article. It is somewhat sweeter than acacia gum. The author, from an examination of the product, concludes that it is obtained by mixing dextrin with a solution of gum arabic, and evaporating in vacuo.—T. L. B.

New Methods and Apparatus for Sugar Factories. Dingl. Polyt. J. 267, 69—75; 132—137.

J. Bock (Deuts. Zuckerindustrie, 1887, 1347) recommends the use of liquefied sulphurous anhydride for neutralising the lime in sugar juices. It is preferable, and more convenient than either the gas or the solution.

Pfeiffer and Langen have a patent (D. R. P. No. 40,942, 1886) for the separation of raffinose and other non-saccharine matters, as insoluble lead salts from sugar solutions, using for the purpose either ready-formed lead oxide or nascent lead oxide prepared electrolytically in the solution. In any case, after mixing well with the oxide, the solution is diluted and filtered. It is questionable whether raffinose is precipitated by lead oxide, and if it is possible subsequently to get rid of all the lead from the solution.

American granulated sugar is prepared in the following manner:—The sugar solution at 30° B. is made distinctly alkaline with lime, then carefully heated to boiling with animal charcoal and blood, filtered through animal charcoal, then treated with sulphurous acid, quickly boiled, and allowed to crystallise. The crystals are dried in an apparatus consisting of two slightly inclined, concentric, revolving cylinders.

Hefftner's process of purification is, according to *Vivien* (Bull. Assoc. Chim. 1887, 266), less efficient than the ordinary method of working with 2·20 kilos. of lime per hectolitre of juice. Moreover, it necessitates frequent cleaning of the coils, and the scum appears to be more greasy and troublesome to separate and wash. Otherwise the process is satisfactory.

Manoury's process, on the other hand, has answered in some factories, but not in others. It gives a less pure product, and it is questionable whether the yield is any greater.

In the Zeits. d. Vereins f. Rübenzuckerindustrie 1887, 997, a useful and efficient apparatus for clearing and drying sugar-beet is described. Deutsche Zucker Ind. 1887, 1505, contains the description of apparatus for the production of hundred-pound blocks of refined sugar.—D. A. L.

New Processes and Apparatus for Sugar Manufactories. Dingl. Polyt. J. 268, 275—280.

H. Leplay has constructed an apparatus for carrying out experiments on osmosis. It consists of two cylindrical tinned copper boxes, each 3 cm. deep and each of which has a flanged rim by means of which they can be bolted edge to edge, a diaphragm of parchment paper being previously inserted between the two in the plane of the flanged rim. The paper is kept flat by a wire sieve on each side. The box is fixed in a stand so that the flanges are vertical. Each box has a vertical graduated glass tube let into it, and a tap underneath. If one side only is filled with water or sugar solution, none of the liquid passes through the diaphragm, but as soon as one side is filled with water and the other with sugar solution, the levels in each case being equal, a Dutrochet endosmotic current sets in.

The apparatus is specially intended to determine such points as the following:—

(1.) The rate of osmosis for each constituent in the molasses, either by itself or in the molasses.

(2.) To determine the extent to which each molasses or other syrup is capable of undergoing osmosis.

(3.) To determine what influence the density of the fluids has on their rate of osmosis.

(4.) To determine the influence of these densities on the loss of sugar.

(5.) To determine the influence of temperature, also the effect of different papers and of dilution.

(6.) And in general to determine under what conditions osmosis is accompanied with the best results.

W. Middendorf has patented a process for the osmosis of molasses (Ger. Pat. No. 41,323, Dec. 16, 1886) which differs from that usually employed, in that a definite quantity of molasses is worked up at a time instead of the continuous process universally employed. The warm molasses are allowed to flow from the reservoir in which they are contained through the diffusion apparatus back again to the reservoir, whilst a current of hot water passes through the other portion of the diffusion apparatus. The molasses are thus subjected to a succession of weak osmoses which effect a slow but steadily progressing improvement in their purity, of course accompanied by an increase in volume due to the diffusion of water.

J. Stuchly has carried out experiments with thick juice to determine whether the increased purity of the juice, when it has been filtered through bone-black and after it has been mixed with the drainings, results in a sufficiently increased yield of sugar to compete with the method of filtering the thick juice through linen. He arrives at the conclusion that the former method shows too slight an advantage to be of service. Stammer objects to this conclusion being applied to the method in general instead of merely to the special cases Stuchly has taken. He points out first, that the action of bone-black rapidly diminishes in efficiency with the concentration of the juice, so that by experimenting with thick juice Stuchly has neglected an important point; secondly, Stuchly uses a quantity of bone-black corresponding to only about 8 per cent. of the beets, a quantity so small that an appreciable improvement in the quality of the juice could hardly be expected; and thirdly, the drainings should have been worked up separately. He maintains that if Stuchly had employed the best known method of procedure the result would have shown a decided advantage on the side of the bone-black filtration method. He is in fact surprised at Stuchly's result being as satisfactory as it is.—F. W. T. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

Improvements in the Manufacture of Spirit. Dingl. Polyt. J. 266, 563—574.

R. Schrohe (Zeits. f. Spiritus Ind. 1887, 2), for the preservation of parent yeast and protection from impurities, recommends storage in cylindrical copper vessels tinned inside and closed air-tight by means of a screw cover. When filled with yeast fermentation continues and gradually produces a high pressure of carbonic anhydride which effectually prevents the admission of air with its accompanying destructive germs, and, moreover, exerts a preservative action on the yeast. *Naumann* (*ibid*, 68) is of opinion that access of air is necessary for the preservation of yeast, but nevertheless recommends storing in air-tight wine-casks on campaigns.

With regard to the ripeness of yeast, *E. Brauer* (*ibid*, 2) remarks that this point cannot be definitely answered, as it is too dependent on local circumstances and on the different kinds of materials employed, but recommends taking off the parent yeast when the sugar amounts to 12° to 14° B. Microscopical examination is, however, more reliable, as the yeast is probably ripe when cell formation ceases.

The advantages and disadvantages of pressed and unpressed yeast are set forth by *Schrohe* (*ibid*, 9); the former is quite efficient, but is liable to form clumps, whilst the latter has not this objection, but it is difficult to measure the quantity of yeast in it with any degree of accuracy.

The employment of residuary liquors is suggested (Zeits. f. Spiritusindustrie, 1887, 10) for the steaming of uncrushed maize. The acidity of the liquor assists the disintegration of the maize, whilst the pressure kills all bacteria. Precautions are taken to prevent the liquors becoming too acid. *J. Hanak* (*ibid*, 17 and 27) finds that the employment of refuse liquor in this way gives a good yield of alcohol, but both the yield and quality of the yeast are unsatisfactory. Many observations on frothy fermentation indicate that it is due to very different causes, and that rapid movements in the mash are by no means the sole cause.

B. Fricker has patented a mode of utilising the water from the manufacture of starch from potatoes for the preparation of yeast. The liquid, however, contains large quantities of bacteria, and is, therefore, not suitable for the preparation, especially by the patented process, which does not include any preliminary destruction of the organisms. *Mohr* (*ibid*, 29) states that rye manured with Chili saltpetre yields less yeast than rye not receiving that manure, and so confirms some previous results by others.

Recent experiments by *Foth* (Wochens. f. Brauerei, 1887, 73) show that sluggish fermentation in closed vessels is rather due to the interfering action of carbonic anhydride and not to lack of movement as has been previously suggested. *Hayduck* (Zeits. f. Spiritusind. 1887, 25) has observed that 0·04 to 0·05 per cent. of sulphuric acid or 0·15 of lactic acid prevent the development of the lactic ferment in mashes, but do not destroy the fermentative power. 1·5 per cent. lactic acid stops lactic fermentation altogether. This is important, as hitherto sulphuric acid has been employed for the purpose, and yeast is injured by a very small quantity of sulphuric acid, but can withstand quite a considerable amount of lactic acid. Moreover, the latter is better adapted for rendering the albuminoid matter of the mash accessible to the yeast. The lactic ferment can withstand much more sulphuric or lactic acid when it has not been exposed to a high temperature during the mashing process; in fact, by heating the mash for half an hour at 60°, 0·05 per cent. sulphuric acid or 0·2 per cent. lactic acid is sufficient to completely suppress lactic fermentation. Lactic fermentation at first produces increasing quantities of lactic acid until a maximum is reached, after about 14 hours, then a continuous falling off begins. Lactic fermentation is not interrupted by oxygen or by 2 per cent. of alcohol; 4 per cent. of alcohol, however, diminishes its activity, whilst 6 per cent. suppresses it completely. Other experiments show that mashing at 60° and fermenting at 50° result in the formation of volatile and non-volatile acids in the proportion of 100 : 3, fermenting the same mash at 38° the proportion becomes 100:31, the predominant acid being acetic. Whilst with mashes prepared without warming and fermented at 38°, the proportion is 100:80, the greater part of the volatile acid in this case being butyric. Lactic and sulphuric acids are even more destructive to butyric fermentation than they are to the lactic. Alcohol is very poisonous to butyric, but in certain quantities even promotes acetic fermentation. It seems that of all the organisms which are generally encountered in the fermentations in question, the lactic ferment and *sarcina* are the only ones which can withstand a temperature of 60°.

Fermentation of the residues only occurs when the mash has been rapidly distilled, and never sets in when the mash has been kept at the boiling point for some time.

The following results of an investigation into the feeding value of dried distillers' residual liquors appeared in the Landw. Mittheilungen d. Halleschen Zeit. 1887, 37. Sample 1 from rye and maize; 2, from rye alone;—

—	1.	2.
Water	8·58	9·93
Digestible albuminoids	16·61	15·65
Indigestible albuminoids	3·53	2·44
Non-albuminoid nitrogenous matter	1·24	4·47
Fat	5·55	4·94
Crude fibre	11·13	10·18
Ash	3·05	7·21
Non-nitrogenous extract	50·31	45·18
	100·00	100·00

It would hence seem that these residues would form a good nitrogenous food for milch kine and might be used to replace one-third or one-half the oat ration for horses. It has a characteristic bread-like odour and on account of its low percentage of water will probably keep well.—D. A. L.

The Physical Properties of Methyl Alcohol. Dittmar and Fawsitt. Trans. Roy. Soc. Edin. 1887, 509.

The research can be divided into the following stages:—

1st. The purification of ordinary wood spirit.

2nd. The conversion of the purified spirit into oxalate of methyl.

3rd. The regeneration of the alcohol by decomposing oxalate of methyl with water.

4th. The dehydration of the aqueous alcohol obtained.

5th. The determination of the physical properties of anhydrous methyl alcohol and the specific gravities of aqueous methyl alcohols.

As is well known, ordinary wood spirit is an impure substance containing a considerable percentage of foreign bodies, the chief of which is acetone, which the authors seem to have successfully got rid of by treating with a large excess of caustic soda. After this preliminary purification they converted the methyl alcohol into oxalate by Wöhler's method, which transformation is useful in that the less volatile constituents are got rid of. The oxalate after pressing was decomposed by boiling with water, the resulting alcohol dehydrated by successively treating it with baryta, lime, and anhydrous copper sulphate.

When the methyl alcohol was considered anhydrous its vapour tension and density were determined in an improved apparatus devised by the authors; also its specific gravity at several temperatures. It was found that the vapour tension determination served as the most critical test for its purity.

The last item on the programme was the determining of the specific gravity of the aqueous alcohols of different strengths at three temperatures. The boiling point of pure methyl alcohol as deduced from the tension curve is 64°·96 C. at 760 mm., confirming Kopp's number 64°·6—65°·2 C. Its specific gravity was found to be ·81015 at 0° C., and ·79589 at 15°·56 C., whilst Kopp's number at 0° C. is ·8142.

The part of the research which seems to be of the greatest practical value is the table for the specific gravities of methyl alcohol from 0—100 per cent. at 0° C. and 15·56° C., and the formulæ necessary for calculating the specific gravity at other temperatures.

This has been a want felt by manufacturers and chemists, as methyl alcohol and wood spirit are now largely manufactured and used for a variety of purposes in this and also in other countries, and hitherto there has not existed a table to which to refer strengths and base calculations. The table usually adopted in this country for wood spirit is made up for ordinary spirits of wine and found in Sykes' Hydrometer Tables, and which at 60° F. gives the highest strength as ·8154, corresponding to only 93 per cent. of methyl alcohol. It would assuredly be much preferable to adopt this table, and instead of saying a wood spirit was so many degrees over or under proof, to have it stated as of a certain percentage.

On comparing the specific gravity table for methyl alcohol with that for ethyl alcohol it will be noticed that for the same percentage the specific gravity is very nearly the same, for instance—

—	Ethyl Alcohol.	Methyt Alcohol.	Difference.
Per Cent. 1	·9981	·9973	—·0008
25	·9651	·9609	—·0042
50	·9183	·9186	+ ·0003
75	·8605	·8629	+ ·0024
100	·7946	·7959	+ ·0013

—B.

On the Fermentation of Galactose. B. Tollens and W. E. Stone. Ber. 21, 1572.

According to Pasteur, Podakowsky, v. Lippmann, Stone, and Tollens, galactose can be easily fermented with yeast; Kiliani, Koch, Herzfeld, Haydiroth, and Bourquelot obtained the opposite result.

Fifty grms. of galactose, which showed at ordinary temperature in 10 per cent. solution (a) D = 80°·2 was recrystallised four times, and finally 21 grms. of pure galactose (at 20°·5 C. (a) D = 80°·7) obtained. This was used for fermentation, and at the same time comparative tests with dextrose and cane sugar were made.

One portion of these sugars was fermented only with yeast, another portion with yeast in a nutritive solution. The former was yeast from lager beer, which was shaken with 3—4 times its amount of distilled water, and was then allowed to settle. The water was poured off and the residue used.

The solution to feed the yeast was prepared by boiling 5 grms. of this residue with 50 cc. of water, the liquid being afterwards filtered.

The experiments were made in flasks with india rubber corks, which were heated during day time in an air bath to 25°—29° C., during night time to 20 C°. After the fermentation was finished, that is, after 8—11 days, half of the contents of the flask was distilled, and the percentage of alcohol estimated by means of the specific gravity of the distillate.

In the first series of experiments four flasks were filled:—

(1.) Galactose, without any food for the yeast.
(2.) „ with food for the yeast.
(3.) Dextrose, without any food for the yeast.
(4.) „ with food for the yeast.

Each flask received 4 grms. of the sugar, 5 cc. of the yeast mixture, containing 0·2 grm. of the yeast prepared in the manner before described. In flasks No. 2 and 4, 10 cc. of the nutritive solution and 40 cc. of water were filled, whilst flasks Nos. 1 and 3 received only 50 cc. of water.

Fermentation of dextrose began after an hour, of galactose only the following day. Fermentation of Nos. 3 and 4 ceased after 3—4 days. Fermentation of Nos. 1 and 2 only after 6—7 days.

RESULTS.

—	Distillate Grms.	Specific Gravity.	Alcohol.	
			Grms.	Per Cent.
No. 1......	22·2621	0·9965	0·4452	11·13
No. 2.....	21·4222	0·9863	1·8059	45·15
No. 3.....	21·2861	0·9915	0·6641	16·60
No. 4.....	23·1686	0·9874	1·8234	45·59

The theoretical quantity which can be formed is 51·11 per cent.

In the second series of experiments 8 grms. of galactose, 10 cc. yeast mixture, 20 cc. of food for the yeast, and 8 cc. of water (No. 1) were used. This was compared with cane sugar with (No. 2) and without food (No. 3) for the yeast.

No. 1 ceased to ferment after 8 days, No. 2 after 4—5 days, No. 3, however, continued to ferment even after 11 days.

RESULTS.

—	Distillate grms	Specific Gravity.	Alcohol.	
			Grms.	Per Cent.
No. 1.....	48·6919	0·9874	3·715	46·44
No. 2......	48·9883	0·9867	3·988	49·85
No. 3......	49·3329	0·9938	1·741	21·76

Theoretical yield is 51·11 per cent. of alcohol.

The author contends that the experiments prove *that galactose can be easily fermented if food for the yeast be present.* Yeast is a plant, and cannot grow well and act well without sufficient food; this explains the difference in the experimental results.—A. L.

Improvements in the Manufacture of Spirit. Dingl. Polyt. J. 266, 593—604.

Gomolka and Bohm's (Zeits. f. Spiritusind. 1887, 16) forms of yeast cooling apparatus are discussed. The latter is automatic and is set to work by the water passing in; the former requires some external power. In E. Theisen's condensation apparatus the hot liquor or steam is run through pipes immersed in the cooling water which is kept in constant agitation, the resulting evaporation being sufficient for the condensation. It is not necessary to use more water than is required to replace that lost by evaporation.

E. Hesse (*ibid*, 45) recommends a flat arrangement of pipes for cooling in preference to pipes placed one above the other.

W. Windisch recommends the following method for detecting small quantities of lactic acid. The substance is carefully oxidised with dilute chromic acid (bichromate and sulphuric acid), and the distillate tested by means of Nessler's solution for aldehyde, which is a product of the oxidation of lactic acid. Alcohol, ammonia, and sugar must be eliminated before applying this test, by which one part lactic acid in 20,000 of water can be detected.

A. Ihl (Zeits. d. Alpinen. Oesterr. Apotheker-Vereins) has observed that the colour reactions of starches and gums with phenols are similar in hue but take place at different temperatures. For example, starch gives the following colours when heated with the phenols and sulphuric acid:—with α-naphthol dark red-violet; with thymol, cresol, guiacol, and pyrocatechol, vermilion; with resorcinol, orcinol, and phloroglucol, yellow-brown. The gums give the same reactions but at lower temperatures. But arabinose gives a cherry-red by heating with alcoholic phloroglucol and concentrated sulphuric acid.

Rominier (J. de l'Agricultnre) recommends the addition of *Saccharomyces ellipsoides* when making spirits from raspberries, strawberries, apples, pears, &c., and in the case of strawberries some sugar should be added as well. The ferment present in strawberries is capable of converting all the strawberry sugar into alcohol, whilst the raspberry yeast only attacks a part of the raspberry sugar.

Washing with calcium hydrogen sulphite is recommended to remove accumulations of bacteria on the walls and implements in fermentation and yeast rooms.

In connexion with the use of bismuth for the prevention of secondary fermentations in spirit-distilleries, although it is an efficient preventative, it is nevertheless expensive, and will probably render the residuary liquors unwholesome.

Gayon and *Dubourg* (Compt. Rend. 1886) show the alcohol producing saccharomyces are without action on dextrin and starch; but that some of the mucors, for example, *Mucor circinelloides*, convert them into sugar and ferment them, these ferments also convert cane sugar direct into alcohol without previous inversion. Other mould fungi, for example, *Eurotium oryzae*, convert starch into sugar and invert cane sugar, but do not ferment them. The mucors act more vigorously on dextrose than on starch.

C. Lintner (Deut. Brauer und Mälzerkalender, 1887) divides enzyme into four classes according to the bodies on which they act: carbohydrate, albuminoid, glucoside, and fat ferments.

J. Frankhausen (Zeits. f. Spiritus und Press Hefe Indust. 1887, 49) asserts that the softening and solution of the cell walls of barley grain are the result of the action of diastase and not of microbes.

G. Kliebham (*ibid*, 12) prepares iodo-aldehyde by the actions of iodine and iodic acid on aqueous aldehyde, by continued action of iodine, di-, tri-, and tetraiodised aldehyde may be obtained.

R. W. Bauer (Jour. f. Prakt. Chem. 1886, 46) has converted lichenin into dextrose by heating for four hours with dilute sulphuric acid.

Michaud (Neue Zeits. f. Rübenzucker Ind. 1886, 318) has prepared a new sugar, cyclamose, $C_{12}H_{22}O_{11}$, from the tubercles of *Cyclamen europæum*. It reduces Fehling's solution and is laevo-rotatory.—D. A. L.

Improvements in the Manufacture of Spirit. Dingl. Polyt. J. **267**, 521—527.

G. Czeczetka (Zeits. f. Spiritus Ind. **10**, 252) describes a mode of converting molasses into alcohol. The molasses is mixed with one-third its volume of water and acidified with sulphuric acid until 100 cc. neutralise 1 cc. of normal soda. It is now steamed under a pressure of two atmospheres, and discharged into a vessel so that the steam evolved escapes into the open air. These operations kill organisms, get rid of volatile fatty acids and nitric acid, and moreover raise the yield of alcohol, converting certain substances into sugar. This mash is mixed with an extract of malt-combs, its acidity is adjusted so that 100 cc. neutralise 6·5 cc. normal soda, and it is then fermented with good beer yeast. The temperature must not exceed 34° to 35° and as little acid as possible should be used. *F. Schütt* (*ibid*, 287 and 305) has made experiments on the respiration of malt. Light exerts no practical influence. The effect of temperature is seen below.

	°	°	°	°
Temperature of the malt	12·5	13·8	15·0	16·3
Carbonic anhydride produced...	72·2	78·3	84·5	92·5

	°	°	°
Temperature of the malt	17·5	18·8	20·0
Carbonic anhydride produced ..	100·0	105·8	109·5

The smallness of the increase in respiration between 18°·8 and 20°·0, which is the most favourable temperature for the germination, is due to the fact that respiration is at a maximum also. The influence of carbonic anhydride in the air on the respiration or malt is illustrated by the following results:—

Percentage of CO_2 in the air	Below 0·5	1·5	2	2·5
CO_2 evolved from the malt	100	98	91·7	83·4
Percentage of CO_2 in the air	3	4	5	10
CO_2 evolved from the malt	75·1	65·0	58·2	57·5

Hence accumulation of carbonic anhydride on the floors, if at any time amounting to 3 or 4 per cent., would act injuriously on the malt. Other experiments lead the author to conclude that in the living plant chemical changes take place even in the absence of oxygen, by which carbonic anhydride is given off and starch is decomposed. In nine days on the malting floors 100 kilos. of dry malting grain yielded 10·9 kilos. of carbonic anhydride, and 3·7 kilos. of water, 6·7 kilos. of starch being decomposed. The highest point was attained in six days, and from then until the ninth day the loss of starch continued high; therefore the malt should not be left on the floors longer than is necessary. 100 kilos. of barley, containing 86 per cent. of dry matter, was found to lose—

	Kilo.
By floating grain, &c. in washing	1·3
„ respiration	5·7
„ other gaseous emanations and germination	3·5
	10·5

thus yielding 75·5 kilos. of malted dry matter. During the nine days' malting 12·9 kilos. of water were evaporated.

Heinzelmann (*ibid*, 132), from experimental observations, concludes, that with mashes of about 28° Ball, the temperature during preparation should be carried to 22°·5, and that during the principal fermentation 27°·5 to 29° should be maintained.

Foth (*ibid*, 95) has considered the still open question as to how far thick mashes ought to be fermented. He publishes the following table for the determination of apparent fermentative degree (or the saccharometer readings of the fermented mash), and the amount of alcohol in mashes in which 78 per cent. of the extract has fermented in such a manner as to yield 60 litres per cent. of alcohol for each kilo. of fermented extract.

Saccharometer Reading of Sweet Mash.	Saccharometer Reading of Fermented Mash.	Per Cent. Alcohol in Fermented Mash.
15	0·825	7·45
16	0·925	7·98
17	1·025	8·51
18	1·125	9·05
19	1·225	9·59
20	1·300	10·13
21	1·375	10·69
22	1·450	11·24
23	1·550	11·80
24	1·650	12·37
25	1·750	12·94
26	1·850	13·52
27	1·950	14·09
28	2·075	14·68
29	2·175	15·26
30	2·300	15·86

Schrohe (*ibid*, 393) recommends the use of a large excess of yeast to prevent frothy fermentation, which he attributes to a high percentage of nitrogenous yeast, nutritive matter, as well as to the consistency of the mash.

Foth (Wochens. f. Brauerei, **4**, 305) points out that his remarks on the influence of carbonic anhydride on fermentation and yeast formation (this Journal, 1888, pp. 510, 515) had reference to the total effect produced by the yeast in aggregate and not by individual cells.

According to *Holderer* (W. f. Brauerei, **4**, 529) the movement of yeast cells during fermentation has a great influence on the whole course of the fermentation.

Thausing (Allgem. Zeits. f. Bierbrau. u. Malzfab. No. 32) has obtained the following results in comparative fermentation experiments:—

	Per Cent.
By adding malt meal	64·7
" " " previously boiled for half-hour	60·9
" " starch meal	52·3
Without any addition	52·3

from which he concludes that indifferent bodies do not assist fermentation. *Foth* (W. f. Brauerei, **4**, 661) criticises this conclusion,

O. Durst (Zeits. f. Spiritusind. **10**, 157) finds that rye, containing a high percentage of nitrogen, yields more and stronger yeast than rye poorer in nitrogen. He also notes that small grained rye is richer in nitrogen than the large grained.—D. A. L.

Recent Improvements in the Manufacture of Spirit. Dingl. Polyt. J. **268**, 178–186.

Bourquelot (Compt. Rend. **104**, 476) compared a diastase solution, which had been heated to 68° C., with that of a normal diastase solution by treating a starch solution with these and then testing with iodine or Fehling's solution. He found (1) that the reducing power of the starch solution treated with the normal diastase, was to that of the starch solution, treated with the heated diastase as 52·4 : 28·4; (2) that on using five times as much of the heated diastase the reducing power was not increased; (3) that an increase in the quantity of starch did not influence the reducing power; (4) that, on the other hand, it appears (as indicated by the iodine reaction) that the first stage in the decomposition of starch, *i.e.*, into achroo-dextrose, is equally rapid when the experiment is carried out with weakened diastase or half as much unweakened diastase. These experiments seem to show that either the quantity of diastase is not diminished by heat (but its properties are changed), or else that diastase consists of several soluble ferments which are destroyed one after another as the temperature rises.

Windisch finds (Zeits. f. Spiritusind. **10**, 157) that lactic acid occurs very widely distributed in nature, and that the presence of organisms is not necessary for its formation. The view that lactic fermentation is due to a specific ferment has already been disproved by Martmann's investigations. Lindner (*ibid*, 169) has similarly observed that *pediococcus* causes a considerable lactic fermentation in malt worts, and Hayduck has noticed the formation of lactic acid in the spontaneous fermentation of a malt wort in which no lactic ferments could be detected and which only contained *sarcina* in bundle form. Windisch believes the view, that lactic acid is always a product of fermentation, to be untenable and he is inclined to look upon it as a product of vegetation. Many seeds contain lactic acid, and he has also found it in potatoes, which may sometimes account for the fact that starch is occasionably slightly acid, as the acid could only be washed out of the starch granules with difficulty.

J. Schrohe (*ibid*, 171) finds that under certain circumstances fermentation is accelerated by the addition of solid bodies to a fermenting liquid.

Heinzelmann (*ibid*, 177) reports on Müller's wort purifying apparatus and on the composition of the potato lees removed from the wort by this means. About 6 per cent. of vat space is gained. The fermentation of the wort is more regular. It is worth noting that the cellular tissues in the lees seem to be saturated with water and to have wort adhering to their surface, so that less wort is lost with them than at first sight appears to be the case. Delbrück confirms this observation.

Schrohe (*ibid*, 337) points out that a certain amount of acid is necessary in yeast in order during fermentation to prevent products of decomposition being formed, which spoil the quality of the brandy; and the fact that the addition of residues (Schlämpe) to the wort improves the aroma of the brandy considerably, is no doubt due to the formation of ethers by the action of the acid in the residues on the alcohol and the fusel oils. The brandy is not only improved by this means but the yield is also greater.

In discussing the various methods which have been proposed for removing the fusel oil from raw spirit, F. Pampe (*ibid*, 95) concludes that it will be very difficult to find a purely chemical method, suitable for practical requirements.

G. Bodländer and *J. Traube* (*ibid*, 99) have estimated the fusel oil in a number of brandies by Francke's method, and have, as a rule, found less than 0·3 per cent., even in the cheaper sorts. They propose that 0·1 to 0·15 per cent. of fusel oil should be taken as the limit. They have also patented a method (Ger. Pat. No. 41,207, 1887) for the separation of mixtures of ethyl or methyl alcohol and water, from fusel oil and ethereal oils, by treating the mixture with an aqueous solution of certain salts, *e.g.*, potassium or sodium carbonate, zinc sulphate, &c. Two layers of liquid are thus obtained, the upper containing the admixtures, the lower the purified alcohol.

Salzer has found 1·5 grms. of vanillin per hectolitre in a spirits of wine sample, and believes that it had been added to hide the odour of fusel oil. Beckurts, Schmidt, and Trommsdorff, on the other hand, point out that the conclusion is, perhaps, a little rash, as it is possible that vanillin may be a product of fermentation. Reinke, too, has observed a vanilla-like odour in fine spirits, but believes that vanillin is formed under the joint action of the spirit and air, when the spirit is stored in casks made of certain kinds of wood.

Claudon and *Morin* (Compt. Rend. **104**, 1109 and 1187) have obtained the following analytical results with a sugar wort consisting of 60 kilos. of sugar in 100 lit. of water fermented at 18°—20° C. with 2 kilos. of yeast, to which a pure culture of elliptical yeast was added. The elliptical yeast was obtained from the sediment of an 1885 wine from Rouillac. 100 kilos. of sugar gave: Aldehyde. trace; ethyl alcohol, 50,612 grms.; normal propyl alcohol, 2 grms.; isobutyl alcohol, 1·5 grm.; amyl alcohol, 51 grms.; oenanthyl ether, 2 grms.; isobutylene glycol, 158 grms.; glycerol, 2,120 grms.; acetic acid, 205·3 grms.; succinic acid, 452 grms. The fermented liquor had a wine-like odour, differing from that of a similar wort fermented with beer yeast only. The bases, usually present in fusel oil, were wanting. A point of special interest is the absence of normal butyl alcohol and butyric acid, a result differing from that obtained by Ordonnean, who has found both present, and looks upon them as products of the fermentative activity of the elliptical yeast.

The same authors (Zeits. f Spiritusind. **10**, 179) and Ordonnean found a considerable quantity of normal butyl alcohol in the distillate from a cognac. They believe that the occurrence of normal butyl alcohol and of butyric acid in this case was due to a secondary fermentation occurring in the wine previous to the distillation of the cognac from it. This view seems to find confirmation in some experiments they carried out, which show that bacillus butyricus is able to convert glycerol and sugar principally into butyl alcohol and butyric acid, even in presence of 8—10 per cent. of ethyl alcohol.

Laborde and *Magnan* (Zeits. f. Spiritusind. **10**, 376) have examined the poisonous properties of the higher alcohols and of the artificial bouquets, which latter are frequently used to produce a bouquet in wine or liqueurs. Most of them have an injurious effect, the action of purpurol (which causes epileptic cramp) being especially marked. They are inclined to ascribe the evil effects of alcoholism to these substances. This conclusion is opposed to that which Hamberg draws from his own experiments.

Gruber (Centralbl. f. Bacteriologie. **1**, 367) finds that clostridium butyricum (*bacillus amylobacter*) includes three forms, two of which are *anaërobic*. All three forms are able to convert carbohydrates into butyric acid and butyl alcohol.

Lindner (Zeits. f. Spiritusind. **10**, 305) gives instructions for preparing coloured yeast preparations.

Attempts have been made to utilise the carbonic acid, evolved during fermentation, in the preparation of sodium bicarbonate from soda. Closed fermenting vessels are of course used, from which the carbon dioxide can be conducted.

Cuisinier (*ibid*, 223) considers that the presence of carbon dioxide does not prevent acetic fermentation, but retards the formation of butyric acid.

In connexion with this subject, Windisch recalls Basswitz' experiments (Zeits. f. Spiritusind. 1878, 199), on the effect of carbon dioxide on diastase, which led to the following result:—(1.) The saccharifying action of diastase is accelerated by its presence. (2.) When it is present, the quantity of sugar formed is greater than in its absence. (3.) In both cases a maximum of sugar formation takes place after ½—4 hours, even in presence of an excess of starch.

Boudonneau and *Foret* (Compt. Rend. **105**, No. 15) find that the direct saccharification of starch in vegetable tissues can be performed without crushing the latter, by treating them at 90°—100° C. with a 1—2 per cent. acid solution. All the saccharine matter can be completely extracted by this method. They have constructed an apparatus for this purpose, and with it 5,000 kilos. of starch-bearing vegetable tissues can be treated at one time.

Hayduck (Zeits. f. Spiritusind. **10**, 351) calls attention to the fact that commercial litmus paper should be selected with care, as samples are met with which are strongly alkaline. Serious errors in work may thus be caused.

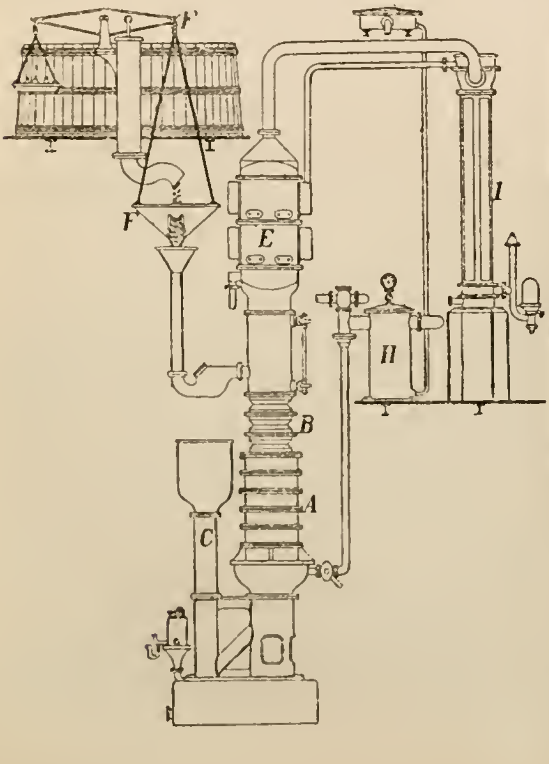
Fokke (Brewer's Guardian, **436**, 193) has observed that the tissues from a freshly killed animal placed in contact with a sterilised fluid are able to convert sugar into acid and starch into sugar in the absence of microbes. He ascribes this action to an animal ferment in the tissue similar to that occurring in the micro-organism.—F. W. T. K.

Recent Improvements in the Manufacture of Spirit. Dingl. Polyt. J. **268**, 270—274.

Péchmann points out that the efficiency of a Pauksch's tube refrigerator can be increased by adding one or more tiers.

Robert Ilges, Bayenthal (Ger. Pat. No. 38,235, Feb. 24, 1886), has carried out some improvements in his wort-distillation column by which a more intimate association of the wort and steam is brought about.

He also describes the following new distilling apparatus:—



By means of the wort regulator F a constant and regular supply of wort is run into the distillation column A B. C is a regulator which allows a corresponding quantity of residue free from alcohol to run off. This it does with great accuracy. The steam regulator H allows a suitable quantity of steam to enter, so that it is possible, with the assistance of a corresponding quantity of cold water passing through the cooler I and the dephlegmator E, to produce a spirit of a certain strength. The apparatus is perfectly automatic, and it is claimed that its use not only ensures a saving in expense but also great regularity in working. An apparatus of this kind has been working uninterruptedly for eight months; it works off 2,400 litres of wort per hour, the spirit drawn off averages 94·5 per cent., and the residue is perfectly free from alcohol. Ilges has patented the above wort regulator (Ger. Pat. No. 38,575, Feb. 24, 1886).

Experiments on the efficiency of *Retter's* mashing and cooling apparatus have given satisfactory results. With larger forms of the apparatus, however, its special advantages do not come into play so fully.

J. Scheibener has given preliminary notice for taking out a patent for a combined wort distilling and rectifying apparatus, the novelty in which consists chiefly in the attachment of a rectifying bulb to the wort still. Heinzelmann has tested O. Heinicke's automatic continuous filtering apparatus for filtering wort and yeast samples (Ger. Pat. No. 38,531). The apparatus mainly consists of a gauze cylinder into which the wort filters continually under the hydrostatic pressure. It is very convenient for examining the progress in the fermentation; the readings, however, are not perfectly satisfactory, as differences of more than 0·5° B. may occur.

Neuhaus reports that the small Siemens and Halske spirit measuring clock for determining the daily yield works satisfactorily.

In another communication it is stated that the clock only measures correctly to within 2 per cent. when at least 1⅓ litres flow through the apparatus per minute.

Gosslich has received several communications on the internal coating of iron spirit reservoirs with cement to the effect that, on drying, the cement can be easily removed with the finger. This he ascribes to careless workmanship. Only the best cement should be used and it should be tested in the following manner. It should be mixed with water to a stiff paste, poured out on clean glass, allowed to set in the air and then immersed in water for eight days. It should then be examined to see whether it shows any cracks at the edges or has got loosened from the glass. If this be found to be the case the cement is no good. This test should also give some idea as to the length of time the cement requires to set. Cement which takes 5—6 hours to set attains a far higher degree of hardness than one which sets quickly. Before applying the cement, the surface of the reservoir should be thoroughly cleaned, any oil spots, especially at the joints, should be removed with soda and soap, and the whole reservoir should be washed out with water. The cement is worked up into a thin paste with water, and is then applied, not too thickly, with a brush. It is prevented from drying too quickly by closing the manhole. After 24 hours a second coating of a rather stiffer paste is applied. The cement permanently closes any small cracks.

—F. W. T. K.

Improvements in Brewing. C. J. Lintner. Dingl. Polyt. J. **267**, 75—81.

Heating worts by means of hot pipes in the vessels is better than applying heat to one part of the exterior of the brewing vessel. *H. Hackmann* has patented a barrel for clearing. It is fitted with a perforated false bottom, which is let down into the barrel when the liquor has commenced to clear, and carries down with it any particles of grains, &c.

P. Lindner (Wochens. f. Brauerei, 1887, 733), to test the air in breweries for micro-organisms, exposes sterilised tubes in different parts of the room for 1½ hour, allows them to develop in sterilised wort, and examines them both macro- and microscopically.

Foth (*ibid*, 74 and 305) maintains that carbonic anhydride is harmful both to the growth and fermentative activity of yeast; whilst Hansen finds that the fermentative activity is not only not injured, but even becomes more energetic in the presence of carbonic anhydride.

E. C. Hansen refers to advantages in the use of pure yeast, and points out that the taste of beer is influenced by the kind of yeast employed. Different breweries thus require different kinds of yeast, and brewers should see that they get the yeast they require. Hansen also describes a method and apparatus for the production of pure yeast. The utensils are sterilised by means of superheated steam, sterilised air only is admitted, and the wort is run in boiling hot.

P. Lindner (*ibid*, 657) has found ascopores and different micro-organisms between the pipes of a cooling apparatus. The same author (*ibid*, 437) proposes the name "*pediococcus acidi lactici*" for the new lactic ferment found in malt mashes. This organism developes with most vigour at 46°, falls off at 50° in fermentative power, and at 62 in vitality as well.

Delbrück (*ibid*, 411) writes on the influence of carbonic anhydride on the keeping power of beer.—D. A. L.

Purification of Methyl Alcohol. E. Huber. Amer. Journ. Pharm. 1888, 129.

As the text-book methods of purifying commercial methyl alcohol proved too expensive, the author used quicklime in place of caustic potash. Commercial methyl alcohol (B.P. 68° C., sp. gr. 0·826) is first treated with oxalic acid to form methyl oxalate, and then with dry potassium carbonate and quicklime in small pieces, in a vessel connected with a condenser. The reaction commences spontaneously in a few minutes, or it may be promoted by gentle heating. The distillation ceases after one-sixth of the original volume has come over. The distillate is odourless at first, but develops feebly the characteristic smell on exposure to the air. A second distillation over sodium carbonate and a crystal or two of potassium permanganate still further diminishes this unpleasant smell. The methyl alcohol thus obtained had a B.P. of 66° C. and sp. gr. 0·889.—G. H. B.

The Occurrence of Coniferyl Alcohol in Spirits of Wine. M. Karcz. Chem. Zeit. **12**, 629.

Bauer (Chem. Zeit. **12**, 151) has thought it probable that coniferyl alcohol and eugenol exist in spirits of wine. This view is here confirmed, sufficient coniferyl alcohol having been obtained to give the characteristic smell of vanillin on oxidation with potassium chromate and sulphuric acid, and eugenol (separated from the coniferyl alcohol with caustic potash) being distinguished by the odour of cloves and by the ferric chloride reaction.

It may therefore be allowed that conifery alcohol occurs in beet, either as such or formed from its glucoside, coniferine. In the latter case coniferine must be originally contained in beet.

Coniferine is converted, by the action of ferments, into coniferyl alcohol and grape sugar, and consequently the coniferine in beet would necessarily, in the process of manufacture, yield coniferyl alcohol, and some of this becoming reduced would give eugenol.

The question whether coniferyl alcohol during fermentation would yield vanillin still remains unanswered. Such a possibility would, however, seem to be in contradiction to the researches of Scheibler and Lippmann.

The author could find no trace of vanillin in the spirit examined.—T. L. B.

PATENT.

Improved Processes for Refining or Purifying Alcohol or Alcoholic Liquids, Fatty or Oily Matters, and Wax, and for Regenerating Materials employed in such Processes. W. R. Lake, London. From S. Roessler, Troppau, Austria. Eng. Pat. 3352, August 18, 1880 (second edition). 6*d*.

It is claimed that the objectionable colours and odours frequently possessed by commercial ethyl alcohol (whether in the form of a potable liquid or spirits of wine), and also those characteristic of animal fats, vegetable oils and waxes, and mineral oils, can be removed by allowing the two classes of substances to act upon each other.

This principle is utilised in the following ways:—

(1.) If the refining of an alcoholic liquid be the chief end in view, some fat, oil, or vegetable wax is added during or after its manufacture. The alcoholic liquid is then separated again by distillation or by mechanical methods. By this treatment it is freed from the substances giving it an objectionable taste and smell, and also from the various higher alcohols, collectively termed "fusel oil" which it may contain.

(2.) "Fusel oil" itself can be rendered colourless and of inoffensive odour by distillation, repeated if necessary, with a fat, oil, or wax, under a pressure equal to or greater than that of the atmosphere.

(3.) If the refining of a fat, oil, or wax be the principal aim it is heated by an open fire, or by steam at atmospheric or a higher pressure, and raw or refined "fusel oil," or the deposit remaining in stills, added.

Both the "fusel oil" and the fat, oil, or wax deposit their evil-smelling impurities, after the removal of which the fatty matter under treatment is separated from the bulk of the fusel oil, and refined by means of animal charcoal, with or without distillation and filtration in addition.

The charcoal used can be regenerated by dissolving out the fatty and colouring matters retained by it, with fusel oil. —B. B.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

PATENT.

New or Improved Method of Preventing the Decomposition of Organic Substances. W. P. Thompson, Manchester. For Chevalier Silvio Moro, Rome, Italy. Eng. Pat. 6478, May 1, 1888. 4*d*.

This method for preserving meat, fish, vegetables, &c., and for exsiccating hides prepared for tanning depends on the use of potassium or sodium silicate, in which the objects are dipped more or less gradually according to their size and nature. Objects to be exsiccated should be dried immediately after this treatment. It is advisable, though not necessary, to dry fat meat beforehand in an exsiccator. To remove the coating the bodies are washed in warm water.—F. W. T. K.

XIX.—PAPER, PASTEBOARD, Etc.

Papers of Ancient Manufacture and the Microscopical Examination of Paper. J. Wiesner. Dingl. Polyt. J. **267**, 137—141.

The author has examined some hundreds of specimens of paper of ancient manufacture and finds that they mostly consist of linen fibres occasionally mixed with hemp fibre, that cotton fibre is rarely met with and then in insignificant quantities only. The fibres are longer than in the papers of the present day, fragments of yarn are frequently found and sometimes pieces of tissue. In many of these papers pieces of the cuticle of the flax stalks were found adhering to the fibres, and occasionally particles of the woody substance from the stem of the plant. These appearances confirm the fact that these papers were made of linen rags, and as the oldest papers come from Egypt or the East it is certain that the manufacture of paper from linen rags is of Oriental origin.

The older papers are sized with starch. The use of animal size dates from the end of the 13th century, whilst resin came into use in the present century.

The author employs the microscope for the detection of the different fibres. Linen and cotton fibres are distinguished by their behaviour with dilute chromic acid mixed with sulphuric acid. After a few seconds treatment with this reagent, slight friction causes linen fibres to break up into little pieces which appear to be cut off obliquely, whilst cotton fibres under similar treatment break up into small splinters. Flax and hemp may be distinguished by the appearance of the pieces of external coverings of the stalks, or better still by the presence of the parenchym cells containing a reddish-brown substance capable of resisting the action of boiling potash and concentrated sulphuric acid for some time. These cells are found between the bast cells of hemp.

The various sizes are readily recognised, starch by iodine or iodine and hydrochloric acid, animal size by Millon's reagent, gums by means of orcinol solution, and resins by the violet colour produced with sulphuric acid in the presence of sugar, the sugar in the case of paper being furnished by the action of the acid on the cellulose. Fat and albumen must be absent in the last test.—D. A. L.

PATENT.

An Improved Manufacture of Gelatinised Cloth or Artificial Parchment. E. A. Sengel and L. F. Dobler, Paris. Eng. Pat. 9949. 6*d*.

The inventors prepare a material, which may be used for writing, printing, or painting upon, by coating cloth with a solution of gelatin containing bichromate of potash or other substance which will render the gelatin insoluble.

—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Recent Discoveries and Improvements in Pharmacy. A. C. Stark. Chemist and Druggist **32**, 651,

The author discusses the results of observations bearing on the employment in pharmaceutical practice during 1887, of various drugs, and refers to the tests in vogue for the examination of the preparations. Concerning cocaine impurities he observes that relatively large quantities of cocaine hydrochloride are now being produced in the form of brilliant white crystals, a great improvement on former and more impure preparations, but still leaving much to be desired, as, even when carefully prepared, the crystals are likely to contain more or less of an extremely irritating and poisonous impurity, probably a decomposition product of cocaine, and thought by some to be identical with hygrine. The salt may be purified by dissolving it in the smallest quantity of anhydrous alcohol, and adding 6 volumes of anhydrous ether which causes a separation of crystals of the pure salt.

As to quinine impurities, it has lately been shown that, besides cinchonidine, two new alkaloids, hydroquinine and hydrocinchonidine are to be found. The author considers 5 per cent. of impurity might reasonably be tolerated, having regard to the slight influence that amount would have on the therapeutic value.

Concerning substances of artificial origin which have been proposed as remedial agents, the author states that "Antithermin," "Betol," "Urethan," "Methylal," "Acetylamidophenol," "Aseptol," "Thalline," and "Kairine," as well as "Phenol-Mercury," &c. are now almost abandoned as medicines, whilst "Salol," "Antipyrine," and "Antifebrine" seem to be well established. Reference is made to the superior excellence of many American pharmaceutical preparations, and the direction for improvement in the English practice is indicated.—G. H. B.

Ipecacuanha Cultivation in India. Chemist and Druggist, **32**, 659.

After many unsuccessful attempts to acclimatise the ipecacuanha plant in various parts of India, it was found to thrive in the valleys of the Sikkim Himalaya. The cultivation has also been successful at Singapore and Johore, in the Straits Settlements, and the fact that about one cwt. of the drug from these places has been recently sold in the London market gives promise of further supplies and of possible future competition with the South American production.—G. H. B.

Terpinol. G. Bouchardat and R. Voiry. Compt. Rend. **106**, 1359--1361.

In this note the authors record the result of an examination of the so-called terpinol obtained by the action of alcoholic potash on the hydrochloride of terpilene, $C_{10}H_{16}$, 2 HCl. The action of the potash is continued for 24 hours at 100°, the liquid then washed with water and distilled under reduced pressure. The distillate comes over in two portions. The first, 175°—180°, is an inactive terpilene, $C_{10}H_{16}$, density, 0·859 to ·863 at 0°. Its composition, odour, boiling point, and density are the same as those of citrene; with dry HCl at 0° it gives $C_{10}H_{16}$ 2 HCl, melting at 47°. The other product which comes over, 215°—220°, is much more fluid than terpol, its density is only 0·924, and it does not crystallise at a low temperature even in presence of a crystal of terpol. Its composition is $C_{10}H_{16}(C_2H_6O)$, *i.e.*, an ethylic ether of terpol, since on treatment with hydrochloric acid at 100° it yields ethyl chloride and $C_{10}H_{16}$.2 HCl, which crystallises as soon as the ethyl chloride is removed, $C_{10}H_{16}(C_2H_6O) + 3\ HCl = C_2H_5Cl + C_{10}H_{16}\ 2\ HCl + H_2O$.

—J. M. H. M.

Hydrate of Methyl Chloride. de Forcrand and Villard. Compt. Rend. **106**, 1357—1359.

The author has measured the vapour tension of this compound at temperatures varying from 0° to 22° C., and gives the results in a table. The tension is equal to that of the air (760 mm.) at 7·3°, and 3,134 mm. above this at 22° C.

—J. M. H. M.

Essential Oil of Eucalyptus Globulus. R. Voiry. Compt. Rend. **106**, 1419—1421.

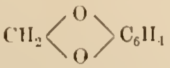
The author has isolated a new substance from oil of eucalyptus, and gives a process for the preparation of pure eucalyptol. The oil is submitted to fractional distillation, and the portion boiling from 170°—175°, cooled in a mixture of ice and salt, when the eucalyptol crystallises out. By repeated crystallisation it is obtained pure, melting at 1°, crystallising at 0°, and having a density at that temperature of 0·940. Its formula is $C_{10}H_{18}O$; it is without action on polarised light; treated with dry hydrochloric acid at a low temperature it yields 2 $C_{10}H_{18}O$. HCl. By distilling oil of eucalyptus at the reduced pressure of 0·4 metre of mercury, a terpilenol is obtained, boiling at 130°—135°, having the formula $C_{10}H_{18}O$ and yielding with hydrochloric acid the compound $(C_{10}H_{16})$ 2 HCl. The author has also detected and isolated acetic and formic acids, butyric and valerianic aldehydes, ethers of the terpilenol with these acids, polymers of $C_{10}H_{16}$, resinous products and a sulphur compound existing in small quantity, and easily decomposed by the heat employed.—J. M. H. M.

Researches on Perseït. Maquenne. Compt. Rend. **106**, 1235.

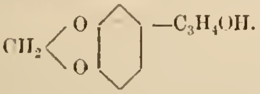
The author confirms the formula $C_6H_{14}O_6$, already given by Muntz and Marcano for perseït isolated from the fruits and leaves. He describes the preparation and properties of the hexacetic ether, $C_6H_8O_6(C_2H_3O)_6$, the hexabutyric ether, $C_6H_8O_6(C_4H_7O)_6$, and the nitro derivative, $C_6H_8O_6(NO_2)_6$. All these compounds yield perseït again on saponification. Perseït is thus a hexahydric alcohol and an isomeride of mannite and dulcite.—G. H. B.

Cubebin. C. Pomeranz. Monatsh. Chem. **9**, 323.

Cubebin gives on oxidation with alkaline permanganate piperonylic acid, and may therefore be regarded as a compound derived from—



in which one atom of hydrogen in the benzene group is replaced by C_3H_5O. By the action of benzoyl chloride on cubebin, an atom of hydrogen in the C_3H_5O group is replaced by benzoyl, and the oxygen is therefore present in this group as hydroxyl, from which benzoic acid may be regenerated by saponification. The graphic formula for cubebin may be represented as follows :—



—J. B. C.

Tannin. C. Böttinger. Ann. **246**, 127.

The author noticed on heating commercial tannin and concentrated hydrochloric acid in a sealed tube to 150°, that a gas was evolved which tinged the flame green. By heating in a sealed tube with water and excess of bromine small quantities were obtained of a product which could be distilled with steam, and which gave true tannic acids. The tannin would thus seem to contain, as impurity, some substance similar to itself. On fusion with caustic potash and a little water, and on boiling with dilute potash, out of contact with air, only gallic acid was obtained. A dilute solution of tannin on standing yields gallic acid, which allied substances do not.

A tannin solution allowed to stand loosely covered in summer gave the following results on titration with a gelatin solution. When freshly made, 1 cc. tannin solution required 1 cc. gelatin solution ; after 16 days, 50 cc. required 5 cc. ; after 20 days more, only 2 cc. A similar solution treated in the same way in winter gave unvarying results during the first six days, after which mould appeared and decomposition began. 20 cc. required, after eight days, 16 cc. of gelatin solution, after a further period of eight days, 8 cc., and after eight more days, 3 cc. only. There is consequently a connexion between the disappearance of tannin and the formation of mould, and further experiments showed that there is a simultaneous loss of solid matter.

An average of 85 per cent. of dry gallic acid was obtained.

A solution of commercial tannin boiled with Fischer's reagent (a mixture of phenylhydrazine, hydrochloride, and sodium acetate) is coloured deep yellow, and on standing, a brownish-yellow substance separates, due to an impurity in the tannin. This separation and colouration were shown not to be due to grape sugar, and according to Wehmer and Tollens tannin yields no silver levulate, so that the author considers that the impurity cannot be due to sugar. It must therefore be some tannin substance, which gives yellow products with phenylhydrazine, especially as this reagent has no action on pure gallic acid.—T. L. B.

Vernonine, the Active Principle of African Batjentjor (Vernonia nigritiana), a New Poison affecting the Heart. E. Heckel and F. Schlagdenhauffen. Compt. Rend. **106**, 1446—1449.

Batiatior or batjentjor (*Vernonia nigritiana*) is a plant found on the East Coast of Africa. Its root has a local reputation, and sells in the market of St. Louis (Senegal) as a febrifuge. In consequence of the emetic properties attributed by some to the root, the authors searched for emetine by Lafort's process, but without success ; the search for alkaloids was also fruitless. The active principle is a glucoside, obtained as a white, slightly hygroscopic powder, soluble in water and alcohol, but very slightly in ether and chloroform. The formula of this glucoside is $C_{10}H_{24}O_7$, and on boiling with hydrochloric acid it yields a resinous body having the formula $C_4H_{10}O_3$, according to the equation $C_{10}H_{24}O_7 + 2\,H_2O = C_4H_{10}O_3 + C_6H_{12}O_6$. Both the glucoside and the resin are coloured, first brown, then violet, by concentrated sulphuric acid. The physiological action of vernonine, as the authors call this glucoside, is similar to that of digitaline, but much less powerful ($\frac{1}{24}$ according to the authors' experiments on frogs and pigeons). 40 mgrms. completely arrest the action of a frog's heart in 45 minutes.—J. M. H. M.

Terpenes. O. Wallach. Ann. **245**, 241—278.

When amylene and amyl nitrite are mixed together in glacial acetic acid, well cooled, and concentrated nitric acid gradually added, a considerable quantity of a nitrosate (Ann. **241**, 290) is obtained. By replacing the nitric acid in the above reaction by concentrated hydrochloric or hydrobromic acid a nitrosochloride or nitrosobromide is produced.

Terpenes and other unsaturated compounds behave similarly to amylene, and the nitrosates, nitrosochlorides, and nitrosobromides briefly described below were prepared by this method.

Pinene nitrosochloride, $C_{10}H_{16}NOCl$ (already obtained by Tilden), is purified by dissolving in chloroform and reprecipitating with methyl alcohol.

Pinene nitrosobromide, $C_{10}H_{16}NOBr$, is purified in a similar manner ; it melts at 91°—92° with decomposition.

Pinene nitrosopiperidine, $C_{10}H_{16}NO \cdot NC_5H_{10}$, prepared by warming the nitrosochloride with an excess of pure piperidine, melts at 118°—119°. The sparingly soluble hydrochloride is precipitated when hydrochloric acid is passed into an ethereal solution of this base.

Limonene nitrosochloride, $C_{10}H_{16}NOCl$ (already obtained by Tilden), was prepared both from limonene and from oil of citron. It is dextro-rotatory, whilst carvoxime, which can be readily obtained from it by boiling with alcoholic potash, is levo-rotatory. The hydrochloride melts at 113°—114°.

Limonene nitrosobromide, $C_{10}H_{16}NOBr$, melts at 90°·5 with decomposition.

Limonene monohydrochloride, $C_{10}H_{17}Cl$, was obtained in an impure state ; it is dextro-rotatory, and has a specific gravity 0·98.

Limonene hydrochloride nitrosate, $C_{10}H_{17}Cl \cdot NO\,(ONO_2)$, is obtained by acting on limonene monohydrochloride with amyl nitrite and nitric acid. It is a white crystalline compound, which melts at 108°—109°.

Limonene hydrochloride nitrosochloride, $C_{10}H_{17}Cl \cdot NOCl$, is formed by acting on the hydrochloride with amyl nitrite and an acetic acid solution of hydrochloric acid. It is purified by dissolving in chloroform and reprecipitating with methyl alcohol. It melts at 109°.

Dipentene nitrosochloride, $C_{10}H_{16}NOCl$, is purified by the method just described. It melts at 101°, is optically inactive, and when warmed with alcoholic potash is quickly transformed into a compound which melts at 92°—93°, and is probably isomeric with carvoxime.

Dipentene nitrolpiperidine, $C_{10}H_{16}NO \cdot NC_5H_{10}$, is obtained by warming the preceding compound with concentrated alcoholic or aqueous piperidine. It is readily soluble in acids, and crystallises from alcohol in colourless needles melting at 153°—154°.

Dipentene nitrosate, $C_{10}H_{16}NO(ONO_2)$, crystallises in leaflets melting at 84° with decomposition. When warmed with piperidine it forms dipentene nitrolpiperidine, and when treated with alcoholic potash it yields the nitroso-compound (M.P. 93°).

Sylvestrene nitrosochloride, $C_{10}H_{16}NOCl$, melts at 106°—107°. It is very readily soluble in chloroform, and when warmed with piperidine it yields a nitrolamine.—F. S. K.

Narcotine. W. Roser. Ann. **245**, 311—326.

When 50 grms. of narcotine are dissolved in 80 per cent. alcohol, a little hydrochloric acid and 95 grms. of iodine added, and the whole boiled for 10 hours, a mixture of two superiodides, $C_{12}H_{12}NO_3I.I_2$ (compare Jörgensen Journ. für Prakt. Chem. [2] **2**, 433) and $C_{12}H_{11}INO_3I.I_2$ deposits on cooling. From 10 grms. of narcotine, 14·5 grms. of the superiodides are obtained. The product is boiled out with alcohol, placed in water, decomposed with sulphuretted hydrogen, and the precipitated sulphur filtered from the hot solution. On cooling, small yellow needles are precipitated, which partially re-dissolve on warming. The whole is quickly filtered and the process repeated, when the sparingly soluble iodotarconinemethyliodide is separated from the the tarconinemethyliodide.

Iodotarconinemethyliodide, $C_{11}H_8INO_3.CH_3I$, is almost insoluble in cold water and boiling alcohol. When treated with iodine solution it yields the superiodide, $C_{17}H_8INO_2.CH_3I.I_2$, which is sparingly soluble in alcohol and glacial acetic acid, and crystallises from these solvents in dark shining needles, melting at 171°.

Iodotarconinemethylchloride, $C_{11}H_8INO_3.CH_3Cl.H_2O$, is obtained by acting on an aqueous solution of the iodide with silver chloride. It is much more readily soluble in water than the iodide, and crystallises from alcohol in yellowish needles. The platino-, auro-, and mercurochlorides are crystalline compounds.

Iodotarconine, $C_{11}H_8INO_3$, H_2O, is obtained in yellowish red needles by heating iodotarconinemethylchloride gradually to 180°, and crystallising the residue from boiling water. The hydrochloride, $C_{11}H_8INO_3 . HCl . 2H_2O$, is readily soluble in water, and crystallises in yellow, shining, silk-like needles.

Tarconinemethyliodide, $C_{11}H_9NO_3$, CH_3I, crystallises from water or alcohol in clusters of long yellow needles, melting at 160°. The superiodide, $C_{11}H_9NO_3.CH_3I.I_2$, is formed when a solution containing free hydriodic acid stands in the air, or by direct combination of the iodide with iodine.

Tarconinemethylchloride is readily soluble in water and alcohol; it crystallises from the latter on addition of ether in fine yellowish needles.

Tarconine hydrochloride, $C_{11}H_9NO_3.HCl.1\frac{1}{2}H_2O$, is prepared by heating 1 grm. of tarconinemethylchloride with 7 grms. of concentrated hydrochloric acid for four hours at 140°—150°, and crystallising the product from hydrochloric acid.

Methyltarconinic acid, $C_{11}H_{11}NO_5$, is obtained by decomposing tarconinemethylchloride with silver oxide, and boiling the solution of the ammonium base. It is almost insoluble in water, alcohol, and ammonia, but dissolves readily in mineral acids and alkalis. The hydrochloride, neutral sulphate, and acid sulphate are crystalline compounds.

Bromtarconinemethylbromide, $C_{11}H_8BrNO_3,CH_3Br, H_2O$, is prepared by shaking an aqueous solution of tarconine methylchloride with bromine water. The yellow superbromide, $C_{11}H_8BrNO_3, CH_3Br, Br_2$, melting at 165°, which is first formed, is decomposed by boiling with alcohol or by treating with sulphuretted hydrogen.

Bromtarconinemethylchloride, $C_{11}H_8BrNO_3.CH_3Cl$, is obtained by digesting the preceding compound with silver chloride; it is very readily soluble in water, less readily in alcohol, and crystallises in fine needles. The platino-, auro-, and mercuro-chlorides are crystalline compounds.

Methylbromtarconinic acid separates in the form of the barium salt when an aqueous solution of bromtarconinemethylbromide is treated with silver oxide and then boiled with baryta. The free acid, melting at 233°, is obtained by warming the salt with acetic acid.—F. S. K.

Conversion of Hyoscyamine into Atropine. E. Schmidt. Ber. **21**, 1829.

A priority claim, the author having first published in the Pharm. Rundschau (1887) notes on the conversion of hyoscyamine into atropine. If the former be heated from five to six hours over its melting point, and the base converted into the gold double salt, it can be easily identified as a derivative of atropine. In the meantime, Schmidt has succeeded in separating the free base atropine from this double salt.—S. H.

Improvement in Saccharine. Chemist and Druggist, **32**, 642.

In order to provide a more soluble form of this substance, Mercier recommends the following process: 10 parts of pure saccharine are mixed with 5 parts distilled water, and to this from 4 to 4·5 parts of sodium bicarbonate are added in small portions at intervals of half an hour during 10 to 15 hours. 20 parts of alcohol are next added, which precipitates most of the sodium saccharinate, leaving the impurities in solution; the magma is drained on a vacuum filter and washed with alcohol and finally with ether. The residue is dried in the air, and is a white soluble crystalline powder, possessing all the properties of saccharine. Heat must not be employed, as the saccharine would then be liable to decomposition. Sodium bicarbonate is preferred to carbonate to insure the absence of caustic soda.

—G. H. B.

Acetanilide. Chemist and Druggist, **32**, 642.

Acetanilide is so apt to induce collapse when administered frequently and in large doses, that some French physicians have expressed the opinion that chemists should not be allowed to dispense it without prescription.—G. H. B.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Cheap Photographic Copies. Phot. Arch. **29**, 135.

Dissolve 1 part of ferric ammonium acetate, 1 part of potassium ferricyanide, 1 part of bichromate of potash, each in 6 parts of water, and mix equal volumes shortly before use. Wash the paper with this mixture and dry in the dark. Copy till the shadows become dark blue and then wash well and place for some minutes in carbonate of soda solution and again wash. Tone with tannin solution.

—T. L. B.

Colour Printing. Amateur Phot. **2**, 55.

To obtain copies in red, float good paper for 20 seconds on a bath containing 2 grms. uranium nitrate to 50 cc. water. Dry in the dark and expose under the negative (10 minutes in the sun, or 1—2 hours in the shade). Wash rapidly in warm water, immerse in a solution of potassium ferricyanide (1:50), and wash well. If the red print be dipped in a solution containing 2 grms. nitrate of cobalt to 100 water, and immediately dried, a green print is obtained. It may be fixed with dilute ferrous sulphate solution. If the red print be dipped in gold chloride solution (0·9 to 100 cc. water), a violet is obtained. For blue prints float the paper on potassium ferricyanide, copy, lay quickly in sublimate solution, wash out and place in a bath of warm oxalic acid.—T. L. B.

PATENTS.

An Improved Process for Manufacturing Isochromatic Emulsion Plates highly Sensitive to Light. H. W. Vogel, Berlin, Prussia. Eng. Pat. 15,532, November 29, 1886. (Reprint.) 6*d*.

By this improved process the inventor is able to make isochromatic plates which are *twice* as sensitive as ordinary gelatin plates, and do not require a yellow glass plate or screen to be placed before the lens, to diminish the power of the blue rays, during exposure, as is necessary in the case of other isochromatic plates. Gelatin emulsion or ordinary dry plates are sensitised by means of "eosides of silver" or of lead (salts of eosin dyes with silver or lead) or by a mixture of both silver and lead salts. Various methods for the preparation of sensitised emulsion and plates are detailed.

Other dyes which act as "optical sensitisers," but do not combine chemically with silver, are, however, rendered more sensitive by the presence of a soluble silver salt, and may thus be employed in the preparation of highly sensitised plates.—O. H.

A New or Improved Process for obtaining Positive Black line Copies from Positive Tracings or Negatives by the Action of Light. G. Bay, Suresnes, France. Eng. Pat. 12,168, September 8, 1887. *6d.*

A paper is prepared with a solution of gum arabic, tartaric acid (or similar organic acid), and perchloride of iron, and, after drying, exposed in a printing frame under an Indian-ink tracing or other suitable negative. The copy is developed in a saturated solution of prussiate of potash and then placed in a bath containing a vegetable colouring-matter until the lines of the copy are quite black, when the sheet is dipped in a "bath consisting of a salt of soda, ammonia, potash, &c. The degree of saturation of the bath is a matter of little importance, provided the salt is neutral and has an acid action with an alkaline reaction. The acid clears the ground whilst the alkaline matter destroys the blue produced by the salt of iron and the prussiate, and fixes the copy, by means of the precipitate with the colouring-matter, either in violet, brown, or black, according to the salt used and the duration of the bath. It is finally washed under a tap, with brush and plenty of water."

The copy may be developed in a single bath containing prussiate and colouring-matter, and afterwards washed "with a brush." The copy then appears black upon a yellowish ground, which is subsequently bleached by means of an alkaline salt.—O. H.

XXII.—EXPLOSIVES, MATCHES, Etc.

Notes on New Explosives. Chem. Ind. **11**, 241.

Favier's Explosive.—The Favier Company, in Belgium, have recently brought out a new explosive, which consists of a mixture of mononitronaphthalene and ammonium nitrate. The cartridges which are made with this explosive are made waterproof by dipping in molten paraffin. The composition of the cartridge core is as follows :—

	Per Cent.	Per Cent.
Mononitronaphthalene (not quite pure, melting point from 51° to 56° C.)	8·15	7·97
Ammonium nitrate	91·55	91·83
Insoluble in water and ether	0·14	0·20

Or if the covering of paraffin be included in the analysis, they test thus :—

	Per Cent.	Per Cent.
Mononitronaphthalene	7·77	6·86
Paraffin (melting point 56° C.)	4·04	4·41
Ammonium nitrate	88·01	88·09
Insoluble in water and ether	0·22	0·34

One molecule of nitronaphthalene requires, theoretically, 21½ molecules of ammonium nitrate in order to burn to carbonic acid, water, and nitrogen. But if both the 4·41 per cent. of paraffin and the 6·86 per cent. of nitronaphthalene are oxidised completely 144·62 per cent. of ammonium nitrate is required, whereas the amount of ammonium nitrate present (88 per cent.) is only sufficient to oxidise the carbon to carbonic oxide. Such an explosive is unsuitable for underground blasting. The new explosive is indifferent to concussion, and burns with difficulty. In order to cause it to explode, two grms. of fulminate are required, but as this priming is about six times as expensive as the priming of a dynamite cartridge, it is questionable whether Favier's explosive can ever hope to compete with dynamite. Favier failed in obtaining a patent in Germany, nor has he been more successful in finding capitalists in that country inclined to work his "invention."

Flameless Powder.—At the commencement of the present year "The Flameless Explosives Company, Limited," was started in London. The flameless powder is the invention of Hermann Schöneweg, of Dudweiler, near Saarbrücken, Germany. His invention consists in surrounding a blasting cartridge with a casing containing oxalic acid or oxalates, with the addition of oxygen-carriers, for the purpose of extinguishing the flame of the fuse and increasing the explosive power of the cartridge. It is mentioned in the prospectus of the company, that if an equal amount of the Schöneweg mixture (consisting of 75 per cent. of ammonium oxalate and 25 per cent. of potassium nitrate) be added to dynamite, blasting gelatine, or similar substances, no flame is produced on explosion, but this assertion has not been sufficiently tested. Besides, dynamite requires a far larger amount of potassium nitrate and ammonium oxalate than has been added in order to burn to carbonic acid, water, and nitrogen, and, in the absence of these oxidising agents, a large quantity of carbonic oxide, ammonia, and perhaps hydrocyanic acid would be given off. For this reason the author does not anticipate a great future for the flameless powder. Schöneweg did not succeed in having a patent granted to him in Germany. He has also conferred the working of his securite patent to the company mentioned. Securite consists of dinitrobenzol and ammonium nitrate. The Royal Mining Inspector, Margraf, testifies in the prospectus of the company to its being absolutely safe in the presence of marsh-gas and coal-dust, whereas the experiments of the Royal Saxon mining authorities gave the very opposite result.—S. H.

PATENTS.

Manufacture, Treatment, and Application to Various Purposes of Hyponitric Anhydride, &c. E. Turpin, Paris. Eng. Pat. 4544, October 18, 1881. *8d.* (Second Edition 1888.)

Hyponitric anhydride or nitrogen peroxide is prepared by strongly heating lead nitrate. It is condensed in enamelled cast-iron condensers, maintained at freezing point. Carbon bisulphide readily dissolves nitrogen peroxide and the operation of mixing is accompanied by a lowering of temperature of from 15° to 20° C. This mixture is called "panclastite." It presents the elementary composition of gunpowder, less one equivalent of oxygen and one of potash, thus :

$$\underbrace{N_2O_4 + CS_2}_{\text{Panclastite.}} : \underbrace{2\,KNO_3 + C + 2\,S}_{\text{Gunpowder.}}$$

Under certain conditions it explodes with an energy equal, if not superior to that of nitro-glycerin, but in order that the detonation may take place, it is necessary that it should receive a violent concussion in presence of fire. In free air its ignition produces a quiet and brilliant combustion. It does not explode by shock of any kind. For the purposes of detonation a priming of fulminate of mercury is employed, or better still, a charge of fine powder placed in the interior of the cartridge, which avoids the danger arising from the employment of fulminate. Fig. 1 represents a cartridge charged with panclastite and fulminate; Fig. 2 represents a cartridge charged with panclastite and fine powder as a priming. These cartridges are absolutely safe; they can be kept and stored for any length of time without risk of spontaneous explosions taking place. Fig. 3 shows the method of preparing planclastite. Two vessels A and B contain the two ingredients; two tubes conduct them into a graduated receiver D, whence the mixture can be directly used for charging shells. The maximum power is obtained by a mixture consisting of equal quantities of the two constituents. Panclastite can be made solid by being absorbed by inert porous substances. Its indifference to concussion renders it very suitable for charging hollow projectiles, torpedo mine chambers, and the like. Its effects under water are formidable. Its property of burning with a brillant flame is utilised for lighting, and Fig. 4 shows a small lighting apparatus. The mixture is poured into a receiver A above a bent capillary tube immersed in cold water, and passes under a steel tray B, in which the mixture is burnt. Fig. 5 represents an apparatus for projecting light provided with a spherical mirror M and a Fresnel lens L. The two liquids enter the fire-cup F separately by means of capillary tubes. The flame is accompanied with the development of heat, the temperature of which may be estimated at about 3,000° C. Iron and platinum are fused almost instantaneously, and even graphite becomes soft. To render the flame still more brilliant four parts of phosphorus are dissolved in one part of the carbon bisulphide used for mixing with nitrogen peroxide. As

Fig. 1.

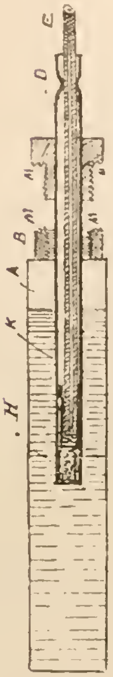


Fig. 2.

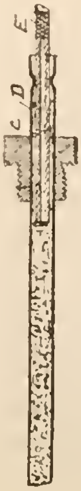


Fig. 3.

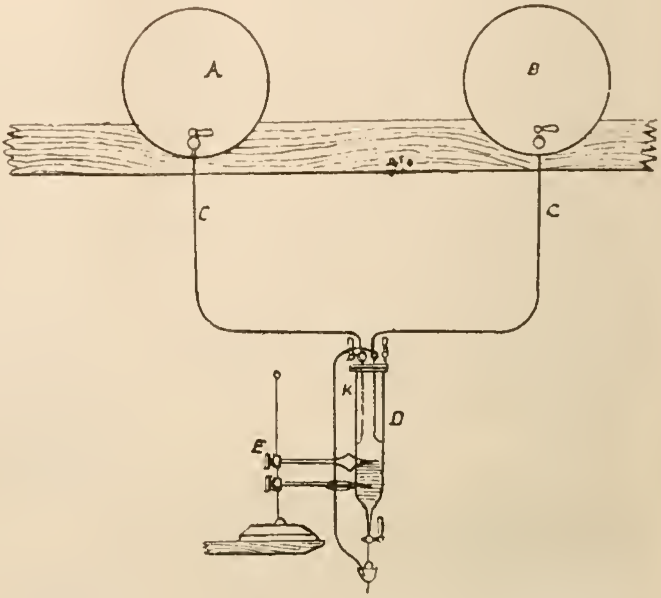


Fig. 4.

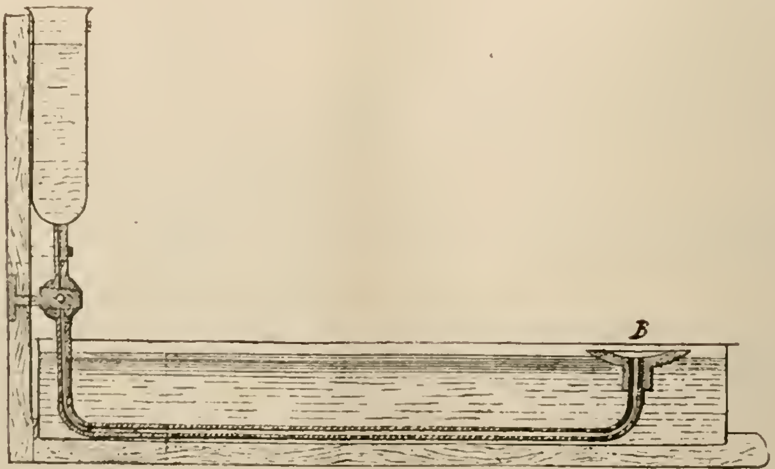
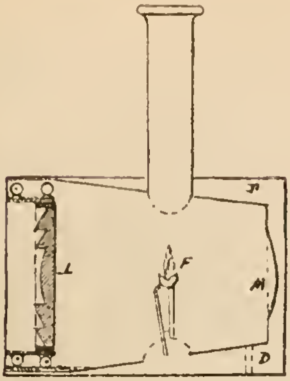


Fig. 5.



soon as these two liquids mix in the fire-cup a spontaneous ignition takes place. The oxidising power of the nitrogen peroxide may be applied in the manufacture of acetic acid from alcohol, &c. The facility with which nitrogen peroxide evaporates in a vacuum producing a cold of 10° to 12° C. may be utilised for the artificial production of ice and cold.—S. H.

An Improvement in the Manufacture of Charcoal for Explosives and other Purposes, and Apparatus for that Purpose. H. Güttler, Reichenstein, Germany. Eng. Pat. 8929, June 22, 1887. 11*d*.

In the apparatus described, the material is suitably contained in an air-tight cylinder which is fitted with a pressure gauge and pyrometer and heated by means of a muffle. The carbonisation takes place in a current of heated carbon dioxide, and the pressure of the same in the cylinder can be varied at will. The temperature is regulated by admitting cold air to the muffle and by varying the supply of heated gas to the cylinder. After the charring is complete, cold air is rapidly drawn through the muffle and cooled carbon dioxide passed through the charcoal, which rapidly cools and absorbs carbon dioxide in its pores. Charcoal treated in this manner is said to be proof against spontaneous ignition.—O. H.

Improvement in Explosive Compound. A. Kuhnt and R. Deissler, Berlin, Germany. Eng. Pat. 5949, April 21, 1888. 4*d*.

As a substitute for the inconvenient water cartridge at present in use in coal mines, the patentees propose nitroglycerin mixed with ammonium carbonate or chloride. "By the addition of this carbonate of ammonium (or chloride), the temperature of the explosion gases is so small that flashing of the gases is prevented."—O. H.

XXIII.—ANALYTICAL CHEMISTRY.

On the Passive State of Iron and Nickel. E Saint-Edme. Compt. Rend. **106**, 1079.

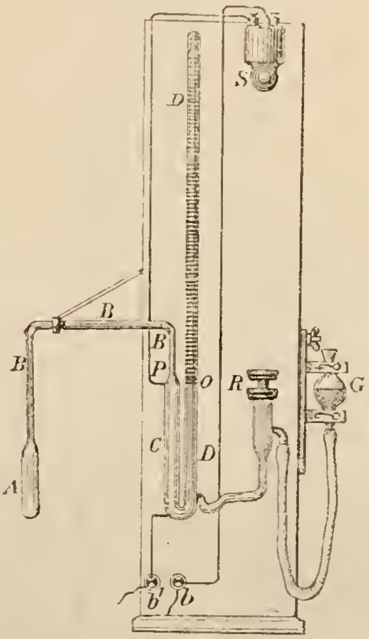
Commercial nickel becomes immediately passive in ordinary nitric acid as well as the fuming acid. Iron, as well as steel, which is attacked by ordinary nitric acid, becomes passive by contact with nickel. The author attributes the property of passivity in iron and nickel to the presence of nitrogen in these metals.—G. H. B.

Tables of Specific Gravity of Aqueous Solutions. G. T. Gerlach. Zeits. Anal. Chem. **27**, 271—358.

This paper contains tables of specific gravities of salts in aqueous solution compiled from the work of various observers. Each table is divided into several columns. The first contains the weight of substance in 100 parts of the solution; the second, the weight of substance in 100 parts of water; the third, the number of molecules for every 100 parts of water; the fourth, the relative volumes, 100 parts of the water in the solution being equal to 100 volumes; the fifth, the specific gravity of the solution, &c. These tables are not adapted for abstraction, and the original paper should be consulted.—J. B. C.

New Gas Thermometer. L. Cailletet. Compt. Rend. **106**, 1055.

The apparatus is designed to measure very low temperatures, for which reason hydrogen is taken for the expansion agent.



The glass vessel A of 25 cc. capacity contains the hydrogen, and is connected by a capillary tube B with a much wider tube C. The Torricellian manometer tube D is shown in connexion with the moveable reservoir G. To use the apparatus it is placed so that the bulb A is submitted to the temperature to be measured. and the position of G is altered until the mercury meniscus in C just touches the end of a platinum wire P corresponding with the zero point of the manometer scale. The moment of contact is indicated by an electric bell, and the flow of mercury is then stopped by means of the screw R. The height of the mercury column in D is then read off, and the required temperature ascertained by reference to a table of corresponding values. In order to eliminate errors of capillarity, C and D are of equal diameter. The end of the platinum wire P is as near as possible to the capillary B, so that the hydrogen remaining in the capillary and space outside of A is only 0·006 of the volume of the bulb A, for which the necessary correction is made. The apparatus is so sensitive that 1° corresponds to a difference of 2·36 mm. in the height of the mercury columns.—G. H. B.

An Apparatus for the Reduction of Gas Volumes to Normal Temperature and Pressure. G. Lunge. Chem. Zeit. **12**, 821.

Lunge (Chem. Ind. **8**, 163) and Winkler (Ber. **18**, 2523) have previously shown in what manner a nitrometer may be used for reducing gas volumes to normal pressure and temperature. The volume of gas to be reduced is compared with the volume taken up by 100 cc. of gas, which are permanently enclosed in a nitrometer at 0° C. and 760 mm. pressure. The quotient forms the factor, with which the gas volume to be reduced has to be divided. Multiplication has been found more convenient in practice, and by substituting for this factor its reciprocal figure, multiplication takes the place of division. The author advocates the engraving on the apparatus the reciprocal figures, and publishes a small table for the guidance of the manufacturer of such apparatus, for which he suggests the term of "Multiplication Reduction Apparatus."—S. H.

Purification of Mercury. B. Karsten. Zeits. f. Instrumentenkunde, 8, 135.

The following process for purifying mercury has been in use for years at the physical institute at Kiel. The metal containing chemical and mechanical impurities is poured into a glass tube A (Fig. 1), into the lower end of which is cemented a piece of bamboo cane. The mercury passes through this in minute streams, leaving behind the coarser dirt, and falls into the glass tube B, about 4 cm. wide and 120 cm. long, and almost entirely filled with dilute nitric acid (1 in 50). The lower part is contracted to a tube of 1 cm. diameter, which is filled with mercury. The metal flows out at D, and is sufficiently pure for some purposes, although somewhat oxidised, and the acid can be drawn off at C.

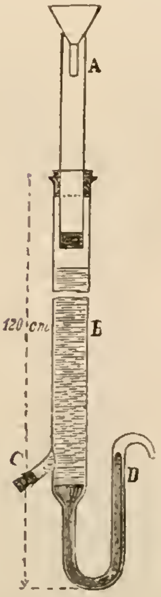


Fig. 1.

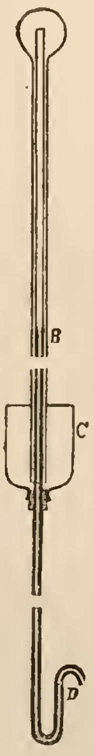
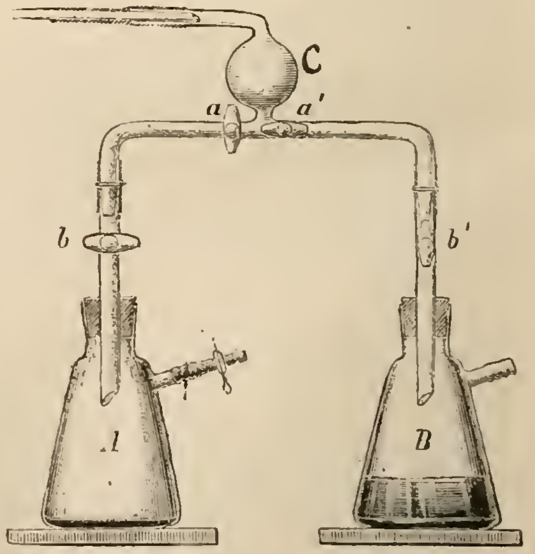


Fig. 2.

To prepare chemically pure mercury the distilling apparatus devised by L. Weber, and which is practically the same as Nebel's, is used (Fig. 2). It consists of a tube B, about 15 mm. wide and 80 cm. long, at the top of which is blown a bulb of about 6 cm. diameter. The open end of this tube is placed in an inverted bottle with the bottom knocked out. Through the cork in the neck of this bottle is passed a second tube about 1 cm. wide (external diameter) and 145 cm. long, and which passes through the other wider tube and up into the bulb at the top of it. This narrower tube is also contracted into a capillary one about 10 cm. from the top, and at the lower end is bent upwards as shown at D. To work the apparatus, either C is filled with mercury and D then connected with a water vacuum pump, or, more simply, the wide tube and bulb are filled with mercury and inverted, which produces the same effect. The vacuum in the bulb is, however, not then sufficiently perfect to begin the distillation, so a few pounds of mercury are poured gradually into the flask so that it overflows drop by drop into the narrow tube, and the apparatus then acts like a Sprengel pump, speedily producing a vacuum. The contents of the bulb are then heated by the flame from a circular burner, and distillation takes place continuously as long as may be required. The absolutely pure mercury flows out at D into a receiver. The height to which the mercury may be poured in C depends of course on the state of the barometer, and the supply of mercury may be effected by a second vessel connected with C by a syphon, &c. When the apparatus has once been set up it can be used for years, and can very readily be started and also stopped. Unless the atmospheric pressure varies greatly the apparatus can be left at work night and day, and only requires the addition of mercury two or three times in every 24 hours.
—E. E. B.

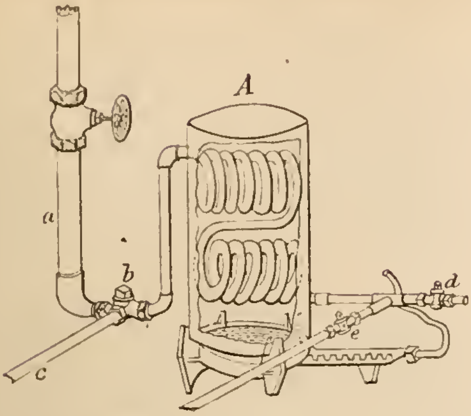
Receiver for Fractional Distillation in Vacuo. E. v. Boyen. Chem. Zeit. 12, 822.

The apparatus consists of a spherical receiver C, from which two branch tubes *a* and *a′* issue, which are in connexion with the flasks A and B. After exhausting the apparatus one flask is disconnected by shutting off the respective tap, while the other receives the distillate. Whenever the receiver is to be changed the position of the taps is reversed.—S. H.



A Laboratory Apparatus for Superheating Steam. J. Lewkowitsch. Chem. Zeit. 12, 822.

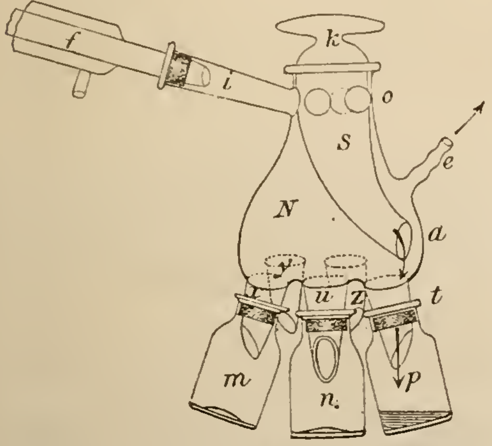
The superheater consists of half inch copper tubing wound to a double spiral. For avoiding loss of heat by radiation it is surrounded with a copper jacket well covered with asbestos. The whole is placed over a Fletcher burner. To start the apparatus the three-way tap *b* is turned so that the condensed water in the steam-pipe *a* escapes through *c*. The tap *d*, which passes the superheated steam on to its ultimate destination, is meanwhile closed, whereas *c* is open. As soon as the steam-pipe *a* delivers dry steam it is allowed to enter the apparatus and the burner is lit. The steam in



the mean time escapes through *e*. The latter is closed and *d* opened when the steam has reached the temperature required.—S. H.

An Adapter for use in Fractional Distillation in Vacuo.

P. Raikow. Chem. Zeit. **12**, 694.

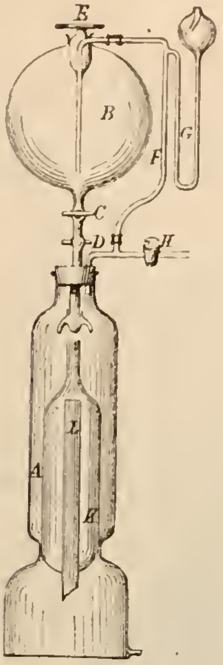


This apparatus is designed to facilitate a change of receiver without interruption of the vacuum maintained during the distillation. It consists of a vessel N, carrying a side tube *i* near its neck. The bottom of the vessel is blown with projecting mouths, to each of which a bottle can be fitted air-tight by means of a caoutchouc ring. The neck of the vessel has a well-ground stopper S, which reaches nearly to the bottom, and is bent in such a form that on being turned it passes directly over the mouths at the bottom. This stopper is hollow, and is bored with holes which coincide with the opening of the side tube *i*, when the end of the stopper is just above the corresponding mouth at the bottom of the vessel N. The distillation condenser tube is connected with the side tube *i*, whilst *l* communicates with the vacuum apparatus. The various fractions of distillate are collected in the several receivers by turning the stopper S at the desired periods. The adapter is useful for conducting fractional distillation in various gases, and where the smell of the substance may be objectionable. It may be obtained from Alt, Eberhard, and Jäger, Ilmenau, Thüringen.—G. H. B.

On Constant Gas Supply, and the Apparatus necessary therefor.

Pollak and Wilde (conclusion). Chem. Zeit. **12**, 755—757. (For previous paper, *see* Chem. Zeit. 1888, 695.)

(1.) *Evolution of Hydrogen.*—The apparatus used is that shown in the cut. About one and a half kilos. of sheet zinc in pieces about 1 sq. cm. in area are placed in the annular space A, and hydrochloric or sulphuric acid of about five times normal strength, containing 10 cc. Cobalt chloride sol. per litre is allowed to flow on to it from the globular funnel B, by turning the cocks C and D and the stopper E, so as to permit the transference of the expelled gas from the lower vessel to the upper by means of the tube F (after the manner of a percolator).



The tube of the stopper E being prolonged nearly to the bottom of the funnel, serves to maintain a constant head, acting on the principle of a Marriotte's bottle, which, indeed, may be substituted for it when the apparatus is to be used continuously for a long period.

The U tube G, filled with mercury, is designed to allow the escape of any small quantity of gas evolved after cutting off the supply of acid if the cock on the exit tube H should happen to be closed.

The solution of zinc salt, as it forms, passes through the holes in the inner tube K, and rises gradually to a level with the upper end of the tube L, down which it flows into the base of the apparatus. By this means the partly-exhausted acid is kept in contact with the zinc until it is almost completely saturated, while at the same time the evolution of gas does not slacken, because of the continual dripping of fresh acid from the funnel.

The function of the adjunct marked M is merely to distribute the acid on each side of the inner tube. The object of the two stopcocks (C and D) is to allow of one of them being left in the position that has been found to give the right flow of acid for any particular work, while the other can be closed when it is desired to stop the evolution of gas for a time.

With this apparatus a very nearly constant pressure of gas is maintained, the maximum variation of a series of 11 experiments being equal to a column of water 2·5 cm. in height.

(2.) *Evolution of Oxygen.*—All that is necessary is a thin copper flask to contain the oxygen mixture (potassium chlorate with ·1 per cent. of ferric oxide), a burner with a gauze cap to prevent it catching back, and an arrangement like an ordinary thermostat (attached to the delivery tube), which is set at the desired pressure, so that on its being exceeded, the gas supply is diminished, returning to its original magnitude on the pressure falling again.—B. B.

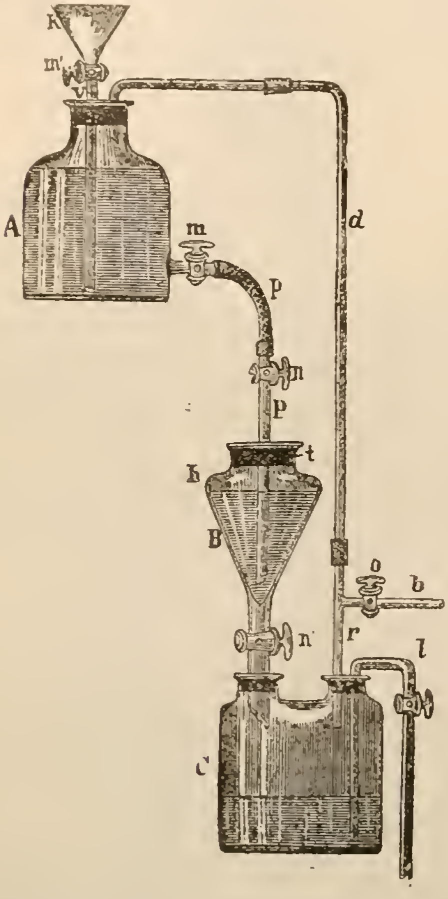
A Method for the Prevention of Bumping during Distillation. Zeits. Anal. Chem. 27, 385—386.

A. Reissmann recommends spirals of platinum wire filled with bits of pumice. *Dannenberg* uses asbestos. *Markownikow* employs capillary tubes about 1 cm. long when distilling under reduced pressure. To prevent frothing in ammonia determinations with magnesia, *Kunz* adds solid paraffin so as to barely cover the surface of the liquid.

—J. B. C.

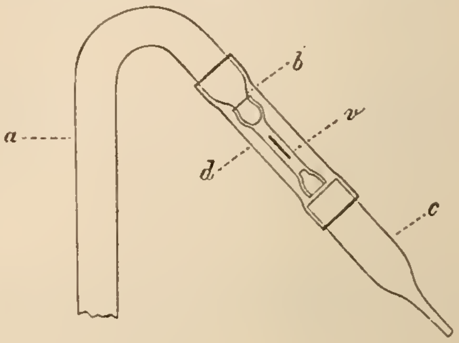
An Apparatus for Filtering and Washing Precipitates in Vacuo or in any Specific Atmosphere. P. Raikow. Chem Zeit. 40, 661.

The apparatus consists of a flask A, which is fitted with a double-bored india-rubber stopper V. Near the bottom there is a side tube *m*, which is connected with the tube *p* by means of the tubing *p′*. The tube *p* passes into the funnel B, and this is closed at the top by the stopper *t*. The funnel is fitted into one neck of a Woulff's bottle, the second neck being furnished with a double-bored stopper, through which pass the tubes *r* and *l*. The tube *r* has a side tube *b*, and is connected, as shown in the figure, with the flask A. The tube *l* passes nearly to the bottom of the bottle, and serves the purpose of emptying it. The working of the apparatus is as follows:—A filter paper having been fitted in the funnel B, the stopper *t* is replaced, and the cocks *m′* and *o* opened. The liquid to be filtered is next run into the flask A, and *m′* closed. The cocks *n* and *n′* are opened, and the air pumped out from the whole apparatus, and thus by connecting *b* with a gas generating apparatus, the whole may be filled with any gas on which it is proposed to experiment. The stop-cock *b* is now closed and *m* opened. The liquid can then pass from the vessel A into the funnel B, and the filtration commences. As soon as the liquid has reached a certain height in the funnel, the flow from the vessel A is stopped in consequence of the compressed air in the funnel between the surface of the liquid and the cork. A glance at the figure will suffice to show that by raising or lowering the tube *p* the quantity of liquid flowing into the funnel can be regulated.



If it is required to wash a precipitate, it is placed in the funnel B, and the wash solution in the flask A, and the process conducted in the manner previously described. In working in vacuo the flow of liquid into the funnel B must be regulated by the stop-cocks *m* or *n*.—G. D.

Improvement in Wash bottles. J. Sobieczky and V. Hölbling. Zeits. Anal. Chem. 27, 365—366.



The exit tube is narrowed at *b*, and closed by a piece of narrow india-rubber tubing *v* containing a slit, and forming a Bunsen valve. Over this a piece of wider india-rubber tubing passes, and is connected with the nozzle *c* in the usual way. When the mouth is withdrawn from the wash bottle, the valve *v* closes, and prevents water passing back from the nozzle and the entrance of bubbles of air.

—J. B. C.

Estimation of the Hardness of Water. E. von Cochenhausen. J. Prakt. Chem. 37, 413—416.

The soap solution used for the estimation of hardness in water is usually standardised by means of a solution of calcium chloride or barium chloride, which represents a certain amount of CaO or an equivalent quantity of BaO. Of these salts, however, which *vary* in their behaviour towards soap, the first only rarely, and the latter never, occurs in natural water. It follows, directly, that a compound which is either present in nearly every water, or into which the greater part of the lime present in a natural water can be converted, is the most suitable for standardising the soap solution. Such an one the author finds to be calcium sulphate.

The author also gives ready methods for the preparation of standard (German) calcium sulphate solutions.—O. H.

Determination of Sulphur in Coal and Coke. F. Stolba. Listy Chemické, 12, 203.

One grm. of the finely powdered coal or coke is mixed with 1 grm. of silver powder and 1 grm. of pure potassium bicarbonate, and the whole carefully heated with frequent stirring till no dark particles are discernible in the mixture. The residue is then warmed with ammonium nitrate, and afterwards cooled.

Hydrochloric acid is added, and the sulphur determined in the usual way.

Coal requires heating 20—25 minutes, coke 30—40 minutes. The method gives very good results.—T. L. B.

Estimation of Sulphur in Iron and Metallic Sulphides Decomposible by Hydrochloric and Sulphuric Acids. L. L. de Koninck. Zeits. Ang. Chem. 1888, 311.

Since 1870 the author has used a method devised by himself and Dietz which is applicable to the estimation of the sulphuretted hydrogen liberated by the treatment of cast or pig iron with hydrochloric acid. It consists in passing the gas through three small wash bottles containing a 2 per cent. solution of silver nitrate, collecting the precipitate on a filter, and decomposing it by the addition of bromine water into silver bromide and sulphuric acid. The amount of the latter is then determined in the filtrate by precipitation with barium chloride.

The author has recently modified this method by substituting cyanide of mercury for silver nitrate. He thus obtains a soluble bromide, and consequently saves the filtration and washing of the silver precipitate. It is recommended to employ a solution containing 4 per cent. of cyanide of mercury and 2 per cent. of ammonium chloride, the presence of the latter ensuring the production of a black flocculent precipitate which is easily filtered and washed.—D. B.

A Method for the Separation and Estimation of Boric Acid. H. N. Morse and W. M Burton. Amer. Chem. Journ. **10**, 154.

This method is stated to yield very accurate results, and is based on the following considerations:—If a solution containing silicates, carbonates and borates, as well as other inorganic salts or bases, be treated with dilute sulphuric acid in the presence of tropæoline OO, an acid reaction is indicated only when all the silicic, carbonic, and boric acids have been set free, the mixture then consisting of neutral salts, water, and silicic, carbonic, and boric acids. If sufficient dehydrated sulphate of copper be now added the water is absorbed, and the silicic acid dehydrated. Treatment with absolute alcohol will now bring the boric acid only into solution. Only chlorides and iron compounds interfere with the separation of the boric acid, and these can be eliminated before the acids are set free. The volume of the solution before treatment with dried cupric sulphate should not exceed 20 cc., and the dehydration of the cupric sulphate should be effected at 150°. The extraction with absolute alcohol is so arranged that the alcoholic solution of boric acid drops directly into a known solution of barium hydrate, which is afterwards saturated with carbonic acid, evaporated to dryness, and ignited. The increase of weight of the residue over that required for carbonate of barium is due to barium metaborate, and gives the necessary data for determining the boric acid.—G. H. B.

A New Method for the Determination of Manganese. L. Schneider. Monatsh. Chem. **9**, 242—254.

The method of estimating manganese by oxidation to permanganic acid by means of lead peroxide in presence of nitric acid is only available for small quantities, as with larger quantities oxidation is incomplete. If bismuth tetroxide be substituted for lead peroxide, oxidation takes place completely and in the cold.

The permanganic acid is titrated with hydrogen peroxide, that being the most suitable reagent. If oxalic acid be used instead it should be added in excess and titrated back with standard permanganate. Sulphurous acid cannot be used because it does not react quantitatively with permanganic acid, a portion being oxidised to dithionic acid.

The strength of the solution of manganese should be such that there is about 1 mgrm. of Mn for every 2 cc. of nitric acid of sp. gr. 1·2, that being the best strength of acid to use. To this end, for steels and crude irons, poor in manganese, 5 grms., and for irons containing several per cent., 1 grm. may be dissolved in 100 cc. of nitric acid sp. gr. 1·2, and the solution heated for some time after all the metal has dissolved. In the first case the solution when cold is diluted with 100 cc. of nitric acid sp. gr. 1·2, and in the last with 200 to 300 cc. of acid of the same strength.

About 10 grms. of bismuth tetroxide are then added, and the whole allowed to stand for some minutes while a gentle evolution of oxygen takes place. The solution is separated from the excess of bismuth tetroxide by passing through an asbestos filter, the residue is washed, and the whole filtrate titrated with a solution of hydrogen peroxide (standardised by permanganate in presence of nitric acid so as to correspond with the working conditions), of which 1 cc. = about 3 mgrms. of Mn.

For very rich spiegeleisen and manganese ores and for ferromanganese 1 grm. is dissolved, the solution diluted to 1 litre, 200 cc. taken, and 100 cc. conc. nitric acid added, and the oxidation proceeded with as before.

Ores or slags which are insoluble in nitric acid may be heated with hydrochloric acid, the residue, which may still contain manganese, treated with hydrofluoric acid, and the whole evaporated with sulphuric acid until fumes of the last named acid come off.

With regard to the reagents used, the chief precaution necessary is to see that the nitric acid is free from lower oxides of nitrogen. As commercial hydrogen peroxide often contains small quantities of chlorides, and traces of silver are generally present in bismuth, a turbidity may appear during the titration, which will not, however, affect the results.

The preparation of bismuth tetroxide is best effected by Fremy's method of fusion of 1 part of bismuth trioxide or basic nitrate with 1 part of potassium chlorate and 2 parts of sodium hydrate. It is better to heat the two former ingredients together first, and then to add the alkali. The melt is extracted with water, and the residue, consisting of hydrated sodium bismuthate, washed until free from alkali.

During the washing it changes from dark to light brown. It is then decomposed with a 5 per cent. solution of nitric acid, soda going into solution, oxygen being evolved, and a dark reddish-brown substance, which has the composition Bi_2O_3, Bi_2O_5, H_2O, being precipitated. This is washed with dilute nitric acid, then with water, dried, and preserved for use. If this substance is digested with nitric acid of sp. gr. 1·2 the greater part dissolves, but there is a dark brown or black residue left, which has nearly the same composition as the original body. Bismuth being expensive it is advisable to work up the residues by nearly neutralising the acid solution, when it is precipitated as a basic salt.
—B. B.

On the Analysis of Raw Materials and Products of the Iron Industry. C. Meineke. Ztschr. f. angew. Chemie. 1888, 259.

The author treats of the use of nitroso-β-naphthol as a precipitant for iron in presence of alumina and other bases (compare this Journal **6**, 384), and testifies to the usefulness of the method in rendering a direct estimation of the alumina possible, and for this purpose he uses a solution of nitroso-naphthol containing 1 grm. of the salt in 2 cc. of acetic acid.—G. H. B.

Analysis of Inorganic Substances. Zeits. Anal. Chem. **27**, 391—393.

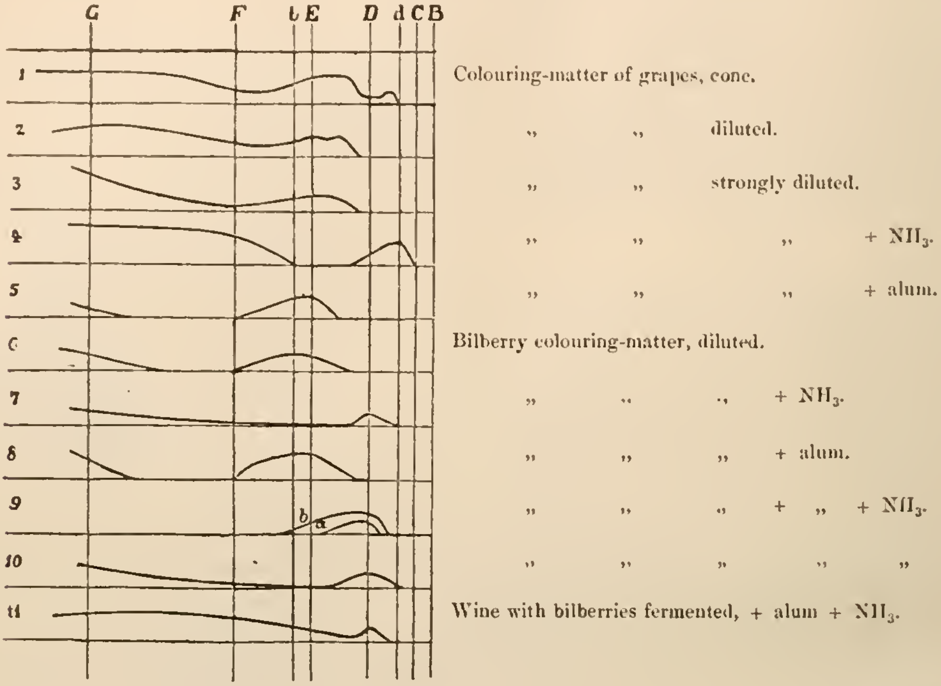
A New Reagent for Copper Salts.—*Aliamet* recommends a cold saturated solution of neutral sulphite of soda in which a certain quantity of pyrogallol is dissolved. This gives a blood-red colour with aqueous copper solution, and is exceedingly delicate.

Detection of Sulphites in presence of Hyposulphites (Thiosulphates) and Sulphates.—*A. Villiers* gives the following reaction:—Barium chloride is added to the neutral sulphite, and a precipitate of barium sulphite is obtained. If an acid sulphite is present, free SO_2 will remain in solution after the addition of barium chloride. If, therefore, a mixture of sulphites and hyposulphites is present, the solution is neutralised, if necessary, and barium chloride added. The solution will now have an acid reaction, and free SO_2 may be distilled off from the liquid.—J. B. C.

On the Difference between the Colouring Matters of the Grape and Bilberry, and the Spectroscopic Examination of Wine. H. W. Vogel. Ber. 21, 1746.

Failure to discriminate between these colouring matters is often attributable to the use of too concentrated solutions and addition of excessive quantities of reagents. In testing for their presence, the solution should be diluted till it shows the absorption spectrum represented by curve 4 or 6 (*see* diagram).

Freshly prepared solutions of these colours have similar, but not identical, absorption spectra. On adding ammonia till the colour turns green, the grape colouring matter gives an absorption band at *d* (curve 4), and that of the bilberry one at D (curve 7). On the addition of alum, followed by ammonia, the grape colouring matter gives the same band as above at *d*, which is, however, not permanent. That of the bilberry changes to violet and exhibits a strong band between E and D (curve 9). Excess of ammonia changes the colour to bluish-grey, and the band shifts to D (curve 10). On neutralising with acetic acid these reactions take place in reverse order. If allowed to stand some time before neutralising, the alum band of the bilberry colour remains unchanged. By this means it may be detected in wine. Age and fermentation change both colours, till at length their reactions disappear altogether.—H. T. P.



Detection of Rosin Oil in Vegetable and Mineral Oils. Holde. Mitt. a. d. kgl. liebn. Versuchsanstatten Berlin, 6, 88.

L. Storch states that by treating mineral oils supposed to contain rosin oil, first with acetic anhydride and then with concentrated sulphuric acid, in presence of rosin oil a violet colouration is produced. This reaction is not equally applicable to vegetable oils, as these frequently contain cholesterin, which gives a similar colouration. The author's method of procedure for the detection of rosin oil in the presence of either mineral or vegetable oil is the following:—The sample to be tested is shaken with sulphuric acid (sp. gr. 1·53), when the acid, in presence of rosin oil, is coloured violet; in the absence of this impurity no colouration takes place. Some samples of mineral oil which in the first instance were clear, on treatment with the sulphuric acid darken and the acid assumes a dark brown colour. In such case the sample is first shaken up with alcohol and the alcoholic solution subjected to the acid treatment; in the presence of rosin oil the violet colour makes its appearance at once.—G. D.

Detection of Creosote. A. Kremel. Pharm. Post. 21, 310.

The detection depends upon the fact that a 1 per cent. solution of ordinary wood creosote gives with ferric chloride no blue colouration, whilst a solution of carbolic acid gives a perfectly stable blue. This test is not very delicate, as it is found that to a creosote which gives no blue colour with ferric chloride, 5 per cent. carbolic acid can be added without any colouration appearing.

The best method of detection is, however, the following:—Shake 2 vols. pure creosote with 20 vols. 10 per cent. ammonia, and on allowing to settle it will be found that the creosote has diminished by 0·5 vol. and the ammonia solution, even on standing 24 hours, is not coloured blue. In the presence of carbolic acid the diminution in the volume of creosote is very much greater and the ammonia acquires a blue colour.—G. D.

The Chemical Character of Peptones. R. Palm. Zeits. Anal. Chem. 27, 359—363.

Peptone may be detected by means of the biuret reaction. A solution of peptone is treated with caustic soda solution and then HCl added until the precipitate which first forms redissolves. A drop of copper sulphate is now added and caustic soda in excess, whereby a greenish-blue precipitate first forms, which on shaking dissolves to a rose-red. Albumen under similar conditions gives a violet-blue colouration. The elementary analysis shows no characteristic difference between albumen and peptone, and further, the optical properties undergo no change during the peptonisation of albumen. Poehl concludes from this, that peptone has the same structure as albumen and is simply albumen swelled up.

According to the author, milk peptone is albumen dissolved in lactic acid. Albumen may be regenerated from peptone by neutralising the solution of peptone with ammonia and adding 95 per cent. of alcohol. The author explains the non-coagulation of peptone solutions on heating by the fact that lactic acid dissolves coagulated albumen. Under the name peptone a solution of protein in acid must therefore be understood.—J. B. C.

Analysis of Organic Substances. Zeits. Anal. Chem. **27**, 395—397.

A General Reaction for Polyatomic Alcohols.—D. Klein and *C. Jehn* find that on the addition of a polyatomic alcohol to a solution of borax, the alkaline solution of borax becomes acid, *i.e.*, if the quantity of borax in comparison with the alcohol is not too great. The same occurs with sodium pyrotungstate, and those polyatomic alcohols which rotate the plane of polarisation give, on the addition of borax or sodium tungstate a much stronger rotation.

Detection of Saccharine.—Herzfeld and *Reischauer*, in testing sugar, acidify with phosphoric acid and extract the saccharine with ether. After distilling the ether, Reischauer fuses the residue with a mixture of six parts of soda and one part of nitre, whereas Herzfeld fuses first with caustic potash and then oxidises the melt. The residue is tested for sulphuric acid. In wine saccharine is detected as follows:—100 cc. strongly acidified wine are extracted three times with a mixture of equal parts of ether and petroleum ether. To the extract caustic soda is added and the solution evaporated nearly to dryness. One-half to one grm. solid caustic soda is added, and the whole heated to 250° for half an hour. The melt is dissolved in water, acidified with sulphuric acid, and extracted with ether. The filtered extract is evaporated to dryness, a little water added, and on the addition of a drop of ferric chloride the violet colouration given by salicylic acid is produced. *Gravill* gives the following process: saccharine shows no distinct crystalline form under the microscope, undergoes no change at 100°, melts at 118°—120°, and boils above 150°, giving off white vapours. These vapours condense to crystalline needles which give the reactions of benzoic acid. Boiled with $K_4Fe(CN)_6$ saccharine yields a light green colouration with evolution of small quantities of hydrocyanic acid.

—J. B. C.

Examination of Lard. Isbert and Venator. Zeits. ang. Chem. 1888, 316.

The authors had occasion to examine a sample of lard, which was said to contain stearin. As the presence of the latter could not be indicated by the specific gravity, it was at first assumed that the sample was pure lard; however, after extracting it with cold ether and allowing the extract to remain for some time in a closed tube at the ordinary temperature, it began to deposit stearin and subsequently palmitin, the separation taking place without allowing the solution to evaporate.—D. B.

Modification of the Reichert-Meissl Process for Testing Butter. M. Mansfeld. Milch Ztg. 1888, No. 15.

In this process the errors in Meissl's method, pointed out by Wollny, are avoided by saponification with a strong ley without the use of alcohol. Five grms. of the melted and filtered fat are weighed out in a flask, taking care to avoid dropping any of the fat on the neck of the flask. Two cc. of caustic potash solution, containing 100 grms. alkali in 100 cc. water, are added and the flask closed at once with a cork, through which is passed a tube containing lime and soda or a tube drawn out to a fine jet. After mixing the ley and fat thoroughly the flask is heated to 80°—100° for a couple of hours in an air-bath, when saponification is complete. 100 cc. of water are added and the flask warmed over a water-bath until the soap is dissolved, when this is decomposed with 40 cc. of dilute sulphuric acid (containing 25 cc. of the concentrated acid per litre), a few small pieces of pumice stone are thrown in and 110 cc. distilled over in the manner described by Wollny. The distillate is filtered and 100 cc. of it titrated with standard barium hydrate solution (approximately decinormal). This process is extremely quick and the results are very accurate. From an examination of 88 samples of butter in Vienna the author considers that if the samples require 25·5 cc. decinormal baryta (for the 110 cc.) they are genuine; if from 25·5 to 24·4 cc. doubtful; and if under 24·5 undoubtedly adulterated.

Goldmann's modification of the original process is condemned on account of the extreme complexity of the apparatus and method.—E. E. B.

Detection of Invert Sugar by means of Methylene Blue. Zeits. f. Zucker Ind. **38**, 347.

Wohl has found that to effect decolourisation the time for which it is necessary to boil the solution is very largely dependent on its strength and alkalinity, so that the test must always be performed under precisely the same conditions:—10 grms. of the sample are dissolved in 50 cc. and clarified with lead acetate as usual. The excess of lead is removed by adding a solution containing 10 per cent. of sodium carbonate, 5 drops at a time, until no further precipitate is produced. One drop of a methylene-blue solution, containing 1 grm. of the blue per litre, is added to 25 cc. of the filtrate, and about 10 cc. of this liquid are boiled briskly over a naked flame for one minute. If the solution is decolourised the sample contains at least 0·01 per cent. invert sugar; if it remains coloured, none or less than 0·015 is present. Ammonium salts prevent or delay the reaction. Cane sugar, treated with a few drops of sodium carbonate solution, is not decolourised even after being boiled for ten minutes. If, however, one drop of caustic soda be used decolourisation soon ensues, since free alkali causes partial decomposition as in Fehling's test.—E. E. B.

An Analysis of Pure 1886 *White Wine from Alsace-Lorraine.* C. Amthor. Zeits. Anal. Chem. **27**, 364—365.

The mean composition of these white wines is the following:—

	Per Cent.
Extract	2·0689
Alcohol, per cent. volume	8·20
„ „ weight	6·59
Glycerol	0·5657
Acid	0·6957
Volatile acid	0·0515
Tartaric acid	0·0177
Tartar	0·1684
Ash	0·2295
Phosphoric acid	0·0383
Nitrogen	0·0282

—J. B. C.

On the Examination of Caoutchouc Goods. R. Kissling. Chem. Ind. **11**, 217—221.

Fifty to 70 per cent. of ash, consisting chiefly of calcium carbonate, are often found in articles of vulcanised rubber.

This is confirmed by the fact that the finished goods cost 3 to 4 marks per kilo. while raw para-rubber is 7·40 marks per kilo. Organic substances such as cork meal are also added to the rubber. No method exists for directly determining vulcanised caoutchouc; no reliance can be placed on the plan of determining the vulcanising substance, whether sulphur or a metallic sulphide, as no constant relation exists between it and the caoutchouc.

The determination of the ash and the quantity of matter soluble in ether, chloroform, carbon disulphide, &c., are of some value when considered in conjunction with the effect on the tenacity and elasticity of the sample by long heating at 100° to 110° C.

The author gives a table of results obtained by such a plan, selections from which are appended.

Kind of Article.	Price M. per Kilo.	* Percentage of Matter Soluble in		†Ash.	Behaviour under 48 Hours' Heating at 100° C.	Figure Representing Durability.
		Carbon Disulphide.	Ether.			
				Per Cent.		
Packing ring for steam pipe flange............	4·20	8·76	1·78	61·04	Became very hard and brittle................	9
" "	3·60	7·56	0·88	59·64	Became very hard and somewhat brittle	8
" "	3·00	17·12	0·44	60·36	Became hard and extremely brittle	10
" "	5·30	6·30	3·06	48·32	Became harder but remained elastic.........	3
Ring for stand pipe	10·18	8·42	1·24	55·20	Remained fairly soft and somewhat elastic...	2
Test piece of para-rubber.	17·60	6·66	2·04	2·16	Remained perfectly soft and elastic..........	1

* The substance was extracted first with carbon disulphide for seven to eight hours, and then with ether for two hours.
† The ash was recarbonated by means of ammonium carbonate.

—B. B.

On certain Sources of Loss in the Estimation of Nitrogen by Means of Soda-Lime. Atwater and Ball. Amer. Chem. Journ. 10, 113.

The authors consider that a free space (canal) is unnecessary and is to be avoided; that a long duration and high temperature of the combustion process is likely to occasion a loss of ammonia by dissociation. Notice is drawn to the fact that some bodies like protein yield the whole of the nitrogen as ammonia at moderate temperatures, whilst others, like strychnine, are thoroughly decomposed only with difficulty.—G. H. B.

Apparatus for the Extraction of Tanning Materials. R. Koch. Dingl. Polyt. J. 267, 513—518.

The following apparatus is found to answer well for the extraction of tanning materials. A glass bottle, 200 cc. capacity, is fitted, air-tight, with a double-bored caoutchouc stopper, carrying a tube bent upwards externally twice at right angles and passing 1 centimeter below the stopper inside the bottle; the other bore carries an inverted funnel-tube bent at right angles externally and passing to the bottom of the bottle. When in use the bottom of the bottle is filled with sea sand, the material to be extracted is then put in, the stopper adjusted, and the mouth of the funnel covered with a piece of linen or gauze, made to dip under the sand, and connected by means of india-rubber tubing with a glass tube running into a litre flask; the other tube is connected with a reservoir of water supported 3 or 4 feet above. The stopper is wired or otherwise firmly held in the bottle; the water from the reservoir is allowed to run in. If the easily soluble tannin is to be estimated, the bottle is not heated; but for total tannin it is immersed up to the neck in a water-bath. The flow from the reservoir to the bottle is regulated by an ordinary pinch-cock, and from the bottle to the litre flask by a screw-cock.

—D. A. L.

Colour Reactions of Starches and Gums with Phenols. Dingl. Polyt. J. 266, 593—604.

See this Journal, 1888, page 511.

Detection of Lactic Acid in Spirit. Dingl. Polyt. J. 266, 593—604.

See this Journal, 1888, page 511.

Examination of Beetroot. H. Pellet. Chem. Zeit. 12, 709.

The author's observations are here summarised as follows:—

Addition of basic lead acetate to an alcoholic sugar solution produces in general diminution of the rotatory power of the saccharose.

If no diminution is observed the reason is to be looked for in the method of preparation of the basic lead acetate. The method used by the author was that of Frühling and Schulz. 600 grms. neutral lead acetate, and 200 grms. powdered lead oxide were boiled with 2 litres of water till the oxide was dissolved. When cool the solution was made to 30° B., and filtered.

Beetroot contains varying quantities of a dextro-rotatory body, which does not belong to the sugar group.

This is considered to be either pectin or galactan. It is insoluble in absolute alcohol, soluble in dilute alcohol, and is precipitated by basic lead acetate.

Consequently, in determining the amount of crystallisable sugar, alcohol may be used instead of water, and great care must be taken to use a sufficient quantity of basic lead acetate in the analysis of the beet.

The liquid obtained on digestion may be perfectly clear without being free from dextro-rotatory substances; these latter may, however, be almost completely precipitated with alcohol, and then the amount of basic acetate required is less. When alcohol is used, 1·5—2 cc. only of acetate are needed for 52·1 grms. beet; with water, however, 6—8 cc. Unripe beet requires much more. When water is used the filtered liquid must be alkaline, and requires then to be neutralised with a little acetic acid. In the case of the alcoholic extraction, small quantities of the lead acetate must be repeatedly used to ensure complete exhaustion, and two, if not three, extractions with alcohol may be necessary. In the case of the alcoholic digestion the slowness of diffusion of the sugar is a disadvantage—70 times slower than in the case of water. Again, if it is necessary in the digestion with alcohol to increase the volume by the addition of cold alcohol, the result obtained from the filtered solution is too low, as the cold alcohol mixes only with the solution outside the cells of the beet. In the case of water the mixing is more complete.

With care both methods yield the same results.

—T. L. B.

On the Methods of Estimating Starch. A. von Asboth. Chem. Zeit. 12, 693.

A reply to criticisms by Monheim and Seyfert on a method elaborated by the author (compare this Journal, 6, 608), who explains the unsatisfactory results obtained by them to insufficient adherence to his method of procedure in all its details, as again set forth at length in the present article.—G. H. B.

Gravimetric Estimation of the Acids in Tanning Liquors. F. Simand. Dingl. Polyt. J. 268, 280—287.

In an article "On the estimation of the free acids in tanning liquors by titration" (Dingl. Polyt. J. 264, 395, and 265, 35), R. Koch maintains that through the formation of difficultly soluble magnesium salts, a considerable error arises in the estimation of these acids by the Kohnstein-Simand method (Dingl. Polyt. J. 256, 38 and 84). This method depends on the formation of soluble magnesium salts in the tanning liquor. 100 cc. of the latter are boiled with an excess of *pure* magnesia in a flask provided with a vertical condenser, the mixture cooled by placing the flask in water, the excess of magnesia filtered off and the magnesium estimated in a portion of the filtrate by the usual method after removing lime. The total acids are calculated from the magnesium obtained as acetic acid. Any magnesium already present in the liquor must be estimated separately and subtracted.

Simand now tries to prove experimentally that the quantity of acid found by the above method is not too low, and that Koch's supposition that difficultly soluble magnesium salts are formed is unfounded. To meet Koch's objection that experiments carried out with acetic, lactic, &c. acid solutions are not satisfactory, as acids may occur in the tanning liquor which do form basic salts, he carried out test experiments with solutions containing the volatile and non-volatile acids prepared directly from the tanning liquor. The results agreed well with each other and with those obtained by titration with a caustic soda solution.

Koch had carried out experiments by the magnesia method which agreed with his contention in so far as he obtained a smaller quantity of acid with the same amount of liquor, the greater the quantity of magnesia used. The author suspected that this result was due to the use of commercial magnesia instead of *pure* magnesia, and now shows, by direct experiments, that this supposition is correct, as commercial magnesia contains appreciable quantities of calcium sulphate, magnesium sulphate, sodium chloride, sodium carbonate, &c. (1·1 per cent.) lime, so that soluble calcium and sodium salts are formed besides the magnesium salts, and as the magnesium is the body estimated in the filtrate, it follows that too little acid is found. He therefore maintains that if pure magnesia is used the method is reliable.

Counceler and v. Schröder have supposed that the solutions used in the Kohnstein-Simand method are too concentrated. The strength is about 20—30 grms. of extract per litre, and they fear that a certain amount of material will remain undissolved, and therefore undetermined. This fear Simand shows to be unfounded, more especially as weaker solutions are not used in tanning, and such insoluble portions are therefore as good as absent for the tanner.

—F. W. T. K.

Trade Report.

(*From the Board of Trade and other Journals.*)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Russia.

Classification of Articles in Customs Tariff.

Note.—Poud = 36·1 lbs. avoirdupois. Funt = 0·902 lbs. avoirdupois.
Gold Rouble = *3s. 2d.*

The following decisions affecting the classification of articles in the Russian Customs Tariff have recently been given by the Russian Government:—

Composition of albuminous substances with an admixture of lime and ammonia.—Section 140. Duty, 2 roub. 40 cop. gold per poud.

Sulphurous carbon imported in iron barrels.—Section 138, Part 1. Duty, 22 copecks per poud, a deduction of 20 per cent. being allowed for tare. The barrels are dutiable under section 164. Duty, 1 roub. 40 cop. per poud.

The importation of "Terrum albumatum liquidum" is prohibited.

Switzerland.

Classification of Articles in Customs Tariff.

Quintal = 220·4 lbs. avoirdupois. Franc = 9$\frac{6}{10}$*d.*

"Creoline" (substance used for dyeing or colouring).—Category 16. Duty, 30 centimes per quintal.

Leather, simply cut, not fitted.—Category 382. Duty, 30 frs. per quintal.

Italy.

Proposed Tariff Changes.

A despatch, dated the 30th June last, has been received from Mr. J. G. Kennedy, Her Majesty's Chargé d'Affaires at Rome, enclosing copy and translation of a Bill at that date before the Chamber of Deputies, to which is annexed a table containing the alterations of the duties on chemical products recommended by the special committee appointed in June 1887. The following is a statement of the changes recommended:—

——		General Tariff.	Proposed Tariff.
		Lire Cs.	Lire Cs.
Phosphoric acid	Per quintal	10	Free.
Gallic and tannic acids, impure	"	Free.	3
Gallic, tannic, and pyrogallic, purified	"	10	25
Raw acetic acid	"	1	2
Citric acid	"	10	15
Tartaric acid	"	10	15
Salicylic and salicylitated	"	5	4
Potash and caustic soda (*a*)	"	5 and 0·50	0·50
Oxide of zinc and white of zinc	"	5	8
Mineral and vegetable alkaline acids, pyrolignite of iron, and aluminium	"	4	2
Acetates not specified	"	1	4
Carbonate of barytes, natural	"	2	0·50
Do. artificial	"	1	1
Bicarbonate of sodium, potassium	"	0·50	5
Chloride of tin	"	4	8
Nitrate of silver (*b*)	"	5	8
Do. soda, refined	"	3	Free.
Borax	"	0·50	1
Sulphate of ammonia	"	0·50	Free.
Do. aluminium	"	0·50	1·50
Do. barytes, artificial	"	1	2
Do. iron	"	2	0·50
Do. copper and zinc	"	2	2·50
Do. potassium	"	0·50	Free.
Do. sodium	"	0·50	1
Sulphate, bisulphate, and hyposulphate of sodium and potassium	"	0·50	1·50
Sulphur of zinc, with or without vegetable sulphates	"	Free.	8
Saccharine	"	4	100
Chromate and bichromate of potassium	"	4	1
Salts of bismuth	"	100 and 200	60
Bromine (*bromo*) and sodium	"	4	Free.
Bromides (*bromuri*) and iodides (*ioduri*)	"	4	25
Glycerine, purified	"	4	12
Oxygenated water	"	4	0·50
Camphor, refined	"	25	12

It is stated that the above modifications of the new general tariff will probably be accepted by the Chamber without further change.

UNITED STATES.

Customs Decisions.

An article called "lightning fluid," which upon investigation was found to consist of a solution of oxides of zirconium, lanthanium, and yttrium in nitric acid, was held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 92) for "all chemical compounds and salts, by whatever name known," &c.

An article called "antifebrine," which is a chemical compound recommended under that name as a substitute for quinine, although one of the numerous class of remote derivatives of coal tar, being similar in all essential particulars to the antipyrine, which is the subject of the Treasury Department's decision of August 26, 1885, is held to be dutiable at the rate of 50 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 90) for "proprietary preparations."

Alcohol and alcoholic preparations, whether imported in bottles or in casks, are not subject to the restrictions as to the number of bottles to the case or capacity of casks prescribed in Schedule H. for spirituous liquors or beverages, it being held that such schedule does not apply to alcohol or any of the alcoholic preparations specified in Schedule A., paragraphs 100 to 103.

Certain so-called amyl acetic, amyl butyric, and amyl valerian, which upon investigation are found to consist of ethers which enter into the composition of certain essences recognised as fruit essences, are held to be dutiable at the rate of 2·50 dollars per pound, under the provision in Schedule A. (T. I., 114) for "fruit, ethers, oils, or essences."

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

IMPORTS INTO THE UNITED KINGDOM FROM SPAIN.

PRINCIPAL ARTICLES.		Three Months ending	
		June 1887.	June 1888.
Chemical products unenumerated	Value £	18,062	18,554
Copper ore and regulus	Tons	10,750	15,197
	Value £	153,307	403,882
Manganese ore	Tons	3,925	..
	Value £	9,830	..
Pyrites of iron or copper	Tons	153,504	146,659
	Value £	283,669	292,292
Quicksilver	Lbs.	1,968,900	1,478,250
	Value £	183,975	146,012
Rags, Esparto	Tons	12,579	11,869
	Value £	71,172	72,201
Total Value	£	2,298,383	2,475,974

EXPORTS OF BRITISH AND IRISH PRODUCE FROM THE UNITED KINGDOM TO SPAIN.

PRINCIPAL ARTICLES.		Three Months ending	
		June 1887.	June 1888.
Alkali	Cwts.	74,349	76,025
	Value £	25,228	23,191
Caoutchouc, manufactures of	Value £	3,102	2,824
Cement	Tons	1,991	1,888
	Value £	3,757	3,514
Chemical products and preparations (including dye-stuffs)	Value £	10,701	9,939
Coal, products of (including naphtha and paraffine)	Value £	2,966	6,326
Glass manufactures	Value £	1,513	2,097
Manure	Value £	62,213	105,576
Painters' colours and materials	Value £	6,198	7,647
Paper of all sorts	Cwts.	2,045	1,241
	Value £	4,155	2,993
Soap	Cwts.	865	638
	Value £	841	563
Total Value	£	814,696	907,448

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

ESTABLISHMENT OF A "COMMERCIAL INFORMATION OFFICE" AT BELGRADE.

A communication, dated the 26th June last, has been received from the Foreign Office, transmitting an extract from a despatch from Her Majesty's Minister at Belgrade, who gives the following information respecting a commercial information office at Belgrade:—

"A commercial information office has been opened at Belgrade under the name of the 'Servian State Commercial Bureau,' the object of which is to supply on demand, and free of charge, every information to foreign manufacturers and merchants as to the best means of disposing of their wares in Servia, and to furnish them with the names of reliable Servian producers and dealers in Belgrade and elsewhere, with all particulars as to their standing, &c.

"It would appear that this bureau, though encouraged by the State, and presided over by an intelligent Government functionary named Radulovitch, who has special facilities for acquiring every information desired by those who may correspond with him, is not an institution, strictly speaking, under the control of the Government, though it is likely soon to be so.

"Until, however, the railway rates in the Balkan Peninsula are lowered, and until the formalities imposed by the Turkish Customs authorities on the transit trade between Salonica and the Servian frontier are removed, and replaced by some system of closed vans for merchandise in transit across Turkish territory, it would be premature for British manufacturers and merchants to make a venture in this country by means of the recently opened railway from Salonica, except in a very tentative form."

With reference to the above, a further communication, dated the 2nd July last, has been received from Mr. F. R. St. John, stating that the Servian Government has recognised and now avows its control over the Commercial Information Office, and that it will shortly establish a branch office in the town of Nisch.

MOROCCO.

Orchella Export.

Another small article, orchella weed, shows a largely increased value, 250*l*., just five times the amount of 1886; but it is noticeable that, while in that year England took this, in 1887 the whole quantity seems to have gone to Spain.

Other Drugs.

Among other drugs, so far as they are specially mentioned, 10,454*l*. of beeswax were exported chiefly from Mogadore, against 21,587*l*. in 1886; 14,520*l*. of brown gum, 14,910*l*. gum sandarac, and quantities of fenugreek seed and cumin.

Cochineal.

In the neighbourhood of Mogadore the cochineal insect has been cultivated on the prickly pear cactus, which is much used as a hedge for small enclosures; but its production has been on a very small scale, and, with the low prices obtained by the cochineal-growers of the neighbouring Canary Islands, may be regarded rather as an interesting experiment than as a remunerative trade.

PERU.

Exports from Mollendo.

The exports from Mollendo during the year 1887 include:—Bark, 10,318 qqls., value 515,900 sols.; rhatania, 153 qqls., value 3,060 sols.; and coca leaves, 3,186 qqls., value 76,484 sols. In 1886 the exports of the latter article were only 705 qqls.

PORTUGAL.

The Olive Oil Industry.

Early in 1887 the Portuguese Government appointed a Royal Commission to investigate and report upon the agricultural condition of the country. In their report the Commissioners assert, with regard to olive oil, that the golden days of the cultivation of the olive tree have passed away for ever. They estimate the depreciation during the last twenty-five years in the value of an olive yard, not profitably susceptible of other culture, at 50 per cent., which is also the exact percentage of the depreciation for the same period in the value of the oil. This result has arisen partly from exhaustion of the trees due to age, or the ravages of parasitical insects and fungi, and partly to the competition of Spanish oil. The Commissioners recommend as palliatives to this evil certain precautions on the frontier to prevent Spanish oil from coming into the market under the guise of (the presumably superior) Portuguese oil, and the engagement by the Government of a limited number of Italian oil-makers, who would teach the Italian processes at various Portuguese centres of production, since, though great improvements have of late years been introduced by some enlightened growers into the manufacture of Portuguese oil, it has never yet reached the degree of excellence attained by French and Italian oils.

UNITED STATES.

Quicksilver.

The exports of quicksilver from San Francisco in 1879 amounted to 9,545 bottles, worth 79,812*l.*, against 7,000 bottles, worth 46,000*l.*, the year before.

Borax.

Of borax, 7,350,073 lbs., worth 82,466*l.*, were shipped from San Francisco last year, against 7,934,000 lbs., worth 80,000*l.*, the year previous.

MISCELLANEOUS TRADE NOTICES.

CAUSES OF THE DECLINE OF BRITISH TRADE IN TURKEY.

In an address by the president of the British Chamber of Commerce of Turkey, delivered on the 1st June last at Constantinople, Mr. Whittall stated that he had devoted some time to the compilation of commercial statistics relating to the imports into Turkey from Great Britain, France, Austria, and Germany, the last two countries being lumped together, and that the results were worthy of attention. The average yearly imports into Turkey for the period 1878-82 were 1,920 million piastres, against a yearly average for the years 1882-86 of 2,014 millions. In 1878-82 the imports into Turkey from Great Britain alone averaged 870 millions yearly, or a proportion of 45·30 of the whole. In 1882-86 they averaged 890 millions, or 44·30, thus showing a small falling off in the proportion to the total. In 1878-82 the imports from Austria-Germany were 286 millions, or 14·90 of the whole, whereas they were 393 millions in 1882-86, or 19·50, thus showing a very great increase. In 1878-82 the average imports from France were 294 millions, or 15·30 of the total, against 264 millions, or 13·50, thus showing a serious falling off. These figures are chiefly interesting to British trade, as showing that whereas the imports of British goods into Turkey have shown a falling off in recent years, those of Austro-German goods have shown a great increase. The president stated that British trade has declined and Austro-German increased simultaneously with an undoubted decline of British and a corresponding increase of German influence in Turkey, and gave it as his opinion that one cause of the increased German trade was the admirable way their manufacturers adapt themselves to retail orders; moreover, the German manufacturer is more versatile in his business than the English manufacturer, and does more to satisfy his clients, especially in the way of supplying articles which intrinsically may be worse than the English ones, but which *look* as well and are lower in price. A second cause is said to be the system of commercial travellers employed by the Germans in such large numbers. They naturally stimulate the purchase of German articles; but it is doubtful, in the opinion of Mr. Whittall, whether this system, which is cumbrous and expensive, will really be more effective in the long run than a system of employing permanent local representatives. A third cause is the relative cheapness of certain kinds of Austro-German goods, such, for instance, as Elberfeld Turkey-red yarns. A fourth cause is the evident reluctance shown by British manufacturers to have local agents to push the sale of their specialities; and the fifth and last cause given by the president is the greater credits given by German as compared with those given by British traders in Turkey.

PROPOSED PIPE LINE IN RUSSIA.

The United States Consul at Beirut, writing under date of the 18th April last, says that the project to connect the Caspian with the Black Sea by a pipe line seems about to be realised. Information has been received to the effect that the Caspian and Black Sea Naphtha Conduit Company has at last been formed, and that the work is to be completed in three years and six months. The conduit, from the small peninsula of Abcheron on the Caspian, is to have a forked line on the Black Sea, reaching Batoum and Poti. The capacity of the proposed line is to be such as to admit of the passage daily of 240,000 poods, or about 1,200,000 gallons of naphtha. The maximum tariff will be 10 copecks, and the company is to pay to the Government a royalty of half a copeck per pood. The capital of the company is fixed at 14,000,000 roubles, and its property and plant are to pass to the Crown after the lapse of 60 years.

UTILISATION OF A WASTE PRODUCT.

Abstracted from the "CHAMBER OF COMMERCE JOURNAL" *for July 5th*, 1888.

The past month saw the completion of experiments which had been made under the auspices of the Chemical Trade Section of the London Chamber of Commerce to determine how far it would be possible to utilise the large quantities of damaged teas, unfit for human consumption, which find their way to our docks, and sometimes into the market. Such teas have, for some time past, been used largely in Germany for the extraction of caffeine, which article forms an important export, both to this country and the United States. Caffeine is well known in the drug trade for its medicinal qualities, and its manufacture has never been conducted here, although the raw material was obtained in large quantities from this country. In fact the German manufacturer practically obtained possession of it in return for removing it from the bonded warehouses. Since this damaged tea was never taken out of bond by the holders in London, it, of course, escaped the duty, and was shipped away to Germany and disposed of for the manufacture of caffeine, the English manufacturers being prevented from utilising it owing to the prohibitive duty of 6*d.* per lb. which was imposed. While there was reason to believe that the Customs authorities would be inclined to waive the duty on such tea, it was also necessary to provide against its entering into consumption without paying the duty to which the Revenue was entitled. The inquiries of a Committee of the Section referred to were directed to ascertaining a means of "denaturising" the tea, so as to make it unfit for human consumption, and yet preserve the constituents from which caffeine could be extracted.

Petroleum and lime were each tried, but for sufficient reasons were not acceptable to the Customs authorities. Eventually assafœtida was decided upon, but after numerous interviews with the Customs officials (who rendered the utmost support in developing the new industry, and overcoming the difficulties of existing rules, while protecting the Revenue), it was considered that it would not be possible to treat the tea with assafœtida in the tea warehouses owing to the odour arising from that drug.

The Secretary of the Customs suggested a plan of sending the waste tea from the bonded warehouses in a licensed barge under bond to the factory, there to be received by an Inspector of Customs, then removed into a chamber in the works, and denatured by the agency of the chemicals to be decided upon. After this operation had been performed to the satisfaction of the Customs officer, the bond would be cancelled and returned to the Custom House, and the denatured tea leaf would remain the property of the manufacturer of the alkaloid. This scheme was considered both practical and satisfactory to all concerned.

The Secretary of the Customs reported to the Treasury that tea "treated similarly to that in one of the samples submitted, in the proportion of about 1,000 lbs. of ground tea to 100 lbs. of lime and 1 lb. of assafœtida, would become incapable of being taken into consumption as tea."

The Lords of the Treasury have sanctioned delivery of tea free of duty for the manufacture of caffeine out of bond, subject to all needful precautions against the use of tea delivered from the Customs charged (free of duty) for this purpose, and the Board will at once formulate the necessary regulations, and be ready to apply them on application from firms desirous of availing themselves of the privilege.

We learn that on the 3rd instant the Customs finally decided on the whole of the details, and tea has actually been purchased from the wharfingers in large quantities for treatment. The caffeine industry is, therefore, now in a fair way of being established in this country, and English producers and consumers will derive increased advantage from its transfer from Germany.

PATENTS IN SWITZERLAND.

Within the last few weeks an Act has been adopted which authorises and regulates the grant of patents for inventions in Switzerland, now a country with considerable industries; and the law will shortly be put into force. The law is modelled very much after the German, but free from many of the defects; the fees are low, and the surplus receipts are to be applied to the laudable object of industrial advancement. The four sections of the Act contain thirty-seven articles. According to these, only such inventions as are unknown in Switzerland at the date of the patent application, and are capable of representation by a model, may be patented. Jurists, however, suppose that chemical inventions and processes may, when recognisable by their products, be included in the provisions of the law. Provision is made for a two years' provisional protection, and fifteen years is the entire duration of the patent, subject to an annual progressive tax being promptly paid. The invention has to be worked in Switzerland within the first five years. Foreigners are required to make their applications through a resident in the country (this is usually arranged by the English patent agent's correspondent being appointed representative), and a patentee may be compelled after the end of the third year to grant licences for the use of the invention. All patented articles should be marked with the Swiss cross and the number and date of the patent. Any patent granted under the law may be expropriated. Infringements with intent are punishable either with a fine, varying from 30 fr. to 2,000 fr., or with imprisonment from three days to one year, or both; whilst illegal marking is punishable either with a fine of from 30 fr. to 500 fr., or imprisonment from three days to three months, or both.

The articles of the law dealing with international arrangements and exhibitions are very similar to those of the British law.—*The Ironmonger.*

THE QUICKSILVER MINES AT IDRIA.

A recent issue of the German *Illustrirte Zeitung* contains an interesting article on the Austrian quicksilver mines at Idria, which were accidentally discovered nearly four centuries ago by a workman, who, filling a pail at a spring, found metallic mercury at the bottom of the vessel, and, realising the importance of his find, commenced to exploit the soil in company with a soldier of his acquaintance and some other associates. In 1504 they sold their interest to a corporation, which began operations energetically. In 1507 the Emperor Maximilian of Austria opened a mine in Idria on his own account, but in the same year the Venetians invaded the country and seized the mine. In 1510, however, they were driven away again by the Imperial troops. The mines were then leased by Maximilian to the St. Achazi Mining Company. In 1580 all the mines came into the possession of the ruling prince, and the Mining Reservation for the Montanwerk was founded by the

"Carolina Mining Law for Idria," which still stands. Since that time the mines at Idria have belonged to the State. The principal entrance to the mine (the "Anthoni-Stollen") is in the centre of the city of Istria, and the necessary water power is supplied by the Idrizza river. The mines cover an area of about 111 acres, are worked by over 1,000 hands, and are provided with six shafts. There are now 958,430 cubic metres of ore in the mines, which, with a yearly output of 13,630 cubic metres, will last 70½ years.

The quicksilver of Idria occurs partly as native mercury in globules (this is collected in leather bags), but most of it is found in combination with other substances, such as idriantin, or "burning ore," which is found at great depths, and, being very inflammable, is thought to be the cause of fires in the mines. In the deepest idriantin shafts a temperature of about 90° F. prevails, although the best appliances for ventilation known are employed. The ore which has been blasted or hewn out is delivered to the stamping mill, where it is prepared dry, and is finally treated in shafts and reverberatory furnaces. The gases from both pass through condensation tubes into a condensing chamber, from which they pass through an enormous chimney into the open air. On account of the great length of the cold tubes through which the quicksilver fumes have to pass, the metal falls like fine rain in the condensing chamber, from which it is conducted through channels to iron vessels, and from these it is poured into iron flasks for shipment. By this treatment the loss of mercury is reduced to a minimum, and the injurious effect on the health of those employed in the smelting works is greatly lessened. A peculiarity of the smelting process at Idria is the appearance of "stupp" in the furnaces. This is a mixture of metallic quicksilver, hydrocarbons, and mercurial salts. It is collected in receptacles, the metallic quicksilver is extracted by pressure, and then the residue is mixed with lime and treated in a reverberatory furnace. The production of cinnabar also forms an important feature of the works at Idria, and from this metallic ore three kinds of vermilion—the light red, the dark red, and the Chinese—are manufactured at Idria. From 1819 to 1881 the Idria mines yielded to the State a net profit of about 2,000,000*l*. In 1874 alone the profit reached 160,000*l*., in consequence of the advance in the price of quicksilver during that year.

LEGISLATION FOR WORKPEOPLE IN GERMANY.

A Bill making provision for workpeople who become incapacitated by age or illness, which has been drawn up by the Committee of the Federal Council, provides for compulsory insurance, the funds for which are to be raised in three parts, one part to be contributed by the Empire by means of assessment, the second part by premiums to be paid by the employers of labour, and the remaining share by contributions from the employed, men paying 21 pfennige (2½*d.*), and women 14 pfennige (1 3-5*d.*) per week. Every man on becoming invalided will receive an allowance of 120 marks (6*l.*), and every woman 80 marks (4*l.*), while the pension of aged working people will commence at the age of 71 with an allowance of 180 marks (9*l.*). There is to be no reduction in the pension of working men who may have been prevented from paying their contributions in consequence of military service.

A NEW WEIGHTS AND MEASURES BILL.

A Bill has just been introduced into the House of Commons by the President of the Board of Trade to amend the existing law relating to weights and measures. It is late in the session to bring forward this Bill, but as it is introduced by a member of the Government it is just possible that an effort may be made to pass it this year.

The first clause provides that *every* weighing instrument used for trade shall be verified and stamped by an inspector of weights and measures, thus extending the operation of the original Act to articles not now required to be stamped.

Section 2 gives power to the Board of Trade to deposit, at the expense of the local authority, with any local inspector under the Act, copies of any of the metric standards, and the Board may also cause to be verified with these copies any metric weights and measures.

Section 3 provides a penalty of 20*l*. for a second or subsequent offence under section 25 of the original Act, and extends the provisions as to forfeiture to weighing-machines.

Section 4 provides for the repeal of the following sections of the principal Act, namely, section 16, relating to the measure of capacity for goods formerly sold by heaped measure; section 22, containing exemptions with respect to vessels not represented as containing any amount of imperial measure, and to vessels not used or intended for use as measures; and section 46, giving power to stamp measures made partly of metal and partly of glass.

Under section 5 the Board of Trade are to prepare new denominations of standards for the measurement of electricity, temperature, pressure, or gravities, as appear to be required in trade.

Section 6 enables local authorities to provide for the use of their officers working standards, verified by the Board of Trade.

Section 7 enables the Board of Trade to take fees for the comparing and verification of weights and measures, not being local standards or coin weights, and for testing, weighing, or measuring instruments.

Section 8 provides that the local authorities may make general regulations as to the procedure to be observed in the verification, stamping, and inspection of weights, measures, and weighing instruments. If the local authorities do not make these regulations the Board of Trade may do so for them.

Section 9 provides that an inspector of weights and measures shall not be a maker or seller of weights and measures, or a scale-maker, or a person employed in the making, adjusting, or selling of weights, measures, or weighing instruments. A sub-section, however, allows the inspector to adjust weights and measures with the consent of the local authority and the Board of Trade.

Section 10 lays down the fees to be taken for verification and stamping, and says that no other fees are to be taken. As this section for the first time seeks to establish uniformity in fees we give the list in full:—

Weights.

	s.	d.
Avoirdupois—		
Each weight of 100 lbs. (central)	0	4
Each weight of 56 lbs. and 28 lbs.	0	3
Each weight of 14 lbs. and 7 lbs.	0	2
Each weight from 4 lbs. to 1 lb., inclusive	0	1
Each weight from 8 oz. to ¼ drachm, inclusive	0	0½
Each weight from 4,000 grains to $\frac{1}{100}$th of a grain, inclusive	0	0½
Each weight from 249 grains to 24 grains, inclusive, commonly called pennyweights	0	0½
Troy—		
Each weight from 500 oz. to 100 oz., inclusive	0	4
Each weight from 50 oz. to 10 oz., inclusive	0	2
Each weight from 5 oz. to $\frac{1}{1000}$th of an oz., inclusive	0	1
Apothecaries—		
Each weight from 10 oz. to 1 oz., inclusive	0	2
Each weight from 4 drachms to ½ grain, inclusive	0	1

Measures.

	s.	d.
Length—		
Each measure from 100 feet to 4 feet, inclusive	0	3
Each measure of a yard, 2 feet, foot, and inch respectively, including their sub-divisions	0	1
Measures from 0·500 to 0·001 inch, in the form of wire-gauge plates:		
For each notch, or for each internal gauge or separate size, from ½ inch to $\frac{1}{1000}$th of an inch	0	0½
Capacity—		
Dry and liquid measures:		
Each measure of 4 bushels (32 gallons) and 1 bushel (8 gallons)	0	6
Each measure from 5 gallons to 2 gallons (peck), inclusive	0	3
Each measure from 1 gallon to ¼ gill, inclusive	0	1
Apothecaries—		
Each sub-divided measure containing more than one hundred sub-divisions	0	6
Each sub-divided measure containing more than fifty but not more than one hundred sub-divisions	0	4
Each sub-divided measure containing one or more than one but not more than fifty sub-divisions	0	2
Each separate measure of 40 fluid-oz. to 1 fluid-oz. respectively	0	3
Each separate measure of 4 fluid-drachms to 1 minim	0	2

Weighing Instruments.

Weigh-bridges and fixed weighing-machines—		
For 10 tons and above	10	0
For under 10 tons and above 1 ton	5	0
For 1 ton or under	2	0
(Exclusive of cost of cartage of standards in each case.)		
Balances, scale-beams, steelyards, and movable weighing-machines—		
For 56 lbs. and above	0	6
For under 56 lbs. and above 1 lb.	0	3
For 1 lb. or under	0	2

This table of fees, although fixed in the Bill, may be varied on the representation of the Board of Trade by Her Majesty by Order in Council. Section 11 provides that, where a person is convicted before any court of any offence under this or the principal Act, the court may, if it thinks fit, cause the conviction to be published in such a manner as it thinks desirable. Section 12 extends the provisions of the Act to the standards used by any local authority in testing gas-meters. Under section 13 a person using weights and measures in the City of London is not to be required to have his weights or measures verified or stamped by more than one authority. Sections 14 and 15 refer to the appointment of inspectors in Ireland. Sections 16 to 27 deal with the sale of coal, and greatly amend the present practice in that respect. Sections 28 and 29 deal with the sale of bread, while sections 30 to 35 are definitive and administrative. It is proposed that the Act (if the Bill is passed) shall come into operation on January 1st, 1889. —*The Ironmonger.*

STATISTICS.

THE PRODUCTION OF COAL IN THE UNITED STATES IN 1887.

The following statistics have been compiled principally from the direct returns of the operators of individual coal mines, and of railroad agents, supplemented by valuable facts contributed by State officials.

The total production of all kinds of commercial coal in 1887 was 123,965,255 short tons (increase over 1886, 16,283,046 tons), valued at the mines at 173,530,996 dols. (increase, 26,418,241 dols.). This may be divided into Pennsylvania anthracite, 39,506,255 short tons (increase, 2,809,780 short tons), or 35,273,442 long tons (increase 2,508,732 long tons), valued at 79,365,244 dols. (increase, 7,807,118 dols.); all other coals, including bituminous, brown coal, lignite, small lots of anthracite produced in Colorado and Arkansas, and 6,000 tons of graphitic coal mined in Rhode Island, amounting in the aggregate to 84,459,000 short tons (increase, 13,473,266 tons), valued at 94,165,752 dols. (increase, 18,641,123 dols.).

The colliery consumption at the individual mines varies from nothing to 8 per cent. of the total output of the mines, being greatest at special Pennsylvania anthracite mines and lowest at those bituminous mines where the coal bed lies nearly horizontal and where no steam power or ventilating furnaces are used. The averages for the different States vary from $2\frac{1}{8}$ to $6\frac{1}{2}$ per cent., the minimum average being in the Pennsylvania bituminous and the maximum average being in the Pennsylvania anthracite region.

The total output of the mines, including colliery consumption, was: Pennsylvania anthracite, 37,578,747 long tons (increase over 1886, 2,725,670 long tons), or 42,088,197 short tons (increase, 3,052,751 short tons); all other coals, 87,837,360 short tons (increase, 14,129,403 tons), making the total output of all coals from mines in the United States, exclusive of slack coal thrown on the dumps, 129,925,557 short tons (increase, 17,182,154 tons), valued as follows: Anthracite, 84,552,181 dols. (increase, 8,433,061 dols.); bituminous, 97,939,656 dols. (increase, 19,458,600 dols.); total value, 182,491,837 dols. (increase, 27,891,661 dols.). The above figures show a notable increase in 1887 over 1886 in the aggregate output and value of both anthracite and bituminous coal.

The total production and the spot value in each State and Territory, exclusive of colliery consumption, are shown in the following table:—

States and Territories.	Quantity.	Value at Mines.
	Short Tons.	Dollars.
Pennsylvania:		
Anthracite	39,506,255	79,365,244
Bituminous	30,866,602	27,806,941
Ohio	10,301,708	9,096,848
Illinois	10,278,890	11,152,596
West Virginia	4,836,820	4,591,979
Iowa	4,473,828	5,991,735
Maryland	3,278,023	3,114,122
Indiana	3,217,711	4,324,604
Missouri	3,209,916	4,298,994
Kentucky	1,933,185	2,223,163
Alabama	1,900,000	2,170,000
Tennessee	1,900,000	2,470,000
Colorado	1,791,735	3,941,817
Kansas	1,596,879	2,235,631
Wyoming	1,170,318	3,510,954
Virginia	825,263	773,360
Washington Territory	772,612	1,699,746
Indian Territory	685,911	1,286,692
New Mexico	508,034	1,524,102
Georgia	313,715	470,573
Utah Territory	180,021	360,042
Arkansas	150,000	252,500
Texas	75,000	150,000
Michigan	71,461	107,191
California	50,000	150,000
Oregon	31,696	70,000
Dakota	21,470	32,205
Montana	10,202	35,707
Rhode Island	6,000	16,250
Nebraska	1,500	3,000
Idaho	500	2,000
Total	123,965,255	173,530,996

—*U. S. Geological Survey.*

BOARD OF TRADE RETURNS.

IMPORTS.

—		June 1886.	June 1887.	June 1888.
Drugs, unenumerated	Value £	61,955	41,784	54,075
Chemical manufactures and products, unenumerated	„	114,696	107,365	116,190
Chemicals and dye-stuffs, unenumerated	„	205,610	143,782	204,397
Oils, not enumerated	„	89,818	102,148	109,019
Alkali	Cwt.	8,241	6,953	4,882
	Value £	6,342	6,681	4,551
Brimstone	Cwt.	68,292	40,900	75,534
	Value £	16,234	10,182	16,698
Nitrate of soda	Cwt.	145,891	172,218	193,292
	Value £	67,287	80,391	73,226
„ of potash	Cwt.	24,742	17,879	25,749
	Value £	21,674	16,005	22,159
Quicksilver	Lbs.	684,741	877,500	1,117,650
	Value £	62,160	76,825	113,074
Cinchona bark	Cwt.	16,281	12,836	10,004
	Value £	91,590	69,983	31,177
Gum Arabic	Cwt.	2,743	2,983	7,867
	Value £	9,796	12,499	30,509
Lac, seed, shell, stick, and dye	Cwt.	8,153	10,873	8,599
	Value £	22,871	27,732	20,358
Bark (for tanners' or dyers' use)	Cwt.	72,037	55,118	34,030
	Value £	44,130	28,017	17,104
Aniline	Value £	15,393	24,299	17,430
Alizarine	„	19,557	14,195	16,060
Other coal-tar dyes	„	..	464	1,629
Cochineal	Cwt.	989	585	229
	Value £	6,395	3,542	1,442
Cutch and gambier	Tons	1,273	1,931	1,058
	Value £	28,151	42,212	28,407
Indigo	Cwt.	2,270	3,357	2,359
	Value £	37,025	57,662	41,705
Madder, madder-root, &c.	Cwt.	1,557	1,327	933
	Value £	1,898	1,695	1,259
Cocoa-nut oil	Cwt.	4,042	17,878	1,805
	Value £	5,736	26,058	3,012
Olive oil	Tuns	1,867	1,644	1,169
	Value £	70,211	62,897	42,993
Palm oil	Cwt.	70,048	67,336	99,589
	Value £	70,078	64,413	91,333
Petroleum oil	Gals.	5,388,918	4,823,942	4,936,462
	Value £	148,717	139,499	127,153
Various seed oils	Tons	949	1,032	981
	Value £	24,420	24,994	24,031
Turpentine	Cwt.	866	5,659	35,405
	Value £	1,055	7,495	49,293

EXPORTS.

—		June 1886.	June 1887.	June 1888.
British and Irish produce:				
Drugs and chemical preparations, unenumerated	Value £	75,571	73,380	77,211
Sundry chemicals -	„	283,337	284,072	352,462
Painters' colours and materials	„	117,891	112,895	132,552
Alkali	Cwt.	494,355	458,181	548,276
	Value £	142,607	130,517	134,431
Bleaching materials .	Cwt.	130,443	104,111	132,211
	Value £	40,273	39,174	50,338
Seed oil.............	Tons	6,494	5,320	6,171
	Value £	138,931	113,956	124,988
Pickles, vinegar, sauces, condiments, and confectionery.	Value £	101,199	85,413	108,395
Soap................	Cwt.	31,238	43,788	37,449
	Value £	32,030	42,631	34,695
Foreign and Colonial merchandise:				
Chemicals, unenumerated	Value £	13,763	35,100	27,946
Cinchona bark	Cwt.	8,692	9,921	11,125
	Value £	42,123	37,342	29,099
Cochineal...........	Cwt.	991	730	408
	Value £	6,527	4,779	2,501
Cutch and gambier .	Tons	767	1,045	814
	Value £	19,714	26,108	22,340
Gum Arabic	Cwt.	3,578	2,906	4,923
	Value £	15,172	10,393	23,401
Indigo..............	Cwt.	1,962	2,323	1,857
	Value £	44,518	52,361	38,989
Lac, seed, shell, stick, and dye	Cwt.	6,213	4,713	8,153
	Value £	18,205	11,776	21,688
Cocoa-nut oil	Cwt.	14,182	11,928	10,163
	Value £	19,096	15,890	13,076
Olive oil	Tuns	147	336	298
	Value £	7,064	13,624	11,898
Palm oil	Cwt.	11,548	16,758	72,218
	Value £	10,809	44,355	68,788
Petroleum oil	Gals.	73,938	18,539	35,385
	Value £	3,591	964	1,509
Quicksilver.........	Lbs.	499,250	560,289	440,145
	Value £	42,474	49,199	40,561

QUICKSILVER.

	IMPORTS.			
	1888.	1887.	1886.	1885.
June...........	Bottles. 11,902	Bottles. 11,700	Bottles. 9,130	Bottles. 16,374
January to June	63,140	50,877	49,765	43,635
	EXPORTS.			
June	5,869	7,471	6,656	4,915
January to June	28,138	31,903	39,996	21,457
Average Price..	£ s. d. 7 10 6	£ s. d. 6 11 6	£ s. d. 6 11 6	£ s. d. 5 17 6

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

8852. J. E. Hall, London. Apparatus for consuming smoke and economising fuel. June 16.

8973. S. Elliott, Newbury. Method and apparatus for the treatment of smoke. June 19.

9058. G. F. Webb, London. Improvements in taps for wines, spirits, malt liquors, vinegar, acids, and other liquids. June 21.

9133. R. H. Michell, London. Method and means for consuming smoke and economising fuel. June 22.

9153. H. H. Lake.—From D. Donahue, United States. Apparatus for separating oil from the feed water of steam-boilers. Complete Specification. June 22.

9188. H. E. Newton.—From Messrs. Langen and Hundhausen, Germany. Condensing and cooling process, and apparatus to be used therein. June 23.

9450. H. T. Hiliischer, London. Apparatus for mixing gases and for regulating or controlling the pressure or flow thereof. June 28.

9533. H. Gehrke and A. Wohlfahrt, London. Filtering apparatus. Complete Specification. June 30.

9540. C. Steffen and C. J. Laugen, London. Construction of monster centrifugal machines. Complete Specification. June 30.

9638. J. Proctor, Manchester. Apparatus for supplying fuel to furnaces. July 3.

9652. H. H. Lake.—From O. B. Peck, United States. *See* Class X.

9658. W. L. Horne, London. Vacuum distillation. Complete Specification. July 3.

9667. J. G. Lorrain, London. Method of straining or filtering fluids, and apparatus therefor. July 3.

9671. H. E. Moul, London. Centrifugal apparatus for separating fluids of different densities. July 3.

9916. G. A. Godillot, London. Furnaces for burning granular or pulverulent fuel, vegetable matter, and combustible liquids. July 7.

10,009. W. Ackroyd and T. H. Ackroyd, London. Improvements in the means or apparatus for consuming smoke and economising fuel. July 10.

* *COMPLETE SPECIFICATIONS ACCEPTED.*

1887.

10,128. E. Appleby. Improvements in blast pipes. July 14.

10,166. J. Imray.—From A. Moszczensky. Manufacture of refractory crucibles, pots, bricks, and lumps for furnaces. July 21.

10,203. H. C. Bull and Co., Limited, and H. C. Bull. Calcining oven. June 23.

10,861. R. H. Michell. Method and means for consuming smoke and economising fuel. June 30.

11,719. R. Fraser. Apparatus for water-circulating, feed-heating, and water-purifying, and check valves therefor. July 7.

12,180. G. Seagrave. Apparatus for heating or cooling air, gas, or fluids. July 14.

12,963. A. Siegert and W. Dürr. Devices for measuring the density of gases. June 30.

17,081. H. Le Neve Foster. Valves for regenerative or similar furnaces. July 7.

17,290. A. Knoop. Apparatus for evaporating brine and other solutions. July 14.

1888.

6487. G. F. Redfern.—From T. T. A. Hensen. Centrifugal separating apparatus. June 30.

7555. E. Passburg. Vacuum drying apparatus. June 23.

7559. A. Knoop. Receptacles for liquid carbonic acid and other fluids under pressure. June 30.

7587. A. D. Birkovits and G. Koszegi. Material for removing or preventing boiler scale and like deposits. June 30.

8119. C. L. Hett. Centrifugal pumps. July 7.

8624. H. Petersen. Centrifugal separators. July 14.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

8782. W. Fraser, Birmingham. Improvements for the better consuming of smoke and the better combustion of fuel. June 15.

8894. J. Bennett, London. Improvements in gas-pipes or burners for the purification of gas. June 18.

9002. C. Huelser.—From A. Jean, France. A new lighting apparatus serving as a substitute for candles. June 20.

9121. H. D. Richards, London. Improvements in valves applicable in the manufacture of coal gas. June 22.

9239. T. Nicholson, Hucknall. Improvements in gas and coke producers, and in apparatus for collecting the bye-products therefrom. June 25.

9266. G. A. Page and R. Fallnicht, London. Improved fire-lighter (so-called artificial resinous pine). June 25.

9437. J. Morris, London. Improvements in the manufacture of artificial fuel. June 28.

9586. J. Thomas, London. Improvements in apparatus for carburetting gas. July 2.

9696. J. Atkinson, London. Improvements in gas-making apparatus. July 4.

9728. H. H. Doty and The Doty Lighting and Heating Corporation, Limited. Improvements relating to apparatus for utilising liquid hydrocarbons for lighting and heating. July 4.

9879. J. Lindler and J. Burn, Sunderland. A machine for the manufacture of artificial fuel. Complete Specification. July 7.

10,023. T. Taylor-Smith. Improvements in the construction of coke ovens. July 10.

10,043. A. Kitson, London. Improvements in carburetting gas lamps. Complete Specification. July 10.

10,087. J. Ward, London. Improvements in fire-lighters. July 11.

10,137. J. Bowing, London. Improvements in the manufacture of fuel from coal and similar substances. 12 July.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

10,205. H. C. Bull and Co., Limited, and H. C. Bull. Gas producers. June 23.

12,519. J. Orchard and H. Lane. Means and apparatus for producing and utilising heat and energy arising from combustion of gases. July 21.

1888.

6496. E. J. Frost. Devices for regulating the quality of carburetted vapour or gas. July 7.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATION.

9893. J. Jones, Glasgow. Improvements in vertical or inclined retorts for distilling shale, coal, and other analogous substances. July 7.

COMPLETE SPECIFICATION ACCEPTED.

1887.

11,689. A. H. Allen and R. Angus. Treatment of the oil or tar obtained by condensation from the gases of blast furnaces, gas-producers, and coke ovens, and utilisation of the products therefrom. July 14.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

8922. A. Bourg.—From Dahl and Co., Prussia. Improvements in the manufacture of dye-stuffs. June 19.

9280. C. Dreyfus, Manchester. The production of new colouring matters suitable for dyeing and printing. June 26.

9281. C. Dreyfus, Manchester. A method for the production of new colouring matters. June 26.

9600. C. D. Abel.—From the Farbwerke vormals Meister, Lucius, and Bruning, Germany. Improvements in the production of colouring matters. July 2.

9614. H. H. Lake.—From K. Oehler, through Wirth and Co. Improvements in the manufacture of colouring matters. July 2.

9812. J. M. Dalman y Pujadas, London. Improvements in the manufacture of colouring matters. July 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

11,880. C. D. Abel.—From The Actiengesellschaft für Anilin-Fabrikation. Production of azo colouring matters. June 30.

11,976. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Porrier, and D. A. Rosenstiehl. Production of azoic colouring matters. July 7.

12,355. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Porrier, and D. A. Rosenstiehl. Production of new tetrazoic colouring matters. July 7.

12,692. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Porrier, and Z. Roussin. Production of colouring matters by combination of nitrodiazobenzoles and their analogues with isomers of naphthionic acid. July 7.

16,493. J. Y. Johnson.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of azo dyes. July 21.

1888.

6319. J. Y. Johnson.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of dye-stuffs. July 21.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

9116. S. Cooper and T. Cooper, Manchester. Improvements in apparatus employed in the manufacture of "wood wool" or "wood straw." June 22.

9145. R. Haddan.—From P. Moll. Improved process of manufacturing artificial wool from ramie and other fibrous vegetable matters. June 22.

9364. S. Cooper and T. Cooper, Manchester. Improvements in apparatus employed in the manufacture of "wood wool" or "wood straw." June 27.

9429. S. Mason, jun., London. Improvements in apparatus for drying and ageing spun cotton or other fibres. June 28.

9430. S. Mason, jun., London. Improvements in apparatus for ageing and preparing raw cotton or other fibres. June 28.

10,155. W. P. Thompson.—From J. Kaufmann, Cottbus. Improvements in or relating to the manufacture of fancy or two-colour yarns and fabrics. Complete Specification. July 12.

COMPLETE SPECIFICATION ACCEPTED.

1887.

12,506. J. Fitton, J. Fitton, jun., and E. Fitton. Method and apparatus for carbonising or destroying vegetable matter in woollen, silk, or other animal fibre. July 14.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

9044. C. Dratz and H. Dratz, London. Process or method of dyeing or painting on fabrics and other materials, and apparatus employed therefor. June 20.

9105. J. Anners and P. McLean, Galashiels. Dyeing and scouring woollen, cotton, silk, and other yarns in the hank. June 22.

9729. T. Hill and T. Mayfield, London. Improved machine for drying bleached or dyed yarns. Complete Specification. July 4.

9900. J. Mallison, Sharples. Dyeing and sizing yarn, and method of fixing and developing the colours of same. July 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

11,355. W. J. S. Grawitz. Preparation of cotton fibres for dyeing. June 23.

11,394. J. H. Gartside and J. Barnes. Dyeing cotton and other vegetable fibres and yarns, and fabrics composed thereof. June 23.

11,812. J. Smith and P. W. Nicolle. Bleaching cotton, flax, jute, rhea, esparto, and similar fibres. June 30.

12,602. C. T. Clegg, H. A. Clegg, and F. Lee. Apparatus for dyeing wool, cotton, silk, and similar fibrous material. July 21.

14,092. F. Rosskothen. Method and apparatus for dyeing, bleaching, impregnating, &c., yarn in bobbins and cops. June 23.

1888.

3606. R. Cooper, H. F. Clayton, and G. H. Holdroyd. Method and apparatus for scouring, washing, dyeing, and drying wool, cotton, and other fibres. July 7.

5453. Brin's Oxygen Co. Limited.—From L. Q. Brin. Improvements in bleaching. July 21.

7796. C. Bohringer. Method and apparatus for dyeing, washing, and drying fibrous or textile materials. June 30.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

8958. M. R. Wood, London. Improvements in the purification of bicarbonate of soda obtained by the ammonia-soda process. Complete Specification. June 19.

9119. H. Kenyon, Manchester. Improvements in vats for washing soda from Le Blanc balls, producing sulphide of sodium and carbonate of soda by specially prepared carbonic acid, evolving sulphuretted hydrogen to produce vitriol. June 22.

9166. H. Suilliot and H. Raynaud, Manchester. Improvements in the production of iodine and iodine compounds. June 23.

9498. J. Plummer, jun., Edinburgh. Process to prepare hypochlorite of lime. June 29.

9763. J. S. Rigby and A. Macdonald. *See* Class IX.

9835. R. Weiss, Tossen. Improvements in and relating to the manufacture of acetic acid and its bye-products. July 6.

9858. J. Löwe, London. An improved process for the manufacture of sugar of lead. July 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

10,955. L. Mond. Obtaining ammonia, chlorine, and hydrochloric acid from ammonium chloride. June 23.

11,281. T. Schloesing. Extraction of chlorine from solutions of chloride of magnesium. June 30

11,799. R. Wyllie. Apparatus for distilling ammoniacal liquors. July 7.

11,846. G. E. Davis. Improved method of manufacturing alkalis. July 7.

12,700. S. Pitt.—From V. Ragosine and P. Dvorkovitch. Producing anhydrous sulphuric acid and its monohydrate, and utilising for the purpose the acid residues of petroleum production, &c., and sulphates of all metals. July 14.

13,323. E. Solvay. Revolving furnace for the decomposition of bicarbonate of soda. July 21.

14,001. F. Bale. Manufacture of ammonia and chlorine, and apparatus employed therein. July 21.

17,050. W. H. Beck.—From P. de Lachomette. Process and apparatus for the manufacture of sulphate and bisulphate of ammonia. July 7.

17,970. E. W. Parnell and J. Simpson. Treatment of sulphide of ammonium solutions with carbonic acid gas for obtaining carbonate of ammonia and strong sulphuretted hydrogen. July 14.

1888.

5937. A Collingridge. Preparation of salt for medical and table use. June 30.

7754. F. Trickett and J. Noad. Production of soda crystals and of chlorides and oxides of various metals. June 30.

8958. M. R. Wood. Purification of bicarbonate of soda obtained by the ammonia-soda process. July 21.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

8940. H. Finney and W. Sheldon, Burslem. Decorating earthenware and china, consisting of flowers, foliage, and ornament, modelled flat and in low relief, having a background in one colour and raised parts in another colour. June 19.

9228. J. Syer, Manchester. Silvering glass by a cold process. June 25.

9251. H. J. Haddan.—From The Grafflich Schaffgotsch Sche Josephinenhutte, Germany. Improvements in the process of manufacturing articles of variegated coloured glass and the like. June 25.

9495. R. A. Johnson, Manchester. Improvements in rings for ring-spinning and doubling-spinning frames, manufacture of ivory colour, vitreous earthenware, glass, vulcanite, or asbestos. June 26.

9528. O. Gibbons, W. J. Hinton, and F. Gibbons, Brierley Hill. Improvements in the manufacture of ceramic mosaic. June 30.

9556. J. Holroyd, London. Improvements in the construction of faience or glazed terra-cotta mantel-pieces, firesides, fronts of grates and fenders for hearths and firesides, and such like articles. June 30.

9793. T. Taylor and W. Tunnicliff, and W. H. Slater, Birmingham. Improvements in or a new or improved method of decorating or ornamenting the surfaces of china and earthenware goods. July 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

12,765. M. W. Samuel. Manufacture of a plastic compound, and treatment thereof for the production of moulded and decorated tiles, slabs, &c. July 14.

1888.

8129. W. J. Parry and J. T. Welch. Utilisation of slate, slate waste, black grit, or similar waste materials in the manufacture of glass and other articles therefrom. July 7.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

8879. T. C. Fawcett and T. Castle, Halifax. A new combination of machinery for mixing or making cement. June 18.

8987. J. Wilson, Liverpool. Improvements in the treatment of timber for preservative purposes, and in apparatus therefor. June 19.

9559. C. J. Howe, London. The production of a cement or plaster suitable for rapid fireproof plastering, and for all other purposes for which Keene's and other similar cements or plasters are used, and which is capable of being produced at about the price of ordinary plaster of Paris. June 30.

9665. P. M. Justice.—From A. Gravelin, Belgium. Improvements in plastic compounds. July 3.

9761. J. S. Palmer, Forest Gate. Plastic wall-decoration composition. July 5.

9763. J. S. Rigby and A. Macdonald, Liverpool. Improvements in the manufacture of cement from the calcium sulphide waste of Leblanc soda manufactories. July 5.

9986. F. W. S. Stokes, London. Improvements in the continuous and economical manufacture of cement. July 10.

10,078. A. J. Boult.—From K. Standfuss, Germany. Improvements in the manufacture of artificial marble and serpentine. July 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

2619. O. Hughes. Utilisation of a waste product, and manufacture of cement and porcelain.

10,530. J. W. H. James and F. Ransome. Furnaces for burning hydraulic lime, cement, and like substances. June 30.

12,524. G. J. Snelus, W. Whamond, and T. Gibb. Manufacture of cements. June 23.

13,322. E. Solvay. Improvements in lime kilns. July 21.

14,394. G. J. Snelus, W. Whamond, and T. Gibb. Manufacture of cements. June 23.

1888.

7747. G. J. Snelus, J. C. Swan, and H. Smith. Manufacture of cement. June 30.

7798. G. E. Belmor. Apparatus for the treatment of bituminous rock to adapt it for paving and other purposes. June 30.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

8783. R. Evans, London. Improvements in means or apparatus for pressing or consolidating quantities of scrap metal. June 15.

8844. P. Evans, Liverpool. Improvements in the manufacture of steel. June 16.

8862. G. W. Gesner, London. Improved method of treating metals. Complete Specification. June 16.

8925. R. P. Wilson, F. J. Wall, F. A. Thurston, T. L. Bibbins, and W. L. Flanagan, London. Improvements in the manufacture of metals. Complete Specification. June 19.

8961. W. H. Beck.—From A. Lévy, France. Improved method or process for depositing metals from their salts. June 19.

9197. G. W. Gesner, London. Improved apparatus for oxidising the surface of metals. Complete Specification. June 23.

9253. E. Walsh, jun., London. Improvements in blast furnaces. Complete Specification. June 25.

9302. R. F. Starkie and A. Copley, London. Extracting fine gold from auriferous ores or tailings, to be called "The Starkie-Copley vortex amalgamator." June 26.

9391. W. G. Forster, London. Improvements in the manufacture of sodium and potassium. June 27.

9392. A. Wilson and S. Oates, London. Improvements in mechanical appliances for manipulating armour plates and other large slabs and ingots in forging presses. June 27.

9457. G. Theodossieff, London. Improvements in tempering or hardening steel or iron. June 28.

9562. M. Scott, London. Improvements in casting ingots or other masses of metal, and apparatus for that purposes. June 30.

9570. T, W, Helliwell, Halifax. An improved method or process of treating steel, iron, or any combination of such metals to prevent their oxidising, rusting, or corroding. July 2.

9652. H. H. Lake.—From O. B. Peck, United States. An improved process of and apparatus for generating steam from heated or molten slag or like material. Complete Specification. July 3.

9783. A. Feldman, London. Improvements in the production of metals of the earths and alkaline earths. July 5.

9811. T. J. Jones and W. H. Tasker, London. Improvements in the production of blocks or masses of peroxide of lead, and in the production of elements for voltaic batteries, and in apparatus used in the production of such blocks or masses and elements. July 5.

9848. J. Summerhill, London. Improvements in carburising and coating iron and steel sheets, and in apparatus for employment therein, such improvements in carburising and coating being applicable also for carburising and coating iron and steel in the form of hoops or of wrought or cast plates, bars, or manufactured articles. July 6.

9886. C. A. Burghardt, Manchester. Improvements in the reduction of zinc oxides. July 7.

9993. E. Jones, London. Improvements in cleaning tin terne, or other metal plates, and in machinery employed therefor. July 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

9235. J. Treherne. Miners' safety lamps. July 7.

10,135. J. A. B. Bennett. Recovering tin from tin scrap, &c. June 23.

10,199A. H. C. Bull and Co., Limited, and H. C. Bull. Production of aluminium alloys. June 23.

10,204. H. C. Bull and Co., Limited, and H. C. Bull. Air heating stove particularly applicable for metallurgical purposes. June 23.

10,206. H. C. Bull and Co., Limited, and H. C. Bull. Process for extracting metals from their ores, and apparatus therefor. June 23.

11,797. A. M. Crossley, Glasgow. Preparing ferruginous materials for smelting, or for use in open hearth or other processes. June 30.

12,111. W. P. Thompson.—From E. Dumas. *See* Class XXII.

12,347. T. J. Tressidder. Means for hardening metal. July 21.

12,575. A. Feldmann. Production of aluminium and its alloys. July 14.

12,683. F. M. A. Laurent-Cely. Manufacture of spongy lead suitable for electrical accumulators. July 21.

15,504. A. N. Contarini. Process and apparatus for separating precious metals from their ores. June 30.

16,183. J. B. Spence. Treating ores for the extraction of gold therefrom. June 30.

1888.

4418. C. D. Abel.—From M. M. Rotten. Extraction of precious metals from minerals and ores. July 7.

7867. W. Crookes. Treatment of auriferous ores, and revivification of the materials used in such treatment. June 30.

7995. H. H. Lake.—From E. Hardmeyer, H. W. Hatch, and J. C. Jackson. Method of converting iron into steel. July 7.

8223. A. H. Reed.—From G. Conkling. Magnetic separator for extracting ferruginous matters from ores, &c. July 14.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

8905. H. Lahousse and Co. and C. Collé, London. Improvements in electric batteries. June 18.

9005. F. Wynne, Westminster. Improvements in dynamo-electric machines. June 20.

9206. C. Lüteke and P. George, London. Improvements in galvanic elements or batteries. Complete Specification. June 23.

9250. Sir S. Forbes, Bart., London. An improved form of voltaic cell, the positive element in which consists of an amalgam of mercury with zinc and sodium, or zinc and potassium. June 25.

9308. J. Edmondson, London. Improvements relating to dynamo-electric machines. June 26.

9381. A. Imschenetzky, London. Improvements in electric batteries. June 57.

9584. S. Miller, London. Improvements in galvanic batteries for electric lighting and other purposes. July 2.

9811. T. J. Jones and W. H. Tasker. *See* Class X.

9854. L. Bristol, London. Improvements in and connected with secondary batteries or electrical accumulators. July 6.

9910. G. Kapp, Manchester. Improvements in and relating to continuous current dynamo-electric machines. July 7.

10,088. J. V. Sherrin, London. Improvements in and connected with primary batteries. July 11.

10,102. W. R. Lake.—From Lacombe and Co., France. Improvements in electric batteries. July 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

10,177. E. L. Mayer and H. Leipmann. Manufacture or treatment of porous pots, plates, or partitions for electric batteries. June 23.

10,199. H. C. Bull and Co., Limited, and H. C. Bull. Electro-metallurgical processes and apparatus therefor. June 30.

10,555. C. P. Elieson. Electrical batteries. June 30.

11,252. H. Mower. Secondary batteries or accumulators. July 21.

11,390. J. S. Stevenson. Manufacture of elements or plates for secondary batteries or accumulators. June 23.

11,502. E. F. H. H. Lauckert. Dynamo-electric and electro-dynamic machines. June 23.

14,270. B. J. B. Mills.—From E. Emerson. Means or apparatus for the production of sheet copper by electro-deposition. June 30.

1888.

1128. A. A. Fortin. Galvanic batteries. July 7.

7536. B. Willcox.—From T. P. Whittier. Galvanic batteries. June 23.

7541. W. P. Thompson.—From H. W. Spong. Dynamo-electric generators. July 7.

7853. W. P. Thompson.—From C. D. P. Gibson. Storage batteries. June 30.

7977. H. G. Morris and P. J. Salom. Mode of filling secondary battery plates. July 7.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

9089. F. Wheen, London. Improvements in the manufacture of household and toilet soaps. June 21.

9123. T. S. Steen, London. An improvement in the manufacture of soap. June 22.

9161. A. Macqueen, Tunbridge Wells. The use of wheat as a substitute for soap, and for the introduction of wheat in the manufacture of soap, to reduce its price and improve its quality. Complete Specification. June 23.

9187. E. A. Ashley, Darlington. Metal and marble polishing and cleaning soap. June 23.

9264. H. Lissagaray and A. Chereau, London. Improved process for the extraction of the oil from the livers of cod and other fish. June 25.

9369. J. Campbell, Dundee. Improvements in the manufacture and preparation of oils. June 27.

9477. W. T. Hicks and J. Elliott, Middlesbro'-on-Tees. An improved lubricating composition. June 29.

9768. S. C. Fenton, J. Fitton, jun., and J. Fenton, Leeds. Improvements in or in the manufacture of soaps and soap compounds. Complete Specification. July 5.

9796. J. M. McCallum, Glasgow. An improved soap powder and the method or means of manufacturing the same. July 5.

9847. M. Taylor, Glasgow. An improved soap compound. July 6.

9857. J. J. Bowley, London. Improvements in the manufacture of soap and detergents. July 6.

9974. J. H. Barry. *See* Class XVIII.—C.

COMPLETE SPECIFICATION ACCEPTED.

1887.

15,774. C. Williams. Purifying compounds for textile materials and washing powders. July 7.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

9436. C. Harrop.—From W. D. Field, United States. Improvements in varnishes and lacquers. June 28.

9980. T. Christy. *See* Class XIV.

10,158. P. White, London. Improvements in printing inks and similar colouring materials. July 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

11,805. S. Banner. Treating resins, oleo resins, gums, pitches, varnishes, bitumens, &c. July 7.

11,879. C. D. Abel.—From C. Wachendorff. Production of compounds of antimonic fluoride with alkaline fluorides, and application thereof, and of compounds thereof, to dyeing and printing. July 21.

12,736. R. Ashton. Preparing blue for laundry use. July 21.

13,671. H. Siebert. Process and materials for producing a substitute for gutta-percha. July 21.

15,406. A. Orr. Improvements in making white lead. July 21.

1888.

6396. P. Hanlon. Preservative composition or polish. July 14.

7929. T. Garton and W. Barkley. An improved black varnish or enamel. July 7.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

9033. F. W. P. Swinborne, London. Improvements in the treatment of hide or skin to obtain gelatinous matters. June 20.

9866. F. W. P. Swinborne and L. P. Swinborne, London. Improvements in the preparation of gelatinous matters. July 6.

9902. J. Myers, London. An improved process of preparing hides and skins for tanning. Complete Specification. July 7.

9980. T. Christy, London. The manufacture of a new or improved composition to be used as a cement or glue or for moulding purposes; or as a substitute for gutta-perchas and the like. July 10.

10,138. J. Myers, London. An improved process of preparing hides and skins for aluming and dyeing. Complete Specification. July 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8369. E. Gerson. Compounds for chemical tanning, and process of tanning without the use of tan bark or tannic acid. July 14.

9353. W. P. Thompson.—From J. P. N. Bidron. Compounds for use in tanning, and manufacture of the same. July 7.

12,396. J. Pujos. Manufacture of leather from rabbit skins. June 30.

XV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

9563. T. C. Darby and G. C. Phillips, London. Improvements in the preparation of manure and in apparatus to be used for this purpose. June 30.

9750. B. Piffard, London. Improvements in the manufacture of manure. July 4.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

8766. A. G. Wass, Westcombe Park. Utilising the residues from the manufacture of starch, glucose, starch-sugar, dextrine, and alcohol. June 15.

9183. G. Fletcher. — Partly communicated by C. A. Matthey, Demerara. Improvements in apparatus for use in boiling and evaporating sugar and other liquids. June 23.

9305. J. W. Bailey and J. A. R. Greaves, London. The manufacture of a new or improved saccharum for the use of brewers, distillers, and vinegar makers. Complete Specification. June 26.

9320. A. H. J. Bergé, Liverpool. Improvements in the acid saccharification of amylaceous substances. June 26.

9617. J. R. Scully, London. Improvements in the construction of sparging apparatus. July 3.

9775. C. Steffen and C. J. Langen, London. An improved process for rapidly refining sugar in loaf form through the combined systematic or simple purification of the loaves with pure liquor within the form under pressure, subsequently driving off the superfluous liquid and regaining the same by means of the centrifugal apparatus, and the apparatus for carrying the process into effect. Complete Specification. July 5.

9888. D. Stewart, Glasgow. Improvements in sugar-cane mills. July 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

7555. E. Passburg. *See* Class I.

7640. W. P. Thompson.—From Diehl and Mensik. Substance for filtering or decolouring liquids, applicable for treating sugar juices, and method of preparing the same. June 30.

8248. E. Keirby. Adhesive mucilage. July 7.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

9210. A. Boake and F. G. A. Roberts, Stratford. An improved means of applying certain antiseptic agents to beer or other fermented drinks. June 25.

9305. J. W. Bailey and J. A. R. Greaves. *See* Class XVI.

9401. V. D'Ostachiewicz and L. De Gerliez, Paris. Improvements in the process of alcoholic fermentation. Complete Specification. June 27.

9895. J. A. McGill, Leeds. The utilisation of the refuse from breweries, distilleries, &c., as malt hops. July 7.

9961. Baron S. Stempel and N. Warenzoff, London. Improvements in the purification of alcohol. July 9.

10,020. W. P. Thompson.—From C. Pfaudler, United States. Improvements in the manufacture or treatment of beer or other fermented liquors or beverages. Complete Specification. July 10.

10,091. J. W. Throop.—From T. D. Jones, United States. An improved process of cleaning and purifying malt, and improved machinery or apparatus therefor. July 11.

COMPLETE SPECIFICATION ACCEPTED.

1887.

11,376. F. G. Burton and T. S. Coleman. Method and apparatus for cleaning malting tiles and brewing coppers and refrigerators. July 14.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

8816. D. T. Gordon and J. M. Lawson, London. Preserving foods. June 16.

9380. A. N. Ford, London. Improvements in treating eggs. June 27.

9952. A. B. Lennox and W. Brown, London. Improvements in the manufacture of cocoa and cocoa products. July 9.

B.—Sanitary Chemistry.

8891. J. A. Muller, London. Improvements in the prevention of fermentation or decomposition of animal and vegetable substances, and in apparatus applicable therefor. June 21.

9312. B. Jagger, London. Improvements in the means employed for purifying sewage and other water. June 26.

9576. R. Hope. *See* Class XIX.

C.—Disinfectants.

9974. J. H. Barry, London. Improvements in antiseptic and disinfecting soaps. July 10.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1887.

10,864. A. R. Roosen. Improvement in the preservation of fish and other substances, and a preparation of antiseptic material for use therefor. July 14.

1888.

6741. G. A. Brinck and A. W. Rehnstrom. Manufacture of food for animals. June 23.

B.—Sanitary Chemistry.

1887.

11,551. T. M. J. Truchelut and J. N. Truchelut. Process and apparatus for treatment of sewage, &c., for extracting ammonia and oxidising sulphur compounds. July 14.

1888.

7583. H. E. Newton.—From A. Ripley. Purification of water, factory slop, and sewage. June 23.

C.—Disinfectants.

1887.

10,747. A. Boake and F. G. A. Roberts. Means and apparatus for disinfecting and deodorising; and for producing spray of antiseptic agents. July 14.

12,222. R. V. Tuson. Preparation of materials to be used as disinfectants, deodorisers, and antiseptics. July 14.

12,483. J. Bennett. A new disinfectant. July 14.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

8840. A. Boake and F. G. A. Roberts, London. An improvement in discharging excess of bleaching agent from paper pulp after bleaching. June 16.

8981. C. D. Aria, London. Improvements in the treatment or preparation of paper, cardboard, paper pulp, leather, and other fabrics and metals to render the same impervious to the action of acids, water, air mineral oils, and other liquids or gases. June 19.

9106. J. H. Annandale, Glasgow. Improvements in preparing pulp for paper-making machines and in apparatus therefor. June 22.

9321. L. G. Danielson, Liverpool. Improved paper, and improvements in manufacturing a paper sized on one side and unsized on the other, or more impregnated with size or glue on one side than the other. June 26.

9339. T. Goodall and T. Webster, London. Improvements in apparatus for straining pulp. Complete Specification. June 26.

9576. R. Hope, Dalkeith. The purification of waste liquors in the manufacture of paper and other industries. July 2.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

12,702. P. E. E. Pesier. Treatment of vegetable materials to fit them for the manufacture of paper, pasteboard, &c. July 21.

13,255. A. B. Warhurst. Paper for toilet and other purposes. July 7.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

9858. J. Lowe. *See* Class VII.

9869. Watson Smith, Liverpool. Improvements in or relating to treating saccharine so as to obtain it in a pure crystalline form, and in dissolving saccharine so as to produce a sweet liquid for medicinal purposes. July 7.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

COMPLETE SPECIFICATION ACCEPTED.

1887.

12,521. J. Brown. Preparation of films for photographic purposes in monochrome or polychrome. July 7.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

8916. C. W. Curtis and W. J. Brown, London. Improvements in the manufacture of pellets and other forms of compressed gunpowder for military and other purposes, and in apparatus therefor. June 18.

8995. E. L. Zalinski, London. Improvements in dynamite or similar shells and fuses therefor. Complete Specification. June 19.

9104. R. Crooke, Liverpool. Improvements in the construction of drying stoves, particularly applicable for use in the manufacture of gunpowder. June 22.

9164. T. G. Hart, London. Improvements in explosives for use in firearms. June 23.

9424. S. Shaw, Manchester. Improved blasting cartridge. June 28.

9494. F. J. Beattie, London. Improvements in the manufacture of explosives. June 29.

9799. J. A. Wanklyn, London. A smokeless explosive. July 5.

9954. H. N. Morgan, London. A torpedo. July 9.

9961. M. E. Hall, London. Improvements in torpedoes. Complete Specification. July 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

4713. C. D. Abel.—From H. Schöneweg. Improvements in explosive compounds and safety cartridges for blasting purposes. June 30.

12,111. W. P. Thompson.—From E. Dumas, Agent for Bickford Smith, and Co. Electric fuses for mines. July 14.

12,424. E. D. Müller. Explosive compounds. July 14.

1888.

7497. H. J. Allison.—From A. S. Fitch. Explosive compounds. June 23.

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ON THE PRESENT POSITION AND PROSPECTS OF THE COAL GAS INDUSTRY.

BY LEWIS T. WRIGHT.

It is not my intention to trace step by step the progress of gas lighting from its foundation to its present position of importance and prosperity, or to review its history, unwritten or otherwise, though the subject would, I am sure, be interesting as well as instructive.

The coal gas industry has been a manufacture somewhat apart from others of the same kind, since it has been protected against its own competition by the parliamentary interference which has been required for the limitation and control of its powers and privileges.

In the earlier days of gas lighting the competition which raged in some parts was doubly detrimental to the public interest, both in regard to the streets and needless expenditure of money. It is the gas consumer who in the long run pays for any extravagance in the cost of production.

Though the history of gas lighting in this country contains, as I say, useful lessons, especially as regards man's feebleness and myopy as a legislative creature, I do not propose to enter into it.

I may be permitted to note one of its striking features, and that is the remarkable and prophetic instinct that seemed in its darkest hours to animate the high priests of the cultus with faith and conviction in the greatness of its future.

In all groups of human actions linked together for the attainment of a certain aim, and possessing a continuity of action in the search after that aim,—and which, in cases where the object sought for is reached by the transformation of useless materials into valuable objects, and the direction of undirected and uncontrolled forces into controlled and directed ones, thereby become arts or industries—the influence of the environment, the century, and even the most accidental circumstances happening during its early infancy, give a determination, manner, and rate of progress to the course pursued, and they further serve to form a matrix of tradition in which the ideas that afterwards may govern its operations are cast.

The manufacture of coal gas (I refer specially to the manufacture and not to its distribution), is unquestionably a process of chemical engineering, and should be carried out in the full light of rapidly increasing chemical knowledge. The construction of the plant used in the manufacture is a purely engineering business, and the form to be given to this plant must be controlled by practical experience; but this experience will be more ripened by leaning on chemical rather than on mechanical science.

From its origin the manufacture of coal gas has been regarded as an engineering operation, and this because, I suppose, in the first foundation of gas undertakings, and afterwards in their rapid development, constructive undertakings requiring mechanical skill occupied a very large share of the total attention paid to the business.

The industry having been thus moulded as an engineering business, and having from the first taken an engineering attitude, has acquired a certain habit of adherence to traditionary types of apparatus and modes of operation, of which habit it is itself unconscious, yet which is a striking feature to those outside its boundaries—a habit I do not think it would have contracted had it started in the world as a chemical manufacture.

I say that when by common consent you pursue gas manufacture as an engineering business you give it a different course and rate of development than that which it will bear if pursued as a chemical industry.

I think it will be admitted that independently of the vast services rendered to the manufactures, trades, and commerce of this country by the introduction of coal gas as an illuminating agent, it has also been of immense special service to practical chemistry by the origination of valuable crude chemical products that would otherwise not so soon found a place as fresh centres of chemical manufactures. I think, too, that had it been carried out and treated as a chemical manufacture, it would have taken a higher position amongst industrial arts than it now occupies, and would have enormously assisted the progress of the study of chemical science in this country.

I do not find fault with this early attempt on the part of our gas industry to ally itself preferably to civil engineering, for it seems to have been but natural under the circumstances, and we must remember that in the days of its origin chemical science was not so developed as engineering; but I think it has too long left the higher developments of chemistry unexplored for knowledge that might advantageously be acquired to its own profit.

It is quite true that many scientific chemists have from time to time interested themselves in the manufacture without being able to leave behind as a mark of their genius some improved process.

This is because they acted only as amateurs and not as professionals actually controlling the manufacture, and were not able to acquaint themselves with the absolutely practical routine, which, however empiric it may be in appearance, is yet the essential primary element of its success.

Before the profoundest chemist can invent processes for us to use he must be a practical gas maker, and intimately acquainted with the exigencies of public lighting, and that is why in ours, as in so many other industries, the purely practical man is infinitely more useful and valuable than the purely theoretical man.

A strongly chemical element will some day infuse itself into gas manufacture. The recent movement in this direction could be traced to the imposition of sulphur clauses about 15 years ago.

One of the drawbacks of the engineering character, a drawback also due to the semi-public nature of the business, is the massive and permanent character given to the constructions, some of them wholly unnecessary, to be found in our gas works, as though every detail of the process were ever going to remain the same.

There are works in this country which would not stand a moment's criticism from the point of view of the economical handling of materials, yet so massive and costly in character that one would tremble before pulling them down to be replaced with others less costly to run. I am no advocate of slovenly, ricketty structures, but in a manufacturing business which by all analogy should suffer modifications, every unnecessary construction should have a sound *raison d'être*, both from considerations of first cost and maintenance.

There is also a general adoption of one set of rules for calculating the capacity of certain apparatus, quite regardless of the fact that different coals differ immensely in character.

In many cases a few series of experiments costing but little, but, conducted according to the scientific method and set out with the intention of obtaining a definite answer to a definite question, would have saved the gas interest many hundreds of thousands of pounds; but what is everybody's business is nobody's business, and each one seeks for his own information in his own way.

The coal-gas business is rich enough to provide for itself an experimental station, where all these questions could be thrashed out in the general interest by a scientific staff.

There is another factor which has had an important influence on the development of improvements in gas manufacturing processes, and that is routine, by which I mean, that regularity in its internal arrangements—that rigid discipline in the organisation of its operations which is absolutely essential to its existence as a business of a public nature.

It is no use saying to a gas consumer that you are out of gas, but that you are expecting a stock in shortly if he will call again in a few days. The gas business has always been denied this sublime privilege of the trader.

There must be a certain routine, and how strong this routine must be in a well-conducted undertaking no one practically unacquainted with gas supply has any idea.

Every one knows how inflexible and inelastic some public bodies are when regulated by a severe routine or red tape, but the public is almost unconscious of the severe routine of a properly-organised gas undertaking.

Works impressed with this routine, protected against competition and debarred from reaping the proper rewards of progress, were not the places where you would expect to find people disposed towards radical changes. All things considered, it surprises me that there has been so much progress in the past as there was. Before introduction of the sliding scale what incentive was there? Witness the state of gas affairs in Paris.

Certain events such as the sliding scale, the sulphur clauses, the energy displayed during the electric lighting scare, and the recent crisis in residual products show that the gas industry is far from being inelastic, and that it possesses a power of economically adapting itself to its environment.

There is one duty it was unfortunate that the gas industry did not take upon itself in its first formation, and that is the actual supply of light, by accepting the responsibility over the whole business from the gas retort to the gas burner, not confining itself to the supply of gas to the gas meter. It has been too late ever since to secure this advantage.

It must not be forgotten that gas light companies only supply potential light, and that however carefully the gas may be supplied and distributed throughout a district, and that however perfect all the arrangements may be, so far as the operations of the gas undertaking are concerned, yet some small imperfection in the internal gas-fitting arrangements, beyond the point where the responsibility of the gas undertaking ceases, may cause the gas supply to be of a most imperfect character.

By far and away the larger portion of the complaints made by gas consumers of bad gas arise solely and entirely from imperfectly arranged gas fittings and burners. It is certainly a weak point in our industry, that all its efforts to produce a satisfactory and competent supply of good gas should be brought to a standstill by matters beyond its control.

Had the installation of the gas fittings and burners been part of the duty of the gas undertaking, the strongest calls of self-interest would have rendered these the most perfect part of the whole business of the supply of gas. As it is they are generally the most imperfect.

That there would have been also a more rapid improvement of gas burners is also probable.

It does not seem, however, that the progress of gas lighting could receive a check, and in spite of bad trade and all the evils of a prolonged and severe commercial crisis, in 1887 the gas sold was 4·25 per cent. in increase of the previous year; since 1883 the sale has increased by over 21 per cent. In 1887 8,657,731 tons, or about 5½ per cent. of the total coal raised in this country, was employed for gas manufacture here.

There is one feature of this increasing business which deserves a moment's attention, and that is the fact that the average gas consumer uses more gas year by year. Whilst the year 1887 showed an increased consumption of 4¼ per cent., the increased number of consumers was only 1·69 per cent.; and taking the period of five years ending 1887, whilst the increased gas consumption was over 21 per cent., the gas consumers had increased 8·03 per cent. This shows that the gas consumer appreciates the various advantages of coal gas and is willing to avail himself of its services.

It is true that a few years ago the gas industry received a shock from the electric lighting scare, and more recently suffered actual loss of revenue by the combined action of the increased knowledge in the carbonisation of coal for the recovery of products and the commercial crisis that followed on the heels of the practical applications of this knowledge; but there are few undertakings that ought not to have been able by this time to recover from the effects of that loss of revenue.

The actual damage done by these events was far less serious than was anticipated.

Whilst the progress of the gas industry has been up to the present time uninterrupted, events have really been developing themselves that cannot fail to produce an influence on its future, and that it will be necessary to take seriously into consideration. I refer to the cheapness of petroleum and similar mineral oils and the increasing improvements in electric lighting.

It was for some time the fashion for electricians to predict the immediate downfall of gas lighting, which was to be replaced *in toto* by electric lighting. In this they made the usual mistake of prophets. They prophesied too much. In the same manner the friends of the gas industry were equally at fault in sneering at and ridiculing the early attempts at electric lighting. It must be self-evident that electricity is securing a place as a lighting agent, and it would be a misfortune to science if the splendid efforts of electrical invention in this direction did not meet with the proper reward. No such misfortune is, however, likely to fall upon electrical science.

I have been at some pains to ascertain the cost of mineral oil lighting with the various lamps in use. The best result obtained was with a duplex lamp burning paraffin retailed at 8*d.* per gallon. The cost per 1,000 candles per hour was 5·63 pence. The extreme result the other way was with the same lamp burning petroleum at 1*s.* per gallon—when the cost per 1,000 candles per hour was 11 pence. A Lampe Belge gave 1,000 candles per hour for 7·9 pence with petroleum oil retailed at 1*s.* per gallon.

Compare these details with Nottingham gas sold at an average price of 2*s.* 3*d.* per 1,000, which will give easily the following results:—

	Per 1,000 Candles.
Schulcke regenerative lamp yielding 10 candles per foot	2·7
Wenham............ „ 7 „ „	3·9
Flat-flame burner... „ 3·5 „ „	7·7

Cost for cost mineral oils will stand no chance against coal gas amongst that class of consumer which can afford to expend the small capital required for a gas light installation.

In such matters the actual relative costs of two systems of lighting are far from being the only considerations. Where the difference in cost is not very considerable there are sure to be other elements that in every case will turn the scale one way or the other. There is little doubt that very poor people who live from hand to mouth would employ mineral oil even if it were considerably more costly for light than gas.

Mineral oil affects the gas industry in this country as a limitation to the extension of gas into the homes of poor people. It will have to be very much cheaper before the more comfortable class of consumers or factories will employ it instead of gas. In Brussels a few years ago, when the gas was sold at 4*s.* 6*d.*, petroleum offered a strong competition with coal gas, but a reduction in the price to 3*s.* 2*d.* per 1,000 brought back the fickle gas consumers, and the consumption has since increased. The increased favour the petroleum lamps enjoyed seemed to have an influence on the fire statistics, which showed that in 1886 12 per cent. of the fires attended by the brigade were caused by petroleum, whilst in 1887 the amount reached 25 per cent. I do not regard the competition of petroleum with coal gas as likely to be severe, but as acting as a barrier for the extension of gas lighting in small installations which it might be necessary for the gas industry to exploit. To effect this the gas undertakings will have to abolish the charges for connecting the mains to the houses and possibly institute a system of more frequent collections of the gas rental, say once a week or month instead of once a quarter as is customary now. Experiments in this direction are being tried, and it remains to be seen with what success; but in applauding the energy that seeks to offer a competition to mineral oil lighting itself, I think there is a more serious matter to be entertained in resisting the competition of electric lighting on the better class of installations.

Just as coal gas is infinitely superior all round to mineral oil as an illuminating agent in its ease and simplicity of management and its applicability to various purposes, and will continue to receive a preference even if more costly light for light, so will electric lighting, for certain installations where difficulties in maintaining low temperatures exist, offer a strong competition against gas lighting even if more costly light for light.

It is quite useless for the gas industry to deny the general charges brought against gas lighting for such installations to argue that sulphur is a useful element as a disinfectant, and so on. There is a deal of exaggeration about these evil effects of gas lighting on valuable pictures, decorations, and other accessories of plutocracy. To begin with, a very small percentage of gas consumers are in possession of these luxuries. That is not the point. If there exists a large class of people who hold these views it is no use for us to argue the point with them, but we must offer them a system of lighting against which these objections cannot by any means be urged. The gas industry cannot govern the public taste, and must accept it as it is. Now every charge of atmospheric pollution and heating where the heating is an inconvenience or undesirable, is capable of being met by showing that with a suitable system of gas lighting not only can the whole of the products of combustion be prevented from ever entering the atmosphere of the room, but actually be utilised as a means of inducing currents of air for ventilation purposes. I have had some experience in ventilation systems of lighting and cannot find, when these are properly designed, a single charge to bring against coal gas lighting. Every objection is removed. It is useless in these cases to say that the atmosphere is polluted, that pictures are being destroyed, &c., &c. On the contrary the hot air, heated from any cause, corporeal or otherwise, in the apartment, is being gently drawn away. The successful installation of these ventilation systems of gas lighting is a matter requiring some experience, and above all a strict compliance with natural laws. I have seen scores of so-called ventilating systems which simply act the wrong way about, and lead to the condemnation of the system. Each case has to be dealt with on its own merits, and its special difficulties suitably avoided. The first thing to secure is a current of air in the flue pipes *always travelling in the right direction*; this being arranged one can go ahead.

On whom is to devolve the development of this rational system of gas consumption? It is quite certain that the present personnel of gas undertakings, which has already sufficient to engage attention in the improvement of gas manufacture and distribution, does not provide the artistic technical skill of the right kind. In the majority of cases the best burners for the ventilation systems of lighting are the regenerative ones, though in many cases the sunlight is convenient, though never so economical, as the duty given by the burners used in these is but one-half of that given by the ordinary regenerative types. The difficulties connected with the artistic arrangement of exposed flue pipes can only be met by architects and artists acquainted with such matters, but I can see no difficulty in these being worked into the general design for the ornamentation of the ceilings. The regenerative lamps certainly require more attention than open burners. The glasses require cleaning and the lamps and burners some care. These are just the sort of duties householders object to and will not undertake, and if not undertaken by some one else interested, these regenerative lamps will not become very popular. How this question of ventilation systems of lighting with intensity burners is to be met in all its difficulties is one of the questions the gas industry itself has to solve. The advantages are great. The heated air is drawn out of the top of the room, where there is usually no circulation at all. I have never found any difficulty in letting air into an apartment. The difficulty is to get the bad air out, and the bad air finds its way to the top. For want of some efficient system of the kind, electric lighting is displacing gas on many important and valuable installations—the sort of lightings that form the backbone of the business and will do so to a larger extent in the future. The gas undertakings themselves must engage in this matter, but it cannot be done with any final advantage with the present staff, without enlisting the services of suitable individuals. A new element will have to be introduced, an admixture of the architect and ventilating and lighting engineer.

As regards the cost of electric lighting it is impossible to secure a practical basis of comparison. I have the schedule of rates of an American electric lighting company, where the light is supplied on a time basis, and I find, assuming the candle power of the lamps to be equal to that stated by the undertakers, that the cost per 1,000 candles per hour for commercial lighting, supposing also that the consumer takes the full time allowed under the particular rates, ranges from 8·3 pence to considerably over 30 pence according to the length of time the light is employed.

But just as it is not possible to compare gas and mineral oil lighting on a basis of cost, light for light, so is it also not possible to institute a comparison between gas and electric lighting. Any one system could obtain a premium over the others if it possessed a greater number of advantages for the case specially in question.

I do not advocate universally systems of ventilation gas lighting. In numerous cases the heat as well as the light from a gas burner is valued and appreciated. To many small gas consumers the small gas burner in use in the kitchen or living room is at once a source of warmth as well as light. In cold weather—and it is in cold weather that light is most wanted—the gas lighting in a house very often avoids the use of a fire. I advocate ventilation systems of lighting for those cases where the gas consumer objects to the products of combustion entering the atmosphere of the apartment, and where he would willingly relinquish all claims to every thing the coal gas affords other than light.

I lighted a large and badly ventilated office with a ventilation system, and though the light was considerably more brilliant than under the old system, the difference in temperature was so great that at first every one complained of the cold. This was, under the circumstance, the greatest compliment that could be paid to a ventilation system, that the room, though more brilliantly lighted, felt cold.

I cannot see on what grounds people talk of the light of the future. There is no one light of the future, there will be several. People do not adopt one mode only of locomotion: some have to walk, others are satisfied with an omnibus or railways, others use four-wheeled cabs, others again indulge in hansoms, whilst some are driven in their own carriages. Each of the three principal systems of lighting will have a place in the future according to their respective deserts and adaptabilities to certain grades of public wants. A healthy competition should not be feared between them. Coal gas stands in the middle, and will have to rub shoulders with both mineral oil and electric lighting, and, according to the ability of those entrusted with its development, will it hold its own and take its share of the new lightings. Cost, though not being an absolute and final basis of comparison, is still a very important factor, and any economies on the cost of production of coal gas resulting in a lowering of the retail price will assist the extension of its use for lighting and heating purposes. But just as cost is not an absolute basis of comparison between one lighting agent and another, so is it not an absolute measure between different gas supplies. Any attempts to sell gas at a low price regardless of its quality and conditions of supply will only injure the cause. You cannot judge of a gas supply by its cost per 1,000, and its quality as determined by the average photometric tests. When a gas user complains of the gas being bad, the chances are nine to one that he is referring, not to its candle power per unit of volume, a matter he knows nothing about, but a deficiency of light due to a deficiency of pressure and therefore of supply. These complaints, generally arising from matters beyond the control of the gas undertaking, such as bad gas-fittings, though sometimes from defective arrangements in the distribution of the gas, irregularity in the quality both as regards candle power and pressure, are most destructive to the confidence of gas consumers. A low pressure uniformly low is better than high and low in a fitful manner. 16 candle gas, not varying a quarter of a candle either way, is much better than 20 candle gas one day and 14 the next. A high average of illuminating power thus obtained may cover matters that have caused the gravest discontent amongst the consumers of the gas. The same remarks apply with equal force to variations in the gas pressure. Low priced gas, which is achieved by starving everything, and which, by being carelessly prepared and distributed, is spasmodically varying in its character from time to time, is a thing to be avoided by the gas industry at least

It is also unfortunately the fact that many large provincial towns have not arrived at the same perfection of gas purification that obtains in London. I cannot speak on this subject without giving offence, and I do not wish to do that. The gas in London, and also now in some places like Nottingham, is absolutely free from carbonic acid, and does not contain more than about 12 grains of sulphur other than H_2S per 100 cubic feet, an amount that can well pass until some means are found for dealing with it.

Those who are content to leave in the gas all the carbon bisulphide it originally contains are not doing well by their industry. The carbonic acid, and also atmospheric air, which latter has unhappily a luring sort of charm as an aid to gas purification, are both to be shunned by gas makers, whose duty it is to turn out the best article in his power, not only with an eye to the photometer and the London Argand burner, but to the burners most in vogue.

It is with this spirit that I shall consider the question of possible economies in the cost of production. If I were offered, in the interest of the gas industry, two alternatives, either a reduction in the price or improvements in all the conditions of its supply, I would unhesitatingly accept the latter.

Among the events that have been recently happening to the injury of the gas industry is the carbonisation of coal for its products without regard to the sale of illuminating gas. The monopoly in gas tar and ammonia no longer exists, and what appeared as an expanding and certain source of revenue is now limited.

It is therefore not possible to look to these as a means of reducing the price of coal gas.

There can be no doubt now that oven coke, gas-tar, ammonia, and coal gas benzol can be obtained from the same plant.

Such plant can work to nearly double the advantage of coal-gas plant, working in summer as in winter. It can work with a plant of very low cost compared with coal-gas plant, and designed at much less expense for labour in running and wear and tear. The recent prices of coal-tar products, moderate as they are compared with what they were only five years ago, have already started the carbonising works; but these carbonising works will suffer a very severe competition from coke ovens with products recovery, which will do all that the carbonising works can do at a less cost.

It is not possible to look to residual products as a means of reducing cost of manufacture.

In reviewing possible economies in the cost of production, it is necessary to consider the question of yield of gas per ton of coals carbonised.

In 1857 the average production in this kingdom was 8,500 cubic feet, and it has been rising since, until in 1887 it reached 10,156 cubic feet. The question of the commercial advisability of obtaining high yields of gas is, to my mind, very largely answered by this fact, that there has been always a progress in this direction. But if it be desirable to argue this question on *à priori* grounds, we must first learn in what manner the luminosity of the gas is effected by the production of an increased volume; to know, in fact, what is the ratio of the loss on the one hand, to the gain on the other. For several years this subject has engaged my attention—a subject that it will be admitted, is even at this time in the regions of surmise. The serious study of this question in regard to the production of various yields of gas by carbonising coal in *clay retorts* at various temperatures has always forced me to one conclusion, though on a serious question of this kind one hesitates at the too ready acceptance even of one's own results, if they be opposed to prevailing views. Having constantly obtained certain practical results, and having from time to time verified and re-verified them, I have endeavoured also to put myself in the position of being able to explain these results on scientific grounds. It will hardly be necessary to state that with experiments of this kind, working with a material like coal, which is not homogeneous, and under practical conditions of high temperature distillation, where it is not possible to secure the same degree of almost absolute control of all the dominant influences, as in our laboratories, and where consequently large groups of experiments have to take the place of single experiments to arrive at a fine result, one has to deal with averages.

It has always been a favourite idea with our critics that whilst increasing the production we are diminishing collaterally the illuminating power; and this idea seems still as strong as ever. The results of my experiments, which have been made on different occasions, uniformly bring me to the conclusion that with yields ranging between 7,500 and 12,000 cubic feet per ton, an increased yield of 50 per cent. in volume is attended with a loss of only 10 per cent. in the illuminating power, and that in increasing the production from 11,000 to 13,000 cubic feet, the loss of illuminating power is scarcely perceptible. I cannot now, without great labour and occupying a deal of time, enter into the details of my experiments, but must be content with the broad results. Where any progressive practice sets up in a manufacture in almost every centre, and stands the test of time, I am inclined to think it is *primâ facie* sound; and I am prepared to say that my investigations provide a complete justification for this particular practice.

Theoretically (if we accept the result above given as correct), from 1857 to 1887 the illuminating power of the gas will have diminished to the extent of about 5 per cent., but the gas consumer will have been compensated by a reduction approaching 27 per cent. in the price of the gas by means of the increased volume of gas obtained from the coal. But I am not prepared to admit that there has been in these 30 years even a diminution of 5 per cent. in the luminosity. On the contrary, practically there has been a gain in the actual luminosity. This may seem a paradox, but within these 30 years there have been great improvements in the routine before mentioned, and the gas is much more carefully manufactured and purified, as it is also more carefully tested. A low yield of gas does not, in practice, mean gas of either good or uniform quality, it simply covers infinite carelessness.

The yield of gas as obtained at the station meter does not actually represent the actual quantity made in the gas retorts, but only more or less approximates to it. There must always be a degree of uncertainty about the actual quantity made in the retort, because it is difficult to estimate what may be lost there and in its after treatment. It is not difficult to make the gas in the retort, the principal art is in getting it all away without loss.

A clay gas retort after a little use becomes cracked in almost every direction, besides being originally porous, but by one of those happy compensations that nature knows so well how to provide, clay retorts are tolerably tight by virtue of the deposit of carbon that forms on their interior surfaces and even in their cracks and pores. At the same time an absolutely tight clay retort does not exist, but, thanks to this carbon deposit and the ease with which holes can be filled with fire-clay, they are, or should be, relatively sound. A clay retort that has been long in use, but well covered with a carbon deposit and free from palpable holes, will leak perhaps four cubic feet of gas per foot super of internal heating surface per 24 hours under half an inch of pressure, and double that quantity under one inch of pressure. This quantity of four cubic feet, when the retort is producing 140 cubic feet of gas per foot super, represents a loss of about three per cent. of the production. A retort that is palpably leaky may leak any quantity of gas. A loss of from 20 to 30 per cent. of the production can easily happen at half inch of pressure in retorts recently "scurfed." It is therefore very difficult to compare the statistics of gas production of 1857 against those of 1887, but it goes without saying that the temperatures are higher now than then, but not so much higher as might be inferred from the increased yield, because carbonisation receives more attention and care than of old.

It is not my experience in practical working that low yields are attended by higher illuminating power, but the contrary. The careless working that produces loss of volume generally produces low and ununiform quality.

I do not give half an inch of pressure as the average obtaining in gas retorts, but use that figure as a basis for the discussion of the subject. My experiments show that within such small ranges of pressure as do occur the loss, all other conditions being the same, is directly proportional to the pressure.

Thirty years ago the difference between the gas made and that accounted for after its distribution was 25 per cent. of the production in the case of undertakings which do not now lose more that 5 per cent.

There is then a possibility of some reduction in the cost of production being obtained by increased yields, but this will only arrive to any considerable extent if the gas profession convinces itself that improvement in this respect is possible.

Of late years, whilst the average yields per ton for the United Kingdom have been rising, it is only by very small increments—thus in

1883 the production was 9,969
1884 ,, ,, ,, 10,068
1885 ,, ,, ,, 10,066
1886 ,, ,, ,, 10,101
1887 ,, ,, ,, 10,156

Reviewing all circumstances connected with cost of production, it does not appear probable that any very radical reduction can take place in the cases of those undertakings already selling gas at a low price —and it is very questionable whether any permanent benefit would result by a straining after low cost without regard to quality, and—what is equally important all round—efficiency in the supply. The points that must, in my opinion, receive competent attention are—

Improvements in gas-lighting ventilation systems to suit the wants of that large and increasing number of cases where the light only is required, and not increased temperature. I have satisfied myself by several installations that this can be done.

Improvements in the regulation of pressure, which is as much a measure of quality of the gas to the user as is its candle power per unit volume.

At present the pressure is regulated by a system of prevision controlled by warnings. What is required is the perfection of a purely automatic system.

The cure of naphthaline deposits in service pipes, &c. This subject requires a serious study from a chemico-physical point of view.

In the case of Nottingham, where the trouble was very intense at times, the nuisance has been practically abated. This was in consequence of information obtained by a special study of the causes that gave rise to it.

Improvements in gas purification. I do not refer to gas undertakings like the metropolitan companies and some others in the provinces, which leave little to be desired in that respect. Absolute freedom from sulphur is a matter to be aimed at.

Reduction in the cost of production and subsequently of selling price. These will come but not to any phenomenal extent. The working expenses of gas companies have decreased 15 per cent. since 1883, so there is all evidence of activity in this direction; but I feel there are matters for the gas industry to deal with more important than this one of price. I am bound to admit that this recent reduction of 15 per cent. in cost of working has not been done with the slightest sacrifice to efficiency. But reductions will not, with the larger undertakings, arrive in any phenomenal manner.

There are no magnificent discoveries to be made that will revolutionise the industry. Coal will not be cheaper, but, if anything, dearer shortly,—though dearer coal means better prices for coke. Residual products are no longer an unexplored Eldorado.

It is possible that a new method of carbonising coal might be arrived at that would dispense with the present piecemeal system of carbonising in small portions, and be carried out at less expense for labour and wear and tear; but I admit the first beginnings in this direction have not been made, and even if it were possible, without losing efficiency in other directions, to reduce these items to one-half, that would represent about 3*d.* per 1,000.

In increased and intelligent attention to gas lighting is to be found the most certain means of maintaining its position in the future. That this attention would be found by the holders of the 60,000,000*l.* of capital invested in this country in gas making if it were felt to be essential to the prosperity of the industry, there can be no doubt. As I have remarked, there has been no break in its progress even up to the present time. But it remains to be seen what value three factors that have been recently developing, viz., carbonisation of coal for residuals, cheap mineral oil, and improved electric lighting, will assume as factors of resistance to its progress.

My own opinion is that gas lighting will be as useful to civilisation in the future as it has been in the past, and that it will advance with the times and adapt itself to new conditions.

DISCUSSION.

The Chairman considered that the meeting had to thank Mr. Wright for a very thoughtful and intelligent inquiry into the present position and future prospects of the gas industry—one which would commend itself by its results and details to the minds of many who had studied the question carefully. He would suggest two reasons why gas lighting originally leaned towards engineering rather than chemistry: firstly, that at that time chemistry did not exist on the scale upon which it was now contemplated; secondly, that chemists were then absolutely ignorant of engineering. We had to thank gas lighting for teaching the immense importance of engineering in connexion with chemistry, and in proportion as other branches of technical industry learnt the same lessons, so would they make the same advance which the gas industry had made already. At the same time it was true that the gas industry had suffered from a lack of chemistry in many of its developments. He had been interested in the remarks made with respect to petroleum oil being the rival of gas for the poor, because they seemed to him to be true and yet not altogether true. The most enthusiastic users of gas were those people who had small houses and wanted to be saved the trouble of lamps. They were the best customers of the gas companies, for their reckless extravagance exceeded that of any other class of users. Where uneducated people were in charge of large buildings, too, it was the practice to use the gas indiscriminately for heating purposes. He spoke from painful experience of the gas bills of the School Board, in which case no amount of authority could stop the gas being lit every cold day. It would be found, he thought, that the very poor used petroleum, but that small householders used gas with the most magnificent extravagance. He was glad to have heard Mr. Wright's strong comments on the defective nature of gas lighting in houses. Undoubtedly the insufferable badness of the average run of burners would account for a vast proportion of the complaints against the gas, and anything that could be done to instruct the user in the necessity of seeing that efficient gas lighting required something more than a burner with two holes of more or less approximately identical size, would tend towards a more economic use of gas. Mr. Wright had spoken of a time coming when we should have architects who would also be ventilating engineers. When that happy day arrived it would be not only the gas industry that would benefit, though one important industry—the medical profession—would suffer.

Mr. T. Tyrer wished to ask the author one or two questions. He might perhaps have failed in catching all that Mr. Wright had said, but there appeared to him to be an absence of speculation upon what might be called the future of gas products. He presumed that in that matter everything would depend upon the advance of science. Still it would have been very interesting to have the views of so expert an engineer and chemist as Mr. Wright upon the probable future utilisation of those residual products. He remembered hearing in that room a discussion on the utilisation of tar as fuel—not so much on account of its cheapness as fuel, but as a means of getting rid of an offensive and superfluous product. He would have been glad to have heard whether there had been any further development in the utilisation of tar as fuel, or whether any other outlets had been discovered for tar as such. So far as he could see, the demand for the residual or final products seemed to keep up; but he would be glad to hear Mr. Wright's views as to whether the present development of the gas industry was directed towards lessening the amount of those products or increasing it with a view to their utilisation in the chemical industries proper. It appeared that the gas engineer had it in his power to produce either more or less of these residuals. The engineer in question was, of course, as much a necessity as ever, but the scientific manipulation of the gas industry seemed to be coming more and more into the hands of such men as Mr. Wright; and it would be interesting to know whether they were aiming at the production of the best quality of gas that could be got—*i.e.*, of the highest illuminating power—or the utmost possible yield of gas together with a large quantity of residuals at a high market value. He supposed that there were conditions under which there could be obtained a maximum yield of both gas and of residual products; and, as a commercial man, he should aim at getting such products, and in such quantity as to bear relatively the highest value. That course might be impossible; but he would be glad to hear from Mr. Wright whether such a point had been attained; if not, why; and whether it was likely to be attained in the future. It might appear absurd to put the proposition in that way; but on the whole he thought it a fair one, and he would be glad of the opinion of one of so much experience as Mr. Wright.

Mr. W. Crowder said there was one point of the subject which the author had somewhat skipped over, and in respect of which it would have been interesting to have heard what progress had been made. Some years ago the late Mr. Siemens, in a paper read before the Society, had called attention to the desirability of applying gas to heating purposes. Since then there had been a considerable extension of the idea, though to what extent he did not know. But he knew that some gas companies were offering to lend stoves as an inducement to people to burn gas, and it would have been interesting if Mr. Wright had given the meeting some account of the progress made in that direction. There was, no doubt, from what Mr. Siemens had said, that there was the probability of a large extension of the consumption of gas in that way, though he believed it would be necessary to produce gas of a lower quality for the purpose. As chemists, he thought they were all interested in that particular direction. There were many cases in the chemical manufactures where gas might be used with advantage and economy.

Mr. B. Blount wished to ask the author whether he had compared the cost of gas illumination when ordinary or regenerative burners were used with that of gas consumed in any of the recently-produced incandescence systems of lighting—the Welsbach or others.

Mr. F. Darlington quite agreed with the author in hoping that in the future chemists would be found at the head of gas companies instead of engineers; at the same time our thanks were due to the engineers who had to a great extent been the pioneers of those undertakings. Referring to the author's remarks as to the desirability of the gas companies having control of the internal fittings, he thought that was a delicate matter. Probably the old saying that "An Englishman's house is his castle" would be found to apply, and consumers would greatly object to the gas companies interfering. But so far as showing consumers the most economical methods of burning gas and the best form of burners to use, he thought the idea was perfectly right.

Mr. Lewis T. Wright, in reply, said:—As to the question of the residual products which interests Mr. Tyrer, the position is simply this: we no longer command a monopoly of the production of these bodies. As I have said to-night and on other occasions, the increased knowledge which exists as to the carbonisation of coal tar for chemical products permits people to perform the work at the pit's mouth, thus enabling them to compete with gas companies in the sale of the crude products. And since they have the same material to deal with that we have, and can deal with it, if not by the same methods, yet on the same principle, they are enabled to produce anything that we can produce. The effect of this will naturally be to limit the prices which we can obtain for these said products. There is no question, as I said once before in this room, that only about 5 per cent. of the coal tar produced ever comes into chemical manufactures, though we may get, perhaps, 28 per cent. of creosote and a large quantity of pitch. So that much remains to be done towards the utilisation of the great bulk of coal tar products in actual chemical manufactures, where they have to be altered in constitution. But whatever may be done in the future—and great things will be done—we shall always have this carbonisation of coal at the pit's mouth, either by plant taking its form from gas-making plant, or by coke ovens. We shall always have something which will limit the price of the crude tar products; so that I cannot see any future development in the utilisation of these products likely to affect our industry. The remarks made by our Chairman were not absolutely in accord with what I stated. I said that the poorer classes, who live from hand to mouth, would use mineral oil in preference to gas even if it were more costly; but the small class of consumers who are thrifty unquestionably use gas largely, and find that the light they have in the kitchen serves them for two purposes, and they appreciate it on that account. But this question of gas lighting for large places requires attention. I have given it a great deal of attention myself, and I am satisfied that good results can be obtained. I have tried some of the recent systems, and am convinced that they are correct—but they will require much care, knowledge, and experience, which will have to be bought. I have not compared the cost of ordinary gas lighting with that of incandescence systems. But the gentleman who asked the question will be able to calculate out the cost per 1,000 candles, which is the basis I have taken. I should like to impress upon the meeting that there are three things which will exert an influence on the future of gas lighting, and that those three things have come into prominence within the last five years. They are (1) the limitation of our monopoly of the production of residuals; (2) the cheapness of mineral oil (which I do not think is serious, but which acts as a limitation to our efforts to extend the use of gas in the poorer class of houses; and (3) electric lighting. But, as I have already said, I feel sure that gas lighting will find ways of meeting all this competition.

NOTE ON SO-CALLED "CAMPHOROGENOL."

BY C. T. KINGZETT, F.I.C., F.C.S.

In the June number of this Journal there is a note by Mr. H. Yoshida, in which that gentleman states that "camphorogenol" is not a peroxide, and does not give peroxide of hydrogen when shaken with water. That statement is perfectly correct, and my present object is to call attention to the fact that in all probability camphorogenol is merely a solution of camphor in ordinary camphor oil. In a paper read before the Society of Chemical Industry somewhat recently,* I discussed the evidence on which the supposed existence of that substance is based; and since that time I have ascertained, by careful experiment, that it is very difficult to free oil of camphor from dissolved camphor by freezing. Indeed, I have ascertained that when camphor is dissolved in air-oxidised camphor oil, even to the (added) extent of 20 per cent., none of it can be removed therefrom by freezing. It is therefore almost certain that the camphor which Yoshida obtained from his oxidised oil (which had been previously subjected to freezing) was pre-existent, and resulted merely from the concentration which ensued upon repeated distillations. Personally, therefore, I am convinced that camphorogenol has no existence, and it is not to be confounded with my camphoric peroxide which yields peroxide of hydrogen when placed in contact with water as represented by the following equations:—

$$C_{10}H_{16}O_3 + H_2O = C_{10}H_{16}O_2 \text{ (soluble camphor)} + H_2O_2.$$

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* J. Soc. Chem. Ind., Feb. 29, 1888, pp. 67–69.

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Communications.

THE TREATMENT AND DISTILLATION OF PEPPERMINT PLANTS.

BY ALBERT M. TODD.

It has been claimed that the herb peppermint, when freshly cut, yields more oil than when dried. Is this so, and does the increased yield of oil compensate for the increased expense of shipping the fresh herb to the distiller?

This question has long been a disputed one, and the discussions have attracted the interest of both scientists and manufacturers. That the importance of making a determination which would be satisfactory and final will be better understood, I will, before stating the results of my experiments, give a brief description of our novel industry, which is rapidly increasing in importance and proportions, prefacing the description with the single remark that distillation is effected with *three-fold rapidity from the dry rather than from the green plants.*

There are now (in 1888) cultivated annually in the United States (almost wholly in the States of Michigan and New York) over 20,000 tons of peppermint plants, yielding over 120,000 lb. of essential oil, thus requiring on the average the production and handling of about 350 lb. of plants in the undried state for a single pound of the essential oil. There are now in America about 250 small distilleries where the crude or natural oil is produced, each distiller distilling, beside his own crop, the plants of about 10 neighbouring growers on the average, making the number of persons engaged in the industry as principals over 2,500, beside a large number of workmen employed in the cultivation and distillation.

The distillers' charge for working up the plants of other growers has by custom been based upon the number of pounds of oil obtained rather than upon the quantity of plants, the present rate in Michigan being 25 cents for each pound of essential oil. This custom is most satisfactory to the grower, as he pays only according to his receipts, but it will be seen that it is not equitable for the distiller *unless the plants are well dried prior to distillation.*

The manufacturing system may be briefly noticed as follows:—The plants having been cut when in full bloom, are drawn to the distilleries, either with or without curing, according to the notion of the grower. The essential features of the distillery are: first, a large boiler for the generation of steam; second, a pair of large wooden vats about 6 feet in height and of equal maximum diameter, which are connected with the boiler with steam pipes, which enter them at the bottom (two vats being used so that one may be emptied and refilled while the other is running); third, a condensing apparatus, which consists of a series of pipes coated with pure tin, either with or without the ordinary "worm," over which cold water is made to flow continuously, this condensing apparatus being connected by a duplex or "changing valve" with the tops of the distilling vats at pleasure; lastly is the receiver, in which the essential oil is collected, the ordinary form of which is a metallic vessel about 12 inches in diameter and 3 feet in height, from the bottom of which an exterior pipe leads to a height nearly equal with the body of the vessel. Recently I have constructed a much more efficient and elaborate receiver for rapidly separating essential oils both heavier and lighter than water; but as this paper is not intended as a technical treatise on apparatus, it will not be described here.

About three inches above the bottom of the distilling vats are placed "false bottoms," containing many perforations, underneath which the steam enters from the boiler. Upon this perforated false bottom is placed a strong iron hoop having a diameter nearly equal with the vat, and supplied with heavy cross-bars. Two pairs of strong chains are secured to this hoop, meeting at the top of the vat in a pair of rings, one of which is fastened on either side of the vat at the top while it is being filled. This apparatus, as will be seen, is for the purpose of drawing the charge from the vats after distillation.

The apparatus being in position, the plants are thrown in by a workman with an ordinary hay fork, while two or three others are engaged in "tramping them down." After the vat is about one-third full, a small supply of steam is let in, which softens the plants and greatly assists in packing. When filled, the vat is closed with a steam-tight cover, and the other charge being now distilled, the entire amount of steam is turned on in the new one. The steam comes up through the perforations of the false bottom, and is diffused evenly through the plants. The oil is contained entirely in minute cells in the leaves and blossoms. The action of the steam is two-fold. It softens the tissues of the oil cells, and at the same time, by its heat, causes an expansion of the particles of oil, so that they burst forth from their miniature prisons and are carried off with the current of steam. The steam, now charged with the essential oil, upon reaching the top escapes into the condensing apparatus, where it assumes the form of oil and water. Separation takes place in the receiver, the water, being heavier, sinks to the bottom and is forced by the pressure from within upward and out through the exterior pipe referred to. The oil collects on the top, and is dipped off at pleasure.

As stated, distillation can be effected with threefold the rapidity from the dry plants, for the effect of drying is to soften the plants, allowing a larger quantity to be used for a charge, while such large charge can also be distilled in one-half the time required for a smaller quantity of green plants. But many growers, fearing that a loss of oil results from drying by diffusion in the atmosphere, cannot be prevailed upon to bring their plants to the distilleries other than in a green state. The *extremes* of difference which I have noticed are as follows:—From a charge of 2,000 pounds of dry plants, well covered with leaves and blossoms, thoroughly dried, I have obtained 20 *pounds* of essential oil in 30 *minutes*, an hourly rate of two tons of plants and 40 pounds of oil; from a similar charge of very coarse plants, with few leaves and blossoms, distilled in the green state, *less than two pounds* were obtained, *requiring one hour for their distillation.*

Upon a clear day in September, in the middle of the day, when no dew or moisture was present, two loads of peppermint plants were cut down side by side at the same time. Both loads were immediately raked up in the green state, containing all the natural juices of the plant, then drawn to the scales and weighed. One load was immediately distilled, the other load being spread upon the ground and dried for two days in the sun. At this time the plants had become freed from nearly every particle of moisture, the leaves being so dry and brittle as to break off quite readily in handling. This second load, which had thus been dried in the sun and open air, was now spread out in a loft and exposed to a farther drying and the action of the atmosphere for a little over six months.

The first charge of peppermint, *which was distilled in the green state,* weighed 2,332 lbs., and produced 6 lbs. 9 ozs. of essential oil, being 1 lb. of oil for each 355·35 lbs. of plants, or 0·2814 per cent. After the second load had been dried and exposed to the atmospheric action, as stated, for over six months, it was then taken from the loft and distilled. I would say here that all the oil in the peppermint plant, as indeed in most if not all essential oil plants, is obtained from the leaves and blossoms, and this load of plants being extremely dry, and having been handled over a number of times, lost in the handling some of the leaves and blossoms. However, in distilling, the yield was more than one pound of essential oil for each 362·5 lbs. of original green plants, which slight loss (about two per cent. in the amount of essential oil), is certainly to be accounted for fully by the portion of blossoms and leaves which rattled off in the re-handlings. The charge of peppermint, which was thus fully dried, had shrunk 49·4 per cent. of its original weight.

It will thus be seen that although the plants are very aromatic both before and after cutting, *there is no perceptible loss of the essential oil by the most thorough drying prior to distillation,* the oil being so tightly sealed in its little prison cells, that a force greater than that existing in the atmosphere or the rays of the sun is necessary to free it. Indeed, I have noticed that the leaves which fall off from the plants in dry seasons and remain upon the ground over winter, even though subjected to rains and snows as well, are often found months afterwards to be so strong that one would hardly suppose that any of the strength had passed off. It is known, though, in practical experience, that when the plants are once thoroughly dried and subjected to rains, the water carries off a portion of the oil, acting in that respect as a slight distilling force.

It is not within the scope of the present article to treat of the chemical effect produced upon the oil by the action of the atmosphere, the tests of the oil, &c. Such determinations may be found by consulting the papers referred to in the note below. The principal results of the experiments recorded herein may be summarised as follows:—

First, in the treatment of peppermint and such other American essential oil plants as have been examined, no perceptible loss of essential oil by diffusion in the atmosphere is occasioned by a thorough drying of the plants in the open air at any ordinary temperatures prior to distillation.

Second, when the drying of the plants is continued through many months a slight oxidation of the oil in the leaf occurs through contact with the oxygen in the atmosphere, decreasing its solubility and increasing its specific gravity, also slightly raising its boiling point through the formation of a non-volatile and insoluble resinoid produced by oxidation.

Third, a long exposure of the plants to atmospheric action prior to distillation does not perceptibly affect the crystallising tendency of the essential oil, nor other of its physical tests except those noted, so far as investigated.

Fourth, to obtain the best results, both as to the quality of the essential oil and the economy of transportation and manufacture, the plants should be dried as thoroughly as possible without endangering the loss of the leaves and blossoms in handling. Distillation should then take place as soon as convenient, to prevent the oxidation of the oil in the leaf by atmospheric action.

Note No. 1.—During the past few years the consumption of peppermint has rapidly increased, so that statistics of production and distilleries now given show a marked increase over those given in my former papers on analogous subjects, which may be found as follows:—In the "Proceedings of the American Pharmaceutical Association" for 1886, page 121, and the "American Druggist" for September 1886, page 161.—A. M. T.

Note No. 2.—Since writing the above, I notice a paper by Mr. Joseph Schenk in the "American Druggist" for June 1888, which corroborates the determination given in the above paper. Speaking of the crystals in the leaves of plants which have been dried for 50 years, he says:—"It is remarkable how long these crystals will remain in the dried leaves. Fragments from an herbarium specimen gathered in Europe in 1827 contain them in as perfect a condition as leaves of plants collected quite recently."—A. M. T.

THE ACTION OF SULPHUR CHLORIDE ON OILS.

BY CHAS. A. FAWSITT, F.R.S.E., F.C.S.

The action of sulphur chloride upon oils has long been known, and, moreover, turned to practical account by manufacturers. Interesting papers have recently been published on this subject by J. Carter Bell and T. P. Bruce Warren, who propose to employ this chloride as a reagent in the testing of oils and fats.

About two years ago I made a series of experiments on the same subject; and, seeing the matter was at present attracting attention, resolved to collect for publication any of my notes which might be of interest.

The first point which must strike the experimenter is the heat reaction between the chloride and certain oils, and which is more marked than when using sulphuric acid (Maumene's test). It occurred to me to make a series of experiments to see if characteristic results could be obtained which might be turned to some account as a test for oils.

The method of procedure was as follows:—30 grms. of oil were weighed in a small beaker, which was then placed into a somewhat larger beaker, and the space between them packed with cotton wool. The temperature of the oil having been taken, the chloride was poured in slowly during constant stirring, and the time having been noted the thermometer was kept stationary until the temperature ceased to rise, when it was noted down, and also the time.

The chloride used was light in colour, and was practically pure S_2Cl_2. This is an important point to observe so as to ensure agreeing results, and which, I note, is mentioned by Warren. By using a dark chloride which contains SCl_2, and varies much in composition, satisfactory results could scarcely be obtained. A chloride which on distillation gives any distillate under 130° C., and leaves above 2 per cent. of solid residue behind, should be rejected. I experienced no difficulty in carrying out the trials with any oil, except castor oil, which was found to be almost unmanageable with pure chloride, as you cannot, on account of its high viscosity, stir in the chloride quick enough to prevent the oil being attacked locally, and it gets very lumpy, some of the oil at the same time being left untouched. This was specially the case when the higher percentage of chloride was used. It suggested itself to dilute the chloride with bisulphide of carbon or benzoline, but this I thought would introduce an error, as the loss of heat occasioned by the evaporation of the solvent would vary as the temperature was high or low.

The results are tabulated, and for the different oils, when 2 cc. of chloride were added, the rise in temperature varied from 0·5° C. per minute in case of palm-nut oil to 27·7° C. for castor oil; for 3 cc. of chloride from 1° C. per minute for palm-nut oil to 27·3° C. for cod-liver oil; and for 4 cc. of chloride from 1°—1·4° C. per minute for palm-nut oil to 48·7° C. for linseed oil.

No doubt castor oil would exhibit a higher rise per minute than cod-liver for 3 cc. added; but the only reliable experiment was with 2 cc. of chloride. The manner in which the temperature rose was noticeable; for instance, with rape and lard it rose very slowly at the commencement, and afterwards proceeded quickly, whilst in the case of others—for instance, linseed and castor—it begins to mount up at once. It would almost seem that in examples of the former type some decomposition had to be effected before the chloride could act freely.

Seeing that the majority of the oils used in the trials were compounds of fatty acid with glycerol, the action of chloride was tried on glycerol, oleic, and stearic acids. It seemed to have little or no action on glycerol, the rise in temperature, as shown in the table, being due, I think, to the decomposition of the chloride by the water contained in the glycerol. It has also little action on stearic acid, but with oleic acid it shows a heat reaction somewhat similar to olive oil, but the product was in no case solid, a result which surprised me.

During the action of the chloride there is in some cases a copious evolution of hydrochloric acid gas—for instance, with palm, cod-liver, castor, rosin, and mineral oils—whilst in others, with seal, rape, and olive oils, the reverse was the case. The evolution of gas had in some cases a marked effect in stopping the rise in temperature, notably in the case of mineral and rosin oils.

In all cases, with the exception of palm oil which appeared to get thinner, the oils were thickened by the action of the chloride, and when the higher proportions were used the resulting product was usually solid. Sperm oil was a notable exception, as, although it became somewhat more viscous, it did not show any signs of solidifying even with 5 cc. of chloride.

A large proportion of the oils solidified long before the maximum temperature was reached.

The solidified oil had usually characteristic physical properties, such as elasticity, colour, transparency, dryness, &c.

As regards the chemical reaction which takes place between the oil and the chloride, it is usually regarded as one in which sulphur replaces hydrogen, and, the latter combining with the chlorine, is evolved as hydrochloric acid. This does no doubt take place to a certain extent with all the oils, although the gas in some cases is not evolved visibly, but besides HCl there is very often SO_2 and H_2S given off in small quantities. I remember that during these trials I wore a silver watch, and it was turned quite black in a short time.

As regards constitution, the oils experimented upon, excepting sperm, rosin, and mineral, are regarded as a mixture of two or more glycerides of fatty acids, glyceride of oleic, stearic, and palmatic acids predominating, with the exception of rape,

Oil.	Specific Gravity.	Number of cc. S_2Cl_2.	Rise in Temperature.	Time in Rising.	Rise of °C. per Minute.	Final Condition of Oil.	Colour of Oil after Experiment.	Gas Evolution.
	°C.	cc.	°C	Mins.	°C.			
Sperm	·882 at 16	2	37	16	2·3	Liquid	Little darker	Very small.
"	"	3	54	11	4·9	Liquid more viscous		
"	"	4	71	8	8·8	Liquid more viscous		
"	"	5	86	6	14·2	Liquid very viscous		
Seal	·923 at 16	2	45	10	4·4	Liquid more viscous	Little altered	None.
"	"	3	79	6	13·2	Solid sticky	Darker	
"	"	4	112	5	22·4	Solid dry	Darker	
Whale	·918 at 16	2	57	6	9·4	Liquid more viscous	Darker	Slight.
"	"	3	71	5	14·1	Liquid very viscous	Darker	
"	"	4	91	3	30·2	Solid dry	Very dark	
Neatsfoot	·916 at 16	2	51	7	7·3	Liquid more viscous	All darker	Slight.
"	"	3	66	5	13·2	Liquid very viscous		
"	"	4	82	4	20·5	Solid sticky		
Lard	·914 at 16	2	40	16	2·4	Liquid very viscous	Not changed	Slight.
"	"	3	62	9	6·9	Solid, got dry on standing		
Rape	·914 at 16	2	53	10	5·3	Liquid more viscous	Not changed	None.
"	"	3	66	7	9·3	Solid, slightly sticky		
"	"	4	89	6	14·8	Solid dry		
Cotton seed	·922 at 16	2	49	11	4·4	Liquid more viscous	Darker	Slight.
"	"	3	64	9	7·1	Liquid very viscous		
"	"	4	93	6	15·4	Solid sticky		
Linseed	·933 at 16	2	57	5	11·4	Liquid viscous	Little darker	Considerable.
"	"	3	79	3	26·3	Liquid very viscous		
"	"	4	97	2	48·7	Solid sticky		
Olive	·916 at 16	2	52	6	8·7	Liquid viscous	Little changed	Slight.
"	"	3	69	5	13·7	Liquid very viscous		
"	"	4	94	4	23·5	Solid dry		
Caster	·9627 at 15·5	2	56	2	27·7	Liquid very viscous	Little changed	Abundant.
"	"	*3	68	3	22·5	Solid sticky	Darker	
Cod liver	·928 at 15·5	2	55	4	13·7	Liquid viscous	All darker	Abundant.
"	"	3	82	3	27·3	Solid very sticky		
"	"	4	103	3	34·3	Solid dry		
Mineral	·893 at 15	2	25	16	1·5	Liquid	Much darker	Abundant.
"	"	3	27	12	2·2	Liquid		
"	"	4	29	11	2·6	Liquid		
Palm	§·858 at 98	†2	35	3	11·6	Semi-solid	Darker	Abundant.
"	"	†3	45	2	22·5	Solid		
Palm nut	§·867 at 98	†2	5	9	0·5	Solid	Little changed	Slight.
"	"	†3	8	8	1·0	Solid		
"	"	†4	9	7	1·4	Solid		
Rosin	·987 at 16	2	31	7	4·4	Liquid more viscous	Darker	Abundant.
"	"	3	33	4	8·2	Little more viscous		
Oleic acid	·8982 at 0·16	2	53	6	10·6	Liquid viscous	Darker	Considerable.
"	"	3	74	5	14·9	Liquid viscous		
"	"	4	99	6	16·5	Liquid viscous		
Stearic acid	"	2	‡5	7	0·7	Solid	Darker	None.
"	"	4	‡8	5	1·6	Solid		
Glycerol	"	4	21	7	3·0	Liquid	No difference	None.

* Unreliable. † Initial temperature, 34° C. ‡ Initial temperature, 65° C. § From Allen's Organic Analysis.

which is said to be composed principally of glyceride of brassic acid. That the action of chloride on oils producing a solid product is due to the presence of the glyceride, is almost proved by the difference in the case of sperm oil, which does not give a solid product, and which is composed principally of oleic ethers of the higher monatomic alcohols, glycerides being almost entirely absent. Mineral and rosin oils, which consist chiefly of hydrocarbons, likewise give a liquid product.

It seems strange that the action of chloride on those oils which are thought to be approximately of the same composition should be so different—one giving off a large quantity of gas, another little or none, and at the same time giving different heat reactions and final products—for instance, palm-nut, linseed, and lard oils, which are said to consist principally of glyceride of olein.

No doubt the action of chloride on oils will help to elucidate some interesting points as to their constitution when their reactions are better understood.

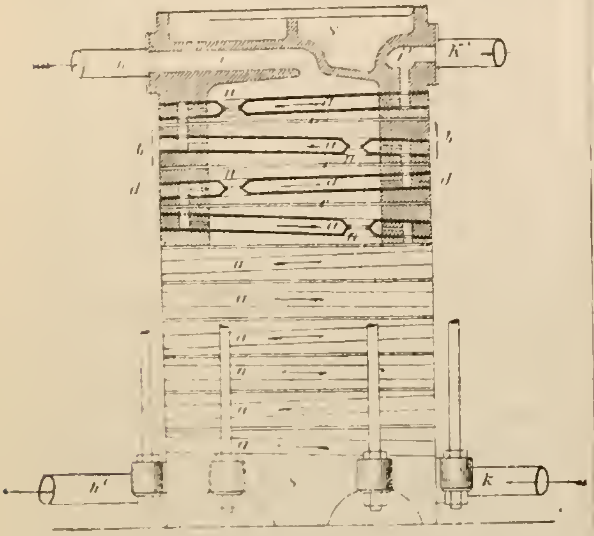
Journal and Patent[*] Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in Apparatus for Cooling, Heating, or Purifying, Liquids, Gases, Vapours, and the like. A. J. Boult, London. From J. Fischer, Vienna. Eng. Pat. 9199, June 28, 1887. 8*d*.

The primary object of this invention is the heating and purification of feed-water used in steam boilers. One of the several modifications described is shown in Fig. 1.; *a a* are plates with frames *d d* between them, forming hollow chambers and separated by frames *b b*, the series being held together by means of tie rods between the end castings S and S¹. The space in the chambers *b* and also that between the plates *a* communicate with each other by ports shown in the sides of the apparatus. Feed-water to be heated enters at *h*, passes over the surfaces of *a a* from one to the other by means of hole *n*, and finally leaves the apparatus at *h*, steam similarly enters at K, and in a reverse direction to that of the water leaves at K¹. The water condensing between the plates enters a vessel closed to the air, and is returned to the boiler by means of a pump. The specification contains 13 clauses covering modifications described of the apparatus.—C. C. H.



Apparatus for Purifying and Softening Water. G. E. Stead and R. Lancaster, Leeds. Eng. Pat. 7726, May 26, 1888. 8*d*.

The apparatus provides for the heating of the water by means of steam coils for the expulsion of the carbonic acid and precipitation of carbonate and sulphate of lime, the water being afterwards cleared by passing through filters.
—G. H. B.

Apparatus for Purifying and Softening Water and Preventing Incrustation. J. Langstaffe and H. D. Peckover, London. Eng. Pat. 8003, June 1, 1888. 6*d*.

A circular brush of vegetable or other fibre or metallic wire for placing in boilers with the object of attracting to it all impurities or mineral matter existing in the water.
—G. H. B.

II.—FUEL, GAS, AND LIGHT.

Preparation of Water Gas. J. Lang. Dingl. Polyt. J. **269**, 130.

An account of researches to determine the degree of interaction of the constituents of water gas at various temperatures, with special reference to methane.

Temperatures under 600° were determined by Naumann's method (Ber. **18**, 1648, and this Journal, 1885, 487), above 600° by observations of the fusion of metals and salts. The reactions took place in a porcelain tube filled with fragments of porcelain.

I. Interaction of CH_4 and CO_2.

Temperature.	CO_2 Percentage in Original.	Percentage Composition of Product.	
		CO_2.	CO.
814°—703°	41·0	41·0	0·6
1054°—954°	33·3	26·8	6·4
1054°—954°	29·4	20·1	8·2

In these experiments, as with CH_4 above, some carbon was separated.

II. Interaction of CH_4 and Aqueous Vapour.

$$T < 1{,}054° \ (-\ Cu) > 954\ (+\ Ag).$$

The gas was saturated with aqueous vapour by passing it through hot water.

Temp. of Water.	Percentage Composition of Product.					
89°	$CO_2=1·2$	O=0·5	CO=2·8	H=48·8	$CH_4=43·5$	N=3·2
96°	5·0	—	9·4	47·1	37·3	1·2

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[*] Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*.	½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*.	1*d*.
„ 1*s*. 6*d*., „ „ 2*s*. 4*d*.	1½*d*.
„ 2*s*. 4*d*., „ „ 3*s*. 4*d*.	2*d*.

The following reactions have therefore taken place :—

$$CH_4 + H_2O = CO + 3\,H_2;$$
$$3\,CO_2 + CH_4 = 4\,CO + 2\,H_2O;$$
$$CO_2 + C = 2\,CO.$$

In these experiments also carbon was separated.

The following results were obtained in passing CO_2 over heated graphite; (*a*) at 600° some CO was formed; (*b*) at 954° the resulting gas contained 90 per cent. CO. With aqueous vapour the following; (*a*) at 600°, some H formed; (*b*) at 1,000°, the resulting gas had the following composition: CO. 19·4, H 13·6, N 67·0 per cent. The latter resulted from the air carried forward by the steam; CO_2 was absorbed by the water over which the gases were collected.

III. Action of Oxygen upon Carbon.

The forms of carbon experimented upon were blast furnace graphite and retort carbon. The experiments at the lower temperatures (500°) were performed in glass tubes.

(*a.*) *With Retort Carbon.*

Percentage Composition of Product.				Time of collecting 100 cc.	Remarks.
—	CO_2.	CO.	N.		
1	89·4	8·4	2·2	2 minutes	Carbon well under red heat.
2	89·2	8·5	2·3	2 ,,	
3	90·0	7·8	2·1	4 ,,	
4	90·4	7·2	2·4	10 ,,	
5	91·4	6·1	2·5	20 ,,	
6	92·5	5·3	2·8	25 ,,	
7	94·3	3·0	2·7	60 ,,	
8	96·2	0·0	3·8	4 hours	
9	90·5	7·4	2·1	10 seconds	Low red heat.
10	89·5	8·4	2·1	2 minutes	Below red heat.
11	88·0	9·8	2·2	1 ,,	

From these results it appears that at or about 500° the formation of CO can be entirely prevented by sufficiently retarding the rate of flow.

(*b.*) *With Purified Graphite.*

Percentage Composition of Gases.				Time of collecting 100 cc.	Ratio CO_2 : CO
CO_2.	O.	CO.	N.		
47·1	46·7	3·5	2·7	30 minutes	13·5 : 1
44·5	49·3	3·3	2·9	30 ,,	13·5 : 1
26·2	68·4	2·7	2·7	15 ,,	9·7 : 1
27·1	67·3	2·8	2·8	10 ,,	9·7 : 1
19·2	74·9	3·1	2·8	1 ,,	6·2 : 1

In further elucidation of these results the author also investigated the interaction of these carbons and a mixture of oxygen (77·7 per cent.) and carbonic oxide (18·5 per cent.).

The results of 13 experiments at temperature from 500° to 734° are given. They show clearly that in the combustion of carbon the formation of CO_2 precedes that of CO.

IV. Action of Aqueous Vapour upon Carbon and Graphite.

(*a.*) Carbonic acid gas saturated with water vapour was passed over carbon heated to a temperature somewhat under 600°. There was an appreciable reaction according to the equation: $C + 2\,H_2O = CO_2 + 2\,H_2$.

(*b.*) Nitrogen saturated with aqueous vapour passed over carbon heated to 630°. There was considerable reaction. The gaseous product had the following composition: CO_2, 20·4; CO, 0·9; H, 39·8; N, 38·9 per cent. The CO is to be regarded as a secondary product.

(c.) *Action of Aqueous Vapour upon Graphite.* Particulars of results in subjoined table:—

Composition of Product.				Temperature.	Length of Graphite Column.	100 cc. collected in
CO_2.	CO.	H.	N.			
13·4	8·8	56·0	21·8	814°—861°	40 cm.	24 hours.
16·2	10·8	62·2	10·8	,,	40 ,,	8 ,,
22·5	6·1	68·0	3·4	861°	40 ,,	1¾ ,,
20·0	10·3	68·3	1·4	954°	40 ,,	15 mins.
17·4	15·6	64·6	2·4	,,	5 ,,	60 ,,
19·4	13·7	65·7	1·2	954°—1,051°	40 ,,	8 ,,
17·5	16·0	65·3	1·2	,,	40 ,,	8 ,,
18·3	17·3	62·0	2·4	,,	40 ,,	8 ,,
18·4	16·9	62·1	2·6	,,	40 ,,	8 ,,

From these experiments it is concluded that the ratio CO : CO_2 increases with the temperature. At the higher temperatures both the reactions, $CO_2 + C = 2\,CO$; and $CO + H_2O = CO_2 + H_2$, take place simultaneously.

V. Reaction between CO_2 and C.

A stream of dry carbonic anhydride was passed slowly over carbon heated to 600°. The issuing gas contained $CO_2 = 96$ per cent., CO = 2, N = 2. The resulting gas was passed repeatedly through the tube, and at the end of four hours was found to contain $CO_2 = 94·7$, CO = 2·3. The limit of the reduction is thus speedily attained. Experiments at higher temperatures, 634°—1,054°, showed an increase of the ratio CO : CO_2 in direct proportion with the increase of temperature. Even at 1,054° there was a small proportion (0·6—3 per cent.) of residual CO_2.

The results were not influenced by dilution of the CO_2 with an inert gas (N).

VI. Reaction between Aqueous Vapour and Carbonic Oxide.

The gas was passed through water at 80°, thence through a tube heated to 950°. The percentage of carbonic acid in the product varies from 15·2 to 18·8. No further increase being obtained on continually repassing the gas through the tube. On passing the carbonic oxide through water heated to 95° the percentage of CO_2 was increased to 40.

VII. Action of Aqueous Vapour upon Carbon at 1,000°.

(*a.*) Nitrogen gas saturated with aqueous vapour at 25°.

Composition of Product.				—
CO_2.	CO.	H.	N.	
0·6	22·1	22·8	54·5	Twice passed through.
1·2	29·6	30·3	38·9	20 times passed through.

(*b*.) A mixture of CO = 32·0, H = 23·5, N = 44·5, saturated with aqueous vapour at 25°.

Composition of Product.				
CO_2.	CO.	H.	N.	
2·1	29·1	24·1	44·7	Twice passed through.
3·1	27·8	25·8	43·3	

Even at 1,000° therefore the decomposition of water by carbon is incomplete.

We may refer those more particularly interested in this subject to the original paper, Zeits. Phys. Chem. 1888 II. 161.—C. F. C.

Westphalian Cannel and Pseudo-Cannel Coal. F. Muck.

Journ. f. Gasbeleucht. **31**, 275.

Comparisons are drawn between the pseudo-cannel, described by the author in 1881, and the true Westphalian cannel. Both coals vary from grey to black in colour, have plane or plano-conchoidal fractures, and are apparently devoid of lamination; but although of about equal hardness, the true cannel is sufficiently tough to withstand turning on the lathe, while the other breaks up under the tool. The true cannel, moreover, is a good gas coal, rich in hydrogen, and especially so in available hydrogen; it is easily kindled, and burns with a bright flame: the coke residue in a crucible is in the form of a flat plate, generally with radial fissures, but never intumescent, whereas the pseudo-cannel gives a greater yield of a coke, which is more or less bulky; and the coal itself is richer in carbon and correspondingly poorer in hydrogen, available hydrogen and oxygen, and is of little or no value as a gas coal. But the chemical differences between the pseudo-cannel and anthracite occuring with it are extremely small. v. Gümbel has submitted the coals to microscopical examination, and finds that the true and false cannel differ as to the parts of plants discoverable in them, whilst the different pseudo-cannels remain constant in this respect; the anthracite (in which traces of structure are almost obliterated) occurring with the pseudo cannel in no way differs from that in which the latter is not present. Finally, v. Gümbel believes the pseudo-cannel to be due to a sedimentary carbonaceous deposit.—W. G. M.

Compressed Oil-Gas and its Applications. A. Ayres.

Proc. Inst. Civil Engineers, April 10, 1888.

The manufacture and compression of oil-gas have formed the subject of many patents, some of which date as far back as the beginning of the present century. The oil chosen for this manufacture is the "product of heavy petroleum or shale oil once distilled; it has a specific gravity of about 0·840, more or less, and flashes at about 220° F." The manufacture, as carried on by the "Pintsch" system, is briefly as follows:—Two cast-iron retorts are set in brickwork and heated in the usual way (this Journal, 1884, 462—3). The upper retort is provided with a series of sheet-iron trays, upon which the oil is allowed to drop at the back end of the retort. Thence it runs forward and finds its way by suitable pipes to the front end of the lower retort, in which there are no trays. This retort it traverses from front to back, and is by this time converted into a dense yellow vapour, which, by passing through a hydraulic main, a condenser, and a lime and sawdust purifier, is freed from tar and other impurities. Under normal conditions there is a pressure of 5 or 6 inches of water in the retorts, gradually diminishing to about 1½ inches in the gasholder. A plant consisting of two pairs of retorts will make about 420 cubic feet of gas per hour. The gas is finally compressed to about 10 atmospheres in portable gasholders to be employed for charging buoys, &c. The illuminating intensity of the gas as made may be taken at from 40 to 50 candles when burned in a London standard Argand burner at the rate of 5 cubic feet per hour under a pressure of 0·5 inch. After compression, however, the gas loses about 20 per cent. of its illuminating power from deposit of hydrocarbon. One gallon of oil yields from 70 to 90 cubic feet of gas. The cost varies according to the conditions of production from 5*s*. 6*d*. to 16*s*. per 1,000 cubic feet.

One of the most important applications of compressed oil-gas is its use for buoys and beacons. Gas buoys, as used by the Trinity House authorities, are of best mild steel, spherical in form and carrying a light wrought-iron superstructure, in which is a lantern enclosing the illuminating apparatus. The gas is contained in the spherical portion of the buoy under a pressure of 5 or 6 atmospheres, and burns at the rate of 0·75 cubic feet per hour. The light can be maintained for 106 nights and days without recharging. The lighting apparatus consists of a group of three small fish-tail burners surrounded by a small dioptric fixed lens, which raises the intensity of the flame from 5 to from 17 to 20 candles. The focal plane of the light is 12 feet 6 inches above the sea surface, and it is visible for about 9 miles. The steadiness of the light is maintained by a highly-sensitive automatic regulator, which depends for its efficiency upon the fact that the pressure of the gas acting upon a flexible diaphragm causes a distention, which sets in motion a system of levers connected with the valve that controls the supply. For the production of a flashing light the pressure of the gas upon a similar diaphragm is made to alternately open and close the pipes conveying the gas from the regulator and to the burner. A small pilot jet, fed independently of the flashing apparatus, ensures the ignition of the gas each time. In 1885 the Trinity House erected two iron lighthouses similar in construction, the one at Stoneness, on the Essex side of the Thames, the other at Broadness, on the Kent side. In the former is burnt a spirit of petroleum called deodorised naphtha—on Lindberg's system—and in the latter compressed oil-gas. The annual cost in the one case is 117*l*. 10*s*. 4*d*., as against 157*l*. 12*s*. in the other, but as the intensity of the Stoneness light is only 60 candles, while that of the Broadness is 500, it will be seen that the advantage is greatly on the side of the compressed oil-gas At Ailsa Craig, gas made from ordinary illuminating paraffin is mixed with air in the proportion of 35 parts to 65 parts of oil-gas and used both for the lighthouse and for five "Otto" silent gas-engines employed in compressing air for working two automatic fog signals. The cost of the gas (for oil and coal alone) is about 5*s*. 9*d*. per 1,000 cubic feet. On December 31st, 1887, there were in use in different parts of the world, on the Pintsch system alone, 149 gas buoys, 17 lightships, and 58 beacons and other lights. Of these, 59 buoys and 39 other lights are on the Suez Canal. Great Britain comes next with 30 gas buoys, four lightships, and eight other lights. Another important and growing application of compressed oil-gas is its use for the lighting of railway trains. It was probably first tried with satisfactory results in 1871 on the Lower Silesian Railway, Germany, but now is very generally adopted by the leading lines of this country and Germany. In England the Pintsch system has a formidable rival in that of Pope and Son, whose patent is in use by the London and North-Western and Great Western Railways. In all it is calculated that there are nearly 9,000 carriages fitted up on both systems in Great Britain, and about 19,000 on the Pintsch system abroad. The chief difference between the two systems is that in the case of Pope's the oil is introduced as a fine spray into the lower retort first, and that no trays are employed in either retort. The Dublin Steam Packet Company have adopted compressed oil-gas for the mail rooms on board their steamers. The gas is made at Holyhead, compressed in gasholders to 10 atmospheres, carried by a ¾-inch lead pipe to a filling box on the pierhead, and thence, by a flexible hose, to a receiver on the main deck.—A. R. D.

Estimation of the Volume of the Gas in Gas-pipes or Flues.

Chem Zeit. **12**, 723.

The estimation of combustion or generator gases by means of mechanical appliances is attended with very great difficulties. The hot gases are liable to destroy such apparatus, ash and dust may render them inefficient, and further they ought to occupy the whole cross section of the flue, as in the different parts of the flue the gas will have a different velocity.

In Munich the estimation of the volume of the smoke gases of 1 kilo. of coal was done in the following manner:—If, for instance, the combustion gases contain of CO_2, 6·12 per cent., CO, 0·89 per cent., H, 0·10 per cent., O, 14·21 per cent., N, 81·60 per cent., and, if the coal which was used contained according to combustion 81·6 per cent. C., then in 1 cm. of the gas is contained as 1 cm. of CO_2 or CO at 0° C. and 760 mm. pressure contains 0·5364 kilos. of C. [0·0612 + 0·0089] × 0·5364 kilos. = 37·60 gr. C.

Now 1 kilo. of coal contains 81·6 per cent. = 816 grms. of C., and will yield therefore $\frac{816}{37 \cdot 6} = 21 \cdot 7$ cm. of dry smoke gases.

These figures are sufficient to estimate the loss of heat from 1 kilo. of the fuel.—A. L.

Explosive Mixtures of Gases fired by Incandescent Lamps. Eng. and Min. Journ. **45**, 475.

Lieut. Hutchins, of the United States Navy, has found that incandescent electric lamps (Swan's 16 cp.), when broken in mixtures of hydrogen with oxygen, or of marsh gas and coal gas with air, cause instantaneous explosion.
—W. G. M.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Process for Treating Gas Liquor and other Ammoniacal Liquids. E. Grahn. Gastechniker **10**, 25.

Instead of boiling off the ammonia from liquors by direct fire or injection of steam, the author proposes to inject a stream of air or chimney gas through the liquor with or without simultaneous heating, and by this means to obtain the ammonia in a condition for absorption without the inconvenience caused by the presence of water of condensation. The absorbing substances may be solid or liquid, and the process is applicable to the impregnation with ammonia of solid manures, such as superphosphate.—G. H. B.

IV.—COLOURING MATTERS AND DYES.

Disazo-Compounds. R. Nietzki and T. Diesterweg. Ber. **21**, 2143—2147.

Wallach (this Journal, 1882, 102) distinguishes compounds with two azo residues from the ordinary azo bodies as disazo-compounds. The authors have prepared the disazobenzene $C_6H_5.N{=}N.C_6H_4.N{=}N.C_6H_5$ which contains the two azo-groups in para position. They first succeeded in obtaining the amidodisazobenzene $C_6H_5N_2C_6H_4N_2C_6H_4NH_2$, to which substance reference was made by Caro and Schraube (Ber. **10**, 2230).

Diazo-azobenzene (from amidoazobenzene) is combined with aniline, and the diazo-amido-compound thus formed is dissolved in four parts of aniline and mixed with the molecular quantity of aniline hydrochloride. The mixture is analysed after having been left standing for 24 hours at 40°—50°, and it is found that nearly all of the diazoamido-compound is transformed into the original amidoazobenzene, and that only a very small quantity of a new body is formed which proves to be the amidodisazobenzene. The latter is separated from the amidoazobenzene by converting the bases into acetyl compounds and by crystallising these from alcohol. The acetylamidoazobenzene is more readily soluble in alcohol, and the two can be separated by crystallisation.

From 1 kilo. of amidoazobenzene only 10 grms. of pure acetylamidodisazobenzene is obtained. It crystallises from alcohol or glacial acetic acid in orange yellow plates, and melts at 227°.

The acetyl group is separated in the usual way with alcoholic caustic potash. The amidodisazobenzene forms yellow needles melting at 170°, it is sparingly soluble in alcohol, and dissolves in conc. sulphuric acid with a dark red colour, which changes into blue on addition of water.

The authors removed the NH_2 group by diazotising and subsequent removal of the diazo-group by boiling alcohol and obtained thus the disazobenzene $C_6H_5N_2C_6H_4N_2C_6H_5$. It crystallises in yellowish red needles which have a melting point of 98°. It dissolves in conc. sulphuric acid with a yellow colour.

Analogous bodies which contain a naphthalene residue instead of a benzene residue are easily obtainable when diazoazobenzene chloride is combined with α- or β-naphthylamine. The amido-α-naphthalenedisazobenzene, $C_6H_5N_2C_6H_4N_2C_{10}H_6NH_2$, forms cantharides green plates, which melt at 170°. Conc. sulphuric acid dissolves it with a deep blue colour. The acetyl compound melts at 275°. The NH_2 group can be removed by the method used with the benzene compound, the resulting α-naphthalenedisazobenzene melting at 143°. The amido-β-naphthalenedisazobenzene melts at 164°, and the acetyl derivative at 206°. The β-compound does not form salts with acids nor can it be diazotised. It is therefore not possible to eliminate the NH_2 group.—A. S.

On some Azo-Dyes of the Hydroxyquinolines. T. Mathëus. Ber. **21**, 1642.

The author describes some colouring matters obtained by combining diazochlorides with ortho- and parahydroxyquinoline.

Benzene-azo-parahydroxyquinoline parasulphonic acid—

$$(SO_3H)C_6H_4N{:}NC_9H_5N(OH)$$

prepared from parasulphodiazobenzene and parahydroxyquinoline, crystallises in small orange needles, soluble in water; the sodium salt forms red needles.

Benzene-azo-parahydroxyquinoline—

$$C_6H_5N{:}NC_9H_5N(OH)$$

diazobenzene chloride and parahydroxyquinoline combined, crystallising from absolute alcohol in long orange needles, soluble in ether and benzene.

Paratoluene-azo-parahydroxyquinoline—

$$(CH_3)C_6H_4N = NC_9H_5N(OH)$$

red needles from alcohol.

Parabrombenzene-azo-parahydroxyquinoline—

$$C_6H_4(Br)N - NC_9H_5N(OH)$$

red needles from chloroform.

β-Naphthalene-azo-parahydroxyquinoline—

$$C_{10}H_7N : NC_9H_5N(OH)$$

dark red needles from alcohol.

Benzene-azo-orthohydroxyquinoline—

$$C_6H_4N : N.C_9H_5N(OH)$$

brownish yellow needles from alcohol.

Paratoluene-azo-orthohydroxyquinoline—

$$(CH_3)C_6H_4N : NC_9H_5N(OH)$$

brownish yellow plates from alcohol.

Parabrombenzene-azo-orthohydroxyquinoline—

$$C_6H_4(Br)N = NC_9H_5N(OH)$$

golden needles when precipitated from its solution in alcoholic sodium hydrate by hydrochloric acid.

β-Naphthalene-azo-orthohydroxyquinoline—

$$C_{10}H_7N = NC_9H_5N(OH)$$

reddish brown needles from alcohol or chloroform.

Amidoparahydroxyquinoline—

$$C_9H_5N\begin{pmatrix}OH\\NH_2\end{pmatrix}$$

was obtained from sulphobenzene-azo-parahydroxyquinoline by reduction with $SnCl_2$ and HCl. The tin was removed by sulphuretted hydrogen. On evaporation sulphanilic acid crystallised out, and the solution contained the amidohydroxyquinoline hydrochloride. The free base is soluble in ether, benzene and chloroform. It crystallises from water in needles, containing 2 mols. of water, which escape at 100° C., and the substance melts at 185° C.

The author describes, further, some salts of this base, and some experiments to determine its constitution, which, however, were unsuccessful.—A. L.

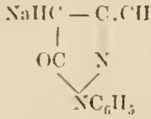
On some Mixed Azo-Compounds. C. Beyer and L. Claisen.
Ber. **21**, 1697.

A SERIES of facts has been published lately, proving that under certain conditions the phenylazo group can be changed into the phenylhydrazide group. Substances obtained from diazobenzene chloride and the sodium salts of certain methylene compounds were identical with bodies prepared from phenylhydrazine and certain ketone- or aldehyde-compounds.

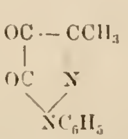
R. Meyer proved that the product from diazobenzene chloride and sodium malonic ether, the formula of which was supposed *à priori* to be $C_6H_5N_2CH\,(CO_2C_2H_5)_2$, was identical with the product prepared from phenylhydrazine and mesoxalic ether, for which $C_6H_5NH.N:C(CO_2C_2H_5)_2$ appeared to express the correct constitution.

Japp and Klingemann proved the product from diazobenzene chloride and methyl-aceto-acetic ether to be identical with E. Fischer's, phenylhydrazinepyruvic acid, and further, that benzene-azo-acetone from benzene-azo-aceto-acetic ether is no azo-compound, but the hydrazide of the pyruvic aldehyde prepared by Pechmann.

Quite recently Knorr stated that the compound from diazobenzene chloride and—



was the same as the one obtained from phenylhydrazine and rubazonic acid—



Japp and Klingemann have proved that the benzene-azo-acetone is really a hydrazide, $C_6H_5NHN:CHCOCH_3$; but in all other cases the question of the constitution has still to be settled.

The authors prepared some derivatives from diazobenzene chloride, which are really azo-compounds, and which have not been changed into hydrazides. The aldehydes and ketones used were aceto-acetic-aldehyde, aceto-acetone, dibenzoylmethane, benzoylaldehyde, benzoylacetone, benzoyl- and acetyl- pyruvic ether. The authors have proved the derivatives of the first three bodies to be genuine azo-compounds; the physical and chemical properties of the remaining ones render it very probable that they are also phenylazo-bodies.

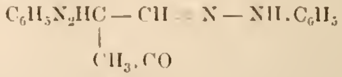
All phenylazo derivatives prepared by the authors are soluble in caustic alkalis, and are precipitated from this solution by carbonic acid.

Phenyl-azo-aceto-acetic-aldehyde—

$$CH_3COCH.CHO(N_2C_6H_5)$$

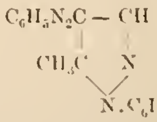
The sodium salt of aceto-acetic-aldehyde is dissolved in water and cooled with ice. The diazobenzene chloride solution is gradually added to it, and the new compound is at once formed, sometimes as an oily body at first, but becoming crystalline very soon. Recrystallised from alcohol it is obtained in dark red prisms, like azobenzene, melting at 118° C. Copper acetate added to its alcoholic solution produces a crystalline copper compound. Phenylhydrazine acts very energetically on phenylazo-aceto-acetaldehyde; if equal quantities are used the mixture gets warm, and a solid yellowish red body is produced, melting after recrystallisation from boiling alcohol at 218° C. The analysis gave figures for $C_{16}H_{16}N_4O$.

If its constitution is—



$$\begin{array}{l}C_6H_5N_2HC - CH = N - NH.C_6H_5\\ \quad\quad\quad\ \ |\\ \quad\quad\ \ CH_3.CO\end{array}$$

it must, like all hydrazides of β-diketones under certain conditions, lose a molecule of water and form a phenylazo-pyrazol derivative—



If it contains, instead of the phenylazo- the phenylhydrazide group, such a loss of water is not to be explained. The experiment proved that an anhydride was readily formed. After boiling for 2—3 hours with glacial acetic acid, and pouring into ice water, microscopic yellow needles are obtained, melting at 112° C. Its formula is $C_{16}H_{14}N_4$.

If phenyl-azo-aceto-acetaldehyde be treated with phenylhydrazineparasulphonic acid, both being in alkaline solution, a yellow precipitate is formed, which dyes from an acid solution like Tartrazine, but which is much weaker than this colouring matter.

Phenylazoacetylacetone—

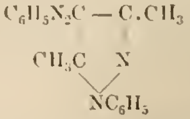
$$CH_3COCHCOCH_3(N_2C_6H_5)$$

isomeric with Japp and Klingemann's acetylbenzene-azo-acetone—

$$CH_3COCH : N.NC_6H_5(CO.CH_3)$$

is obtained by mixing sodium acetoacetone and diazobenzene chloride. Melting point, 90° C.

Phenylazophenyldimethylpyrazol—



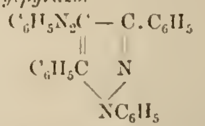
is obtained by mixing phenylazoacetylacetone and phenylhydrazine and heating on the oil bath to 130°—140° C., so long as steam is given off. It consists of yellow needles, melting at 63° C.

Phenylazodibenzoylmethane—

$$C_6H_5COCHCOC_6H_5(N_2C_6H_5)$$

yellowish red prisms, melting at 153°—154° C.

Phenylazotriphenylpyrazol—



prepared from phenylazodibenzoylmethane and phenylhydrazine by heating for half an hour to 120° C., melts at 156°—157° C. The sulphonic acid of this body is prepared by using phenylhydrazineparasulphonic acid instead of phenylhydrazine. It dyes wool in an acid bath a greenish yellow.

Phenylazobenzoylaldehyde—

$$C_6H_5COCHCHO(N_2C_6H_5)$$

dark red prisms, melting at 103° C.

Phenylazobenzoylacetone—

$C_6H_5COCHCOCH_3(N_2C_6H_5)$

yellowish red prisms, melting at 99° C.

Phenylazoacetylpyruvic ether—

$CH_3COCHCOCO_2C_2H_5(N_2C_6H_5)$

yellow prisms, melting at 115°—116° C.

Phenylazobenzoylpyruvic ether—

$C_6H_5COCHCOCO_2C_2H_5(N_2C_6H_5)$

yellowish red prisms, melting at 116°—117° C.—A. L.

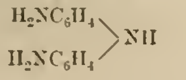
On Pr. 3 Phenylindole. E. Fischer and Theodor Schmidt. Ber. **21**, 1811.

Phenylacetaldehydephenylhydrazone produces, when melted with zinc chloride, Pr. 2 phenylindole. If this body, dissolved in five times its quantity of alcohol, is, however, heated with one-fifth of its volume of alcoholic hydrochloric acid, ammonium chloride is formed. After dilution with water and addition of ammonia, an oil is precipitated, which solidifies when cold. It is Pr. 3 phenylindole, $C_{14}H_{11}N$, melting at 88°—89° C. It can be distilled without decomposition, and forms a compound with picric acid, melting at 107° C. If heated with five times its amount of zinc chloride to 170° C., it is converted into Pr. 2 phenylindole.—A. L.

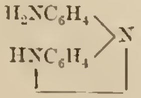
On the Indamines and Indophenols. R. Nietzki and R. Otto. Ber. **21**, 1736.

Nietzki observed several years ago that when paradiamidotoluene and orthotoluidine are oxidised together a green colouration is produced, which the two bases when oxidised by themselves do not show. It was proved later on that nearly all paradiamines give a similar reaction on oxidation with mon- or diamines, in which the paraposition as compared with the amido-group is free. The first stable colouring matter of this kind, the toluylene blue, was discovered and analysed by Witt. Bindschedler, by oxidising dimethylparaphenylenediamine with dimethylaniline, obtained a compound of this class, known as Bindschedler's Green. Witt's indophenols must also be considered as analogous bodies.

The intermediate products, which are formed in making safranines, were called by Nietzki indamines, and its simplest representative is obtained by oxidation of a mixture of equal molecules of paraphenylenediamine and aniline; it has the same relation to diamidodiphenylamine as a colouring matter has to a leuco base:

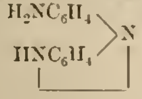


Diamidodiphenylamine.

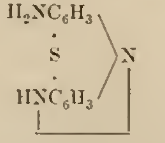


Indamine.

Bernthsen proved then that *Lauth's Violet* and *Methylene-blue* may also be considered as indamines—

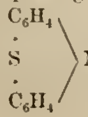


Indamine.



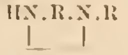
Lauth's Violet.

Bernthsen, however, considers the group $<\substack{N\\S}>$ as a chromophor, speaking frequently of the compound—



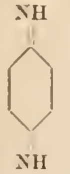
NH as a chromogen.

This, however, is wrong; its simple derivatives are not coloured and only able to act as leuco-bodies of colouring matters. The indamines contain, according to the authors' view, the same chromogen—

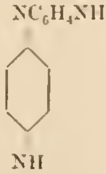


which is a quinone-imido-group.

The simplest indamine may be considered as a derivative of the still unknown quinone-imide, and a formula might be used corresponding to the one which expresses the quinones as double ketones.



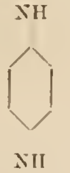
Quinone-imide (unknown).



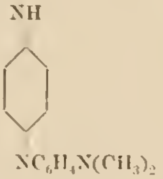
Indamine.

This hypothesis explains a fact which has been repeatedly mentioned before.

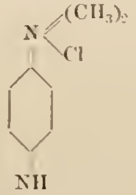
If on the one hand dimethylparaphenylenediamine and aniline, on the other paraphenylenediamine and dimethylaniline are oxydised, two isomeric indamines and on boiling with aniline hydrochloride two isomeric safranines are obtained—



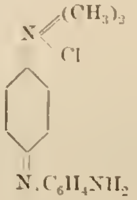
Quinone-imide from Paraphenylenediamine + Dimethylaniline.



Indamine 1.



Quinone-imide, from Dimethylparaphenylenediamine + Aniline.



Indamine 2.

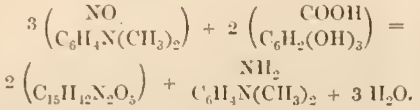
Wurster's oxidation product of dimethylparaphenylenediamine, a red body, is probably dimethylquinone-imide; all its properties and reactions tend to support this view. It combines with amines and phenols, forming indamines and indophenols.

Nitrosodimethylaniline and quinonedichlorimide act in a similar way. Indamines and indophenols are unstable bodies, which are decomposed by mineral acids, quinones being formed. But if two benzene rings are once more linked together, for instance, by a sulphur atom, a greater stability is insured, as is the case with the thio-indamines. Witt, Köchlin, and Meldola have observed that phenols, when treated with nitrosodimethylaniline or oxidised with paraphenylenediamine at a higher temperature, yield different products to those yielded at ordinary temperature. In the former case stabler bodies are obtained than in the latter. Meldola's *Naphthol blue* and Köchlin's *Gallocyanine* are instances of the reaction performed at a higher temperature.

Bernthsen's view that an oxygen atom plays the same part as the sulphur atom in the thio-indamines seems to be correct, though a definite proof for this theory is still wanted.

Gallocyanine.—In 1881 Köchlin obtained a patent for a series of colouring matters prepared by the action of nitrosodimethylaniline on gallic acid, quino-tannic acid, and on cutch. The product from gallic acid is alone of importance, it dyes cotton mordanted with chrome a beautiful violet, and is called *Gallocyanine* or *Fast violet.* This colouring matter is readily formed when nitrosodimethylaniline acts on gallic acid, dissolved in alcohol or glacial acetic acid. If equal molecules are used some of the gallic acid is not acted upon, and in the mother liquors there is always dimethylparaphenylenediamine found. This proves that the action of nitrosodimethylaniline is not solely to combine with gallic acid, but that it acts also as an oxidising agent.

Gallocyanine forms green shining needles, difficultly soluble in most solvents; aniline dissolves it in abundance, but changes its character. Concentrated acids produce salts with it, which are decomposed by water. Caustic alkalis and carbonates dissolve it, forming a reddish colour; acetic acid reprecipitates it, and was used for purification. The formula of *gallocyanine* is $C_{15}H_{12}N_2O_5$. Its formation is explained by the following equation:—



$$3\left(\begin{matrix}NO \\ C_6H_4N(CH_3)_2\end{matrix}\right) + 2\left(\begin{matrix}COOH \\ C_6H_2(OH)_3\end{matrix}\right) =$$
$$2\left(C_{15}H_{12}N_2O_5\right) + \begin{matrix}NH_2 \\ C_6H_4N(CH_3)_2\end{matrix} + 3\,H_2O.$$

On heating *gallocyanine* with aniline, two aniline groups combine with it, one molecule of water being eliminated. The formula of this body is $C_{27}H_{24}N_4O_4$, and it is either the aniline salt of an anilide, $C_{21}H_{17}N_3O_4$, or a combination of this compound with chrysaniline. This aniline derivative forms salts with acids, which are, however, not very stable; caustic alkalis decompose it into *gallocyanine* and aniline. *Gallocyanine* combines with sodiumbisulphite and forms soluble compounds decomposing when heated, and therefore useful for printing purposes.

The methylether of gallic acid forms, on treatment with nitrosodimethylaniline, a dyestuff similar to *gallocyanine*, it is, however, more basic and forms stable salts. Its formula is $C_{15}H_{11}N_2O_5 . CH_3$. Recrystallised from aniline the compound $C_{16}H_4N_2O_5 + C_6H_7NH_2$ is formed.

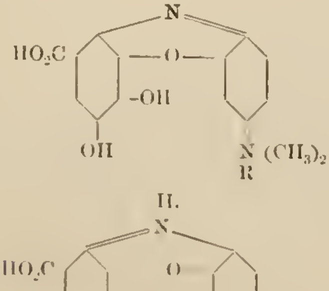
Anhydrous acetic acid and sodiumacetate act on *gallocyanine* and on *methyl-gallocyanine*. The former product could not be purified, the latter yielded a pale green acetyl compound, crystallising from alcohol in small needles.

$C_{18}H_{16}N_2O_6$ one Acetyl Calculated.	$C_{20}H_{18}N_2O_7$ two Acetyl Groups Calculated.	Found by Analysis.		
		I.	II.	III.
C 60·67	60·3	60·12	..	..
H 4·49	4·52	4·96	..	..
N 7·86	7·03	..	6·9	6·94

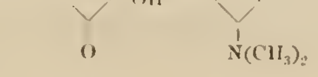
The analysis shows that the body contains two acetyl groups.

Of the two formulæ which may express the constitution of *gallocyanine*—

I.



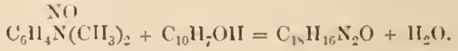
II.



No. II. could only yield a monacetyl compound; as there is a diacetyl compound formed, No. I. is probably the correct one.

Action of Quinonedichlorimide on β-Naphthol.—Several years ago Meldola obtained a blue colouring matter by the action of nitrosodimethylaniline on β-naphthol. This body, called *Fast Blue*, is at the present time used for dyeing purposes.

Medolaa believes the formula to be $C_{18}H_{16}N_2O$ according to the equation—



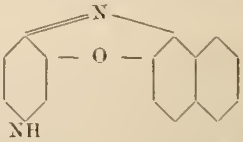
$$\begin{matrix}NO \\ C_6H_4N(CH_3)_2\end{matrix} + C_{10}H_7OH = C_{18}H_{16}N_2O + H_2O.$$

From the results arrived at with *gallocyanine*, this formula was considered to be wrong, and the authors proved the right one to be $C_{18}H_{14}N_2O$. An experiment showed that when nitrosodimethylaniline acts on β-naphthol, equal molecules being used, there is always dimethylparaphenylenediamine formed, and that the reaction is not a quantitative one. Instead of nitrosodimethylaniline the authors used quinonedichlorimide in alcoholic solution, and obtained a reddish violet colouring matter, which can be easily precipitated from its alcoholic solution as a zinc chloride double salt. It is purified by precipitation with nitric acid, a difficultly soluble nitrate, $C_{16}H_{10}N_2O\ HNO_3$, being formed.

The reaction, therefore, takes place according to the equation—

$$ClNC_6H_4NCl + C_{10}H_7OH = C_{16}H_{10}N_2O + 2HCl$$

and the constitution of this body is probably:—



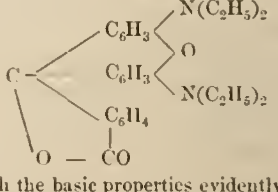
Nitrous acid does not convert it into a diazo compound; anhydrous acetic acid acts on it, but not on *Meldola's Blue.* Sulphuric acid dissolves it, forming a green colour, which, on dilution with water, changes through violet and blue into red. It dyes wool and silk like magenta. Ammonia precipitates from its salts a yellow base soluble in ether and alcohol.

The reactions of this body resemble in many respects those of *Lauth's Violet,* and its constitution may be similar.

—A. L.

On Certain New Colouring Matters. E. Knecht. Jour. Soc. Dyers and Colourists.

Rhodamine.—The first representative of a new and interesting class of dyes obtained by fusing the amidophenols or their derivatives with phthalic anhydride. Rhodamine is formed by heating together 1 mol. of phthalic anhydride with 2 mols. of diethyl-meta-amidophenol $C_6H_4\{N(C_2H_5)_2\}OH$, for several hours at 200°. The constitution of the pure product obtained is—



a body in which the basic properties evidently predominate. The commercial product is the hydrochloride. It is obtained as a brown red powder, easily soluble in water, with a fine crimson colour and a characteristic orange fluorescence. The scarlet fluorescence of the glacial acetic acid solution is very fine. On heating the aqueous or acetic acid solution to about 90° the fluorescence vanishes but reappears on cooling. Tannic acid produces in presence of sodium acetate a bright crimson precipitate (Rhodamine tannate) which is not fast to light. The triple compound, however, of rhodamine, tannic acid, and antimony produced by adding tannic acid to a solution of rhodamine and tartar-emetic exposed along with the tannate was found to resist the action of light very well. With stannous chloride the aqueous solution shows a most characteristic reaction; a cinnabar red precipitate is produced which, whilst still in a fine state of division, transmits a bright blue light. In strong sulphuric acid, rhodamine dissolves with a yellow colour, which, on dilution with water, gives place to red again. To wool and silk, rhodamine is best applied in a neutral bath, but it can also be dyed in an acid bath, and can therefore be employed along with some of the acid dyes. The colours obtained are various shades of pink, which show a marked orange fluorescence. The shades stand light better than those produced by any strong coal-tar colour (with the exception, perhaps, of Magdala red). They also stand soaping fairly well (wool), but when milled strongly are liable to bleed into the white.

On cotton, rhodamine is best applied with the tannic acid and tartar-emetic mordant. It may also be fixed on cotton mordanted with Turkey-red oil; in this case the colours obtained are fluorescent.

Nile Blue.—The composition of this colouring matter has not yet transpired, but from its reactions it appears to belong to the same class of dyes as rhodamine. The commercial product forms a dull blue powder, which dissolves easily in water with a reddish blue colour. With excess of hydrochloric acid the aqueous solution produces a violet precipitate, which in a fine state of division transmits a pink light. Tannic acid in presence of sodium acetate produces a Prussian blue precipitate. Stannous chloride produces a dull greenish-blue precipitate: on warming, the liquid exhibits a green fluorescence with blue transmitted light. With concentrated sulphuric acid Nile Blue dissolves with a red-brown colour, which, on diluting with water, becomes blue.

On wool and silk, Nile Blue is applied in a neutral bath, and yields red shades of blue. The colours obtained are not fast to light, and when strongly milled with soap are liable, like rhodamine, to bleed into the white. On cotton Nile Blue is best applied with the tannin and tartar-emetic mordant.

Paraphenylene Blue.—This dye comes into commerce in three shades, which are designated respectively G, R, and B. They belong to a class of dyes obtained (according to Eng. Pat. 10,134, 1886) by heating paraphenylenediamine (or its homologues) with certain amidoazo compounds—*e.g.*, amidoazobenzene.

Paraphenylene Blue R dissolves easily in water with a reddish-blue colour. Hydrochloric acid produces no change in the aqueous solution, but caustic soda completely precipitates the dye in the form of a dark violet precipitate. Tannic acid, in presence of sodium acetate, yields a blue precipitate and the liquid is rendered colourless. The boiling aqueous solution yields a black precipitate with bichromate of potash. Concentrated sulphuric acid dissolves with a blue colour with a solution of hydrochloric acid. The reactions shown by the other shades are similar. On wool, Paraphenylene Blue dyes direct in presence of a small quantity of acid. On cotton it is fixed by means of tannin and tartar-emetic. The shades obtained resemble those produced by Methylene Blue. When chromed after dyeing the shades become considerably darker. For dark blues on cotton and mixed goods this dye will no doubt be found useful.

Azo-eosin.—Nothing has hitherto been made public regarding either the method of manufacture or composition of this new colouring matter. The commercial product forms a scarlet powder which dissolves easily in water with a scarlet colour, but without any fluorescence. Ammonia turns the solution orange; hydrochloric acid produces a crimson precipitate. In concentrated sulphuric acid, azo-eosin dissolves with a deep cherry-red colour. Tannic acid, in presence of sodium acetate, produces no precipitate in the aqueous solution.

On wool, azo-eosin produces a brilliant scarlet which stands light well and is scarcely affected by soaping.

Santaline Sulphonic Acid.—Since the introduction of the alizarin colours in wool dyeing, the employment of the red dyewoods—viz., sanders, barwood and camwood—has decreased considerably, owing, no doubt, mainly to certain drawbacks which are experienced in their application. Probably the greatest drawback in their application is met with in the necessity of stuffing or boiling the material, first with the dye and afterwards developing or saddening in chrome or copperas. By being obliged to adopt this method of dyeing there is not only a considerable waste in dyestuffs, but it is also difficult to obtain even shades and an exact match.

The inventor of the new product has sought to overcome these difficulties by converting the insoluble colouring matter (santaline) contained in these dye-woods into a soluble sulphonic acid (Eng. Pat. 875, 1887. This Journal, 1888, 32), but although the experiments have so far met with only partial success, they are of sufficient interest to be referred to here. The preparation of sulphonic acid may be briefly described as follows: Sanders, or other of the red woods, is extracted with a little weak alkali, in which the santaline dissolves readily. The solution is then acidulated with dilute sulphuric acid, which completely precipitates the crude santaline. The latter is dried, dissolved in concentrated sulphuric acid, the solution poured into water and the dye salted out.

The dye is produced in the form of free sulphonic acid and of its sodium salt. Both form greyish-brown powders which dissolve in water with a yellowish-brown colour, but otherwise show no characteristic reactions. It is found to be best applied in an acid bath in presence of Glauber's salts. After dyeing, it must be saddened with chrome or copperas in order to produce the best results. Chroming first and dyeing afterwards does not give such full shades. This mode of application renders it possible to employ along with the new dye any of the acid coal-tar colours for the production of compound colours. Santaline sulphonic acid produces, with chrome, shades which are much yellower than those obtained with the red woods themselves. Compared with the coal-tar colours—*e.g.*, Bismarck Brown—the dye is a weak one.

It was expected that the fastness of the colours produced by the new dye would have been diminished by the introduction of a sulphonic acid group, but careful comparative experiments with an equal depth of shade produced with camwood showed that this was not the case. Both to light and to milling the shades were found to be equally as fast as the camwood shades.—W. S.

Primuline and Ingrain Red. A. Kertész. Chem. Zeit. **12**, 923

The author gives the following results of experiments made with these new cotton colours of Messrs. Brooke, Simpson, and Spiller (this Journ. 1888, 179).

Primuline dyes well with a salt bath, and produces a very even lemon yellow. It has a great advantage over *Chrysamin* in that it gives a paler yellow. It is, however, much more fugitive to light than *Chrysamin*; it stands soaping as well, but rubs off easier than *Chrysamin*. *Ingrain Red* is formed on the fibre by dyeing with *Primuline*, then diazotising and taking through the red developer. The shade is more of a blue-red than *Congo*, *Benzopurpurin* 4 B, and somewhat duller. It is much superior to these in that it stands rubbing; in fact it is in this respect equal to *Alizarin Red*. Light has, however, as much influence on it as on *Benzopurpurin*.

For detection on the fibre the following tests suffice:—

——	Boiled with a Hydrochloric Acid Solution of Tin Salts 30°—35° B.	Treated with conc. Sulphuric Acid.	Treated with Caustic Soda of about 20° B.
Primuline	The fibre becomes orange-yellow, ether added remains colourless.	Fibre turned brownish-yellow.	Fibre unchanged, solution scarcely coloured.
Ingrain Red	When well boiled, fibre turned orange, solution light yellow, added ether light yellow.	Fibre blue-violet.	Fibre claret colour, solution colourless.

—T. L. B.

Synthesis of Dianilidoquinone-anil and of Azophenine. E. von Bandrowski. Monatsh. Chem. 9, 414—420.

The author has already shown (Monatsh. Chem., February 1888) that the formation of quinonephenylimide from parahydroxydiphenylamine, and of diphenylparazophenylene from diphenylparaphenylenediamine are analogous to that of quinone from hydroquinone; he was then led to consider that quinonephenylimide and diphenylparazophenylene would show a similar analogy to quinone.

By acting with aniline in the warm for half an hour on quinonephenylimide, parahydroxydiphenylamine is formed together with dianilidoquinone-anil; and by acting with aniline at a temperature of 100°—110° for 15—30 minutes on diphenylparazophenylene, diphenylparaphenylenediamine is formed together with azophenine.

Since azophenine is thus formed its formula must be $C_{30}H_{24}N_4$, and not, as was stated by Witt, $C_{36}H_{29}N_5$: the constitutional formula, $(C_6H_5.N)_2C_6H_2(NHC_6H_5)_2$, given to it by O. Fischer and Hepp, receives support from this synthesis.—T. L. B.

On Mono-Iodo-Phenols. E. Noelting and Th. Stricker. Bull. Soc. Ind. Mulhouse, 1888, 277—284.

Ortho-iodophenol is prepared by heating the chloride or sulphate of orthodiazophenol with a solution of KI. It melts at 43°, and the white needles are scarcely altered in colour by prolonged exposure to light. In the KOH melt it is converted into catechol only, no resorcinol being observed, as in the case of orthochloro- and bromophenol. *Meta-iodophenol* was obtained by diazotising metanitraniline, boiling the solution of the latter with KI, then reducing, and from the iod-aniline thus formed, the phenol was prepared in the usual way. It melts at 39°. Melted with KOH, it is converted into resorcinol.

Par-iodophenol. Prepared from par-amidophenol. It melts at 93°—94°. Like the ortho derivative, HNO_3 sets iodine at liberty, whereas met-iodophenol is not affected by this acid.

The abnormal reactions often observed in KOH and NaOH melts, and which are generally put down to molecular transpositions, the authors believe they can explain without this hypothesis. It is well known that fused alkalis frequently exhibit an oxidising and as frequently a reducing action, probably due to the decomposition of water or of the caustic potash or soda, in the presence of oxidisable or reducible substances. Now, assuming both actions take place in a melt, then *e.g.* the formation of resorcinol from parabromophenol could be formulated.

I.

$$C_6H_4\left\{\begin{matrix}OH\ (1)\\ Br\ \ (4)\end{matrix}\right. + O = C_6H_3\left\{\begin{matrix}OH\ (1)\\ OH\ (3)\\ Br\ \ (4)\end{matrix}\right.$$

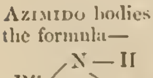
II.

$$C_6H_3\left\{\begin{matrix}OH\ (1)\\ OH\ (3)\\ Br\ \ (4)\end{matrix}\right. + H_2 = C_6H_3\left\{\begin{matrix}OH\ (1)\\ OH\ (3)\end{matrix}\right. + HBr.$$

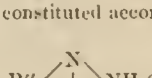
On the same principle we may account for the formation of alizarin from anthraquinonemonosulphonic acid, which acid again, when air or oxidising agents are excluded, is reconverted into anthraquinone. In the presence of air, the hydrogen which is disengaged in the melt is partly oxidised, with $KClO_3$ no anthraquinone whatever is formed.—A. R.

The Constitution of Azimido-Derivatives. E. Noelting and A. Abt. Bull. Soc. Ind. Mulhouse, 1888, 284—290.

Azimido bodies are considered as constituted according to the formula—



(Kekulé) and not

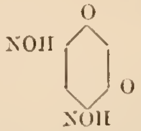


(Griess),

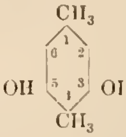
since ethylazimidotoluene may be prepared from ethylorthotoluylene-diamine by diazotising, and is identical with the product obtained by ethylating azimidotoluene. Were azimido-bodies constituted according to Griess's formula, monosubstituted orthodiamines should yield no azimido-bodies.—A. R.

On Dinitrosocresorcinol. St. de Kostanecki. Bull. Soc. Ind. Mulhouse, 1888, 237—243.

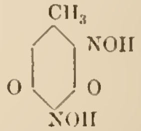
It has hitherto been assumed that, in accordance with the rule that the azo- and nitroso-groups enter in the para position to the hydroxyl in monohydroxylated phenols, dinitrosoresorcinol has the symmetrical constitution, viz.—



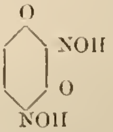
Now, by the action of nitrous acid on β-orcinol—



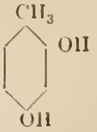
a mononitroso-derivative is formed, whereas orcinol gives a dinitroso-body. As it can only be by the methyl group in position 4 that β-orcinol differs from orcinol, therefore the latter does not form a dinitroso-derivative because of this position being already occupied. From this it may be concluded that dinitroso-orcinol is constituted thus:—



and dinitrosoresorcinol, as the lower homologue of orcinol,—



That this view is correct was ascertained by the action of nitrous acid on cresorcinol—



when a dinitroso-derivative was formed. Were dinitrosoresorcinol constituted according to the symmetrical formula, a mononitroso-derivative should have been produced, only one para-position to the OH group being free in cresorcinol.

Dinitrosocresorcinol melts at 160°, and its solutions dye cloth mordanted with iron salts a dark green shade, resembling the colour produced with dinitrosoresorcinol. Nitric acid converts it into dinitrocresorcinol, melting at 90°.—A. R.

Nitration of Hydroxyazobenzene. E. Nölting. Bull. Soc. Ind. Mulhouse, 1888, 244—248.

By the action in the cold of nitric and sulphuric acid on hydroxyazobenzene dissolved in sulphuric acid, a mono- and dinitrohydroxyazobenzene is produced. On reducing the former, a mixture of bases, showing the reaction of paradiamines and paramidophenols, is obtained, which proves that the nitro group has entered the non-hydroxylated ring, and probably in the para-position. This fact is confirmed by the formation of the same mononitrohydroxyazobenzene from diazotised paranitraniline and phenol. The dinitro-derivative above mentioned has the constitution—

$$\underset{4\ :\ 2\ :\ 1}{C_6H_3(NO_2)_2\ N:NC_6H_4OH}$$

as it can also be produced by the action of phenol on diazotised dinitraniline of the constitution—

$$C_6H_3NH_2(NO_2)_2\ (NH_2:NO_2:NO_2=1:2:4).$$

—A. R.

On Spontaneous Combustion in Aniline Works. Robert Hirsch. Chem. Zeit. **12**, 722.

The author has observed that when the acid for nitration of benzene was passed through the S tube, through which, by mistake, toluene had been allowed to run shortly before, this acid became instantly hot, and white vapours were observed to emanate from it. A workman tore the tube out, and as soon as he had thrown it away spontaneous combustion took place.

Spontaneous combustion may also take place, if the agitator does not work, when the acid for nitration runs into the apparatus. This acid falls to the bottom of the vessel, and when afterwards the agitator moves again, the violent chemical action produces great heat, which may lead to combustion, and, if several vessels are connected with each other, combustion, and sometimes explosion, may ensue in all of them.—A. L.

PATENTS.

Preparing Colouring Matters for Dyeing and Printing. J. H. Johnson, Lincoln's Inn Fields. From H. Caro, Mannheim. Eng. Pat. 5305, December 29, 1879. 2nd Ed. 6*d.*

The colouring matters referred to are nitrosulphonic acids of α-naphthol, the most important being dinitro-α-naphtholsulphonic acid. These compounds cannot be produced by the direct sulphonation of dinitro-α-naphthol nor by the nitration of the monosulphonic acid of α-naphthol. According to the present invention the sulphonic acids of α-naphthol submitted to nitration are those resulting from the sulphonation by means of a stronger sulphuric acid or a larger quantity of acid or a higher temperature or a longer time of heating. New naphtholsulphonic acids are thus formed, the most important being a trisulphonic acid, which on nitration retains one sulpho-group and is converted into dinitro-α-naphtholmonosulphonic acid. The acid used may be fuming or anhydrous, or in any form capable of producing sulphonic acids. The point at which to stop the operation can be ascertained by withdrawing a sample from time to time, heating with excess of nitric acid and diluting with water. When the sulphonation has reached the desired stage and the foregoing test is applied, there should be no precipitation of dinitro-α-naphthol, and the addition of caustic potash should cause a precipitation of the potassium salt of the dinitrosulphonic acid. The following example illustrates the practical method of carrying out the process:—10 parts of α-naphthol are gradually mixed with 20 parts of fuming sulphuric acid containing about 25 per cent. of anhydride, the mixture being well agitated and kept at 40°—50° C. till a specimen dissolves in water, forming a clear solution. The monosulphonic acid thus formed is then further sulphonated by adding 18 parts of fuming acid containing about 70 per cent. of anhydride, and keeping the mixture at 40°—50° C. till the required degree of sulphonation is reached as ascertained by the test above described. The product thus obtained is diluted with 75 parts of water and mixed gradually with 25 parts of nitric acid of 1·38 sp. gr. The mixture is agitated and kept below 50° C. for 12 hours, when a crystalline deposit of the monosulphonic acid of α-naphthol (in an impure state) separates out, while other nitrosulphonic acids remain in the mother-liquor. The crude crystalline deposit is drained and converted into the potassium, sodium, or ammonium salt. The nitrosulphonic acids in the mother-liquor, among these being the dinitrodisulphonic acid, are converted first into calcium salts and then into the corresponding potassium salts.
—R. M.

Process for the Production of Azo-Colouring Matters. Reprint, 2nd Edit. C. D. Abel, Southampton Buildings. From the "Actiengesellschaft für Anilin-Fabrikation," Berlin. Eng. Pat. 11,880, September 1, 1887. 6*d.*

The cotton-dyes formed by the combination of diazotised benzidine and tolidine, diamidodianisoïl, diamidodiphenetoïl, diamidostilbene and its disulphonic acid with the naphthylamines and their mono- or di-sulphonic acids can be alkylised by heating with the haloid alkyls with or without the addition of alkali. With high boiling-point alkyls the reaction takes place in alcoholic solution by simple cohobation; with low boiling-point alkyls autoclaves must be used. When the reaction is over the alcohol is distilled off and the colouring matter salted out. The process is also applicable to the mixed azo-colouring matters containing two dissimilar amines or phenols. The alkylised products dye cotton of a bluer shade than the original compounds. As examples the following are given:—(1.) Benzopurpurin B, from tetrazoditolyl and Brönner's β-naphthylaminemonosulphonic acid, is methylated by cohobation for five hours with methyl iodide and alcoholic soda. The product dyes cotton a bluish-red. (2.) A similar colour is produced by the methylation of the mixed colour derived from tetrazoditolyl, one molecule of β-naphthylaminedisulphonic acid and one molecule of Brönner's β-naphthylaminemonosulphonic acid. (3.) Deltapurpurin 5 B. from tetrazodiotolyl and β-naphthylamine-δ-monosulphonic acid is heated in an autoclave in alcoholic solution with methyl iodide and calcium carbonate for 10 hours to 100° C. The product is treated as before.—R. M.

Production of Azoic Colouring Matters. J. Imray, London. From "La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, and D. A. Rosenstiehl," Paris. Eng. Pat. 11,976, September 3, 1887. 6*d.*

These colouring matters are prepared from the nitrotoluidine of m. p. 78° C. and the nitroxylidine of m. p. 123° C. by reducing the alkaline solution with zinc dust and submitting the products of reduction to the action of nitrous acid. The polyazo salts thus obtained are combined with amines, phenols, sulphonic, and carboxylic acids, &c. in the usual way. (*See* Eng. Pat. 9315, June 30, 1877; this Journal, p. 499.) The following examples illustrate the carrying out of the process:—(1.) 2 kilos. of the nitrotoluidine are dissolved in 300 litres of boiling water and 100 kilos. of soda lye of sp. gr. 1·36 added to the solution, together with 15 kilos. of zinc dust (of 88 p.c. Zn). The zinc and soda are added in two portions with an hour's interval. The mixture is heated for 8—10 hours, allowed to cool and filtered, the product being purified by crystallisation from alcohol. This product is diazotised in the usual way with hydrochloric acid and sodium nitrite and gives the following colouring matters:—With α-naphthol-α-sulphonic acid, β-naphtholdisulphonic acid, R salt, and resorcinol red; with β-naphthol-β-sulphonic and α-sulphonic acids orange red; with naphthionic acid orange; with metaphenylene diamine and "α-oxynaphthoic acid" brown; with β-napththylamine sulphonic acid yellow; and with α-naphthylamine red-brown. (2.) The reduction of the nitroxylidine is conducted as in the last example, 16·6 kilos. requiring 1,300 litres of water, 144 kilos. of caustic soda (36° B.) and 19 kilos. of zinc dust. The product of reduction when diazotised gives red, yellow, orange, or brown colouring matters with the phenols, amines, sulphonic, and carboxylic acids above specified. The dyestuffs can be used for cotton, wool, or silk in an acid, alkaline, or neutral bath.—R. M.

Production of new Tetrazoic Colouring Matters. J. Imray London. From "La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and D. A. Rosenstiehl," Paris. Eng. Pat. 12,355, September 12, 1887. 6*d.*

The starting point in the manufacture of these colouring matters is a benzidine derivative prepared from paracresol in the following manner:- Diazobenzene-chloride is combined with paracresol in alkaline solution and the resulting azo-compound dried and ethylated in alcoholic solution by cohobating with the necessary quantity of ethyl iodide and caustic soda. The product (benzene-azo-*p*-cresyl ethylate) is reduced by sulphuretted hydrogen in ammoniacal alcoholic solution, and the hydrazo-compound thus produced is boiled with dilute sulphuric acid in order to convert it into the diphenyl-derivative, the sulphate of which separates out on cooling. The latter compound is diazotised in the usual way, and the tetrazo-salt combined with amines, phenols, &c., giving rise to a reddish-blue dyestuff with α-naphthol-α-sulphonic acid; a reddish-violet with β-naphtholdisulphonic acid. R salt, and with β-naphthol-α-sulphonic acid; orange with resorcinol and α-hydroxynaphthoic acid; red with naphthionic acid; violet with α-dihydroxynaphthalene; and brown with metaphenylenediamine and α-naphthylamine. The diazobenzene used in the preparation of the parent azo-compound can be replaced by its homologues and other alkyls used instead of ethyl. The colouring matters possess the usual properties of the benzidine dyestuffs.—R. M.

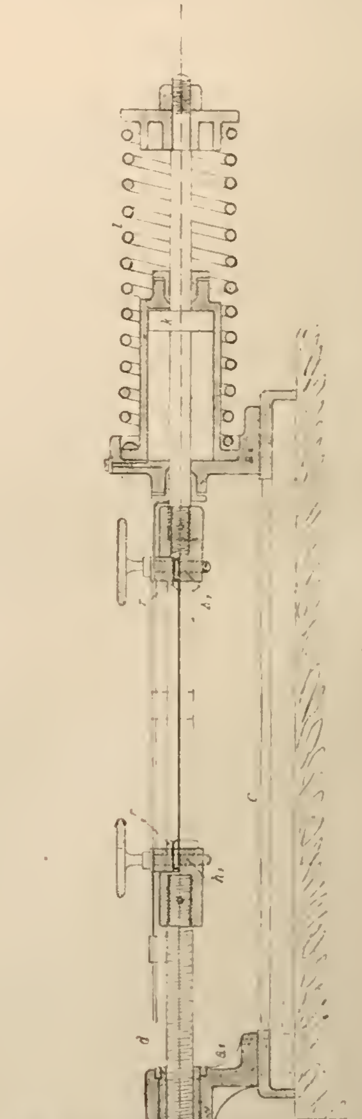
Production of Colouring Matters by Combination of Nitrodiazobenzenes and their Analogues with Isomers of Naphthionic Acid. J. Imray, London. From "La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and Z. Roussin," Paris. Eng. Pat. 12,692, September 19, 1887. 6*d.*

This is an extension of the specification No. 4490 of 1878, having for its object the production of colouring matters by combining the diazotised nitraniline homologues with the isomers of naphthionic acid discovered since the previous specification. The acid chiefly dealt with is that discovered by O. N. Witt and prepared by sulphonating α-naphthylamine hydrochloride with fuming sulphuric acid containing 28—30 per cent. of anhydride at a temperature not exceeding 29 C. The colouring matters are prepared in the usual way by allowing the diazotised nitranilines to act upon the sodium salt of the sulphonic acid, and are bluer in shade than the corresponding compounds from naphthionic acid.—R. M.

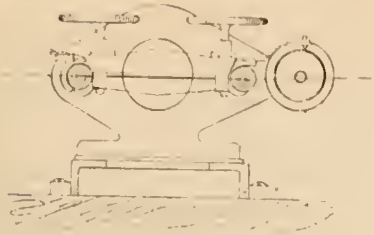
V.—TEXTILES: COTTON, WOOL, SILK, Etc.

An Apparatus for Testing the Resistance of Tissues. J. Amsler-Laffon. Bull. Soc. Chim. Mulhouse, 1888, 307.

The principle of the apparatus is thus illustrated: A piece of the tissue, held at each end by nippers, is stretched by means of a screw and the tension produced measured by the compression of a spiral spring. The violent shocks at the moment the fabric tears are avoided by a flow of oil. The pieces a^1 and a^2 joined by the transverse pieces b^1 and b^2 and the plate *c* form the frame. In the cross piece *a* is the nut in which is worked the shaft *d* of the screw *e*. The screw advances or recedes by turning with the handle *f*. It is preferable, however, to have a uniform motion and to turn by machinery, as the tensile strength of a fabric does not only depend on the force of the tension, but also on the time in which the tension is exerted. The screw is attached to the nipper h^1, which also holds one end of the tissue. The other nipper, h^2, is attached to the rod of the piston *k*. The rod carries a flange at its extremity which rests on the spring *l*. The piston moves in a cylinder filled with oil and is provided with a small valve to allow the oil to pass freely when the piston advances. When the tissue is torn the piston recedes very slowly. At the side of the transverse piece *b*, a ruler strikes against the nipper h^2. As the fabric is stretched the spring is compressed and the nipper h^2 advances pushing the ruler forwards, which latter slides in two grooves. The fixed index *m* and the divisions *n* engraved on the ruler indicate the weight in kilogrammes which correspond to the compression of the spring. The index carried by the nipper h^1 and the divisions *p* give directly the length corresponding to the weight indicated by the divisions *n*. When the tissue tears the ruler remains in its place and checks the weight accurately. Before making another trial the ruler must be made to strike against the nipper h^2. The resistance and the increase in the length of the tissue are at the same time registered on the drum *q*. The nippers are constructed so as to prevent the tissue being more susceptible to the tension at the ends. Each end is folded round a blade *r*, which is stretched in the nipper by means of two detached screws. The nippers must be tightened in proportion as the fabric stretches. It is best to employ two different springs according to the resistance of the tissue; for ordinary purposes one of 250 and 500 kilos. maximum resistance. The length of the spring should be 10 cm.; the piece of fabric should be 20—40 cm. in length and its width must not exceed 10 cm.—A. R.



Elevation.



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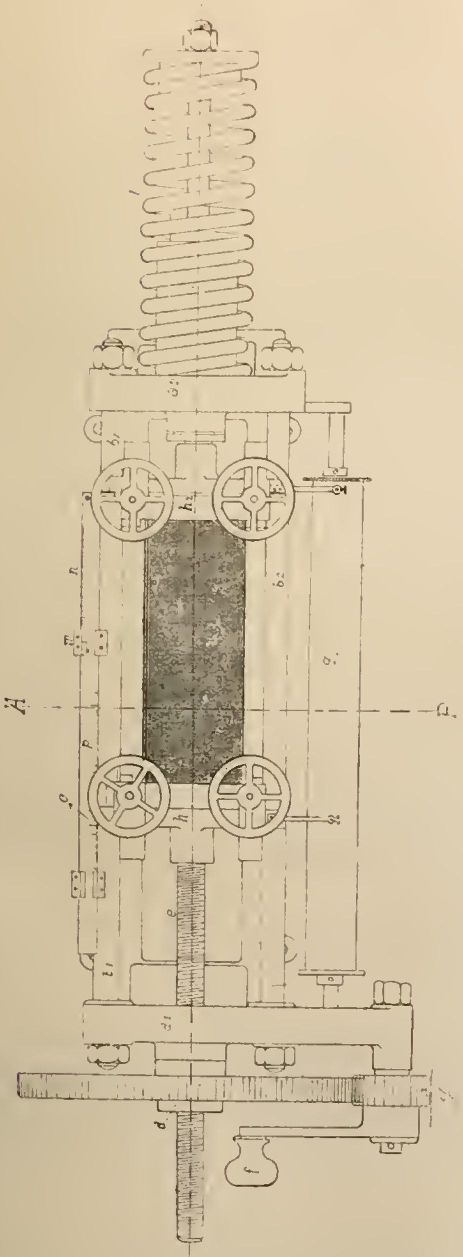


View on Plan.

—A. R.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

On the Indigo Vat for Wool Dyeing. B. Lindenberg. Chem. Zeit. **12**, 721.

The present mode of indigo dyeing requires a great deal of experience, without which the whole of the vat is very often lost. The author describes a method discovered by himself, which is perfectly safe even in the hands of ordinary careful workmen. He calls it the flour vat.

15 kilos. of wheat flour are mixed with cold water to a milk, care being taken that a homogeneous mass is formed and then poured into the vat, which is filled with water and heated to 81° C. 6 kilos. of finely-ground indigo and 30 kilos. of soda crystals are added and the mixture is left to fermentation, which begins in about 24—28 hours. If necessary

3 kilos. of indigo,
3 ,, flour,
6 ,, soda crystals,

are added in the evening at 69° C., so that the vat shows the following morning the correct temperature for dyeing of 62·5° C. If no new indigo is required, the addition of 1 kilo. of flour and 2 kilos. of soda crystals and heating up to 69° C. daily is necessary. Lime, but never more than one-third of the quantity of soda, is employed as usual; but with very pure indigos the addition of it may be omitted.

Crystal soda is preferable to calcined on account of its regular chemical composition. As is well known, vat fermentation produces at first lactic acid, which is then converted by hydrogen into butyric acid. The used-up vat is a very good and cheap source for butyric acid.

It is essential for a good vat that the indigo is in a very fine state of division, and the author recommends the addition of 1 kilo. of caustic potash and 2 kilos. of starch sugar to 6 of indigo before grinding it, and to heat this mixture after grinding, to boiling.

The author doubts whether the zinc dust vat, so very useful in cold dyeing, has ever been applied to warm dyeing on account of the rapid oxidation of the white indigo thus formed. To prevent it, he recommends the addition of neutral sodium sulphite. The zinc vat is made up of—

3 kilos. of ground indigo,
6 ,, zinc dust,
2 ,, sodium hydrate,
3 ,, calcium hydrate.

These ingredients are boiled with water until the indigo is reduced, and the mixture is poured into the vat containing water of 62·5° C. and 10 litres of neutral sodium sulphite of 20° Baumé.

To re-charge this vat—

3 kilos. of indigo,
3 ,, zinc dust,
1 ,, sodium hydrate,
1 ,, calcium hydrate,
1 litre of sodium sulphite,

are used. In addition to these substances 1 kilo. of soda crystals is taken for each kilo. of indigo.

This vat works very well, keeps, and may be interrupted at any time.—A. L.

Fixing Aniline Steam Colours with Tannin and Tartar-emetic. Prudhomme. Soc. Ind. de Mulhouse, May 23, 1888.

With aniline steam colours, where the mordant is tannin, tartar-emetic acts very satisfactorily as a fixing agent. By steaming the lake formed from tannin and the colouring matter, the lake penetrates the fibre, though it is by no means rendered fast. Addition of tartar-emetic brings about the fixation and forms a better lake of colouring matter, tannin, and antimony oxide.—T. L. B.

Koepp's Double Fluoride of Antimony and Sodium. E. Kopp and S. Bruère. Bull. Soc. Ind. de Rouen, **16**, 69.

Experiments in three baths, containing respectively 7·05 kilos. of Koepp's double fluoride, 10·12 kilos. of de Haen's "antimony salt" (antimony fluoride with ammonium sulphate), and 11 kilos. of tartar-emetic, in each case dissolved in 2,200 litres of water, with 6 kilos. of Solvay soda added, showed that the two former gave less brilliant colours in the finished stuffs than did the latter. This might be due to their greater acidity, and therefore soda was added, which caused a considerable precipitation of antimony oxide. The authors conclude that these compounds cannot satisfactorily replace tartar-emetic.

—W. G. M.

Use of Chromium Fluoride in Wool Dyeing. H. Lange. Leipzig. Monatsschr. f. Text. Ind. 1888, 3.

The chromium fluoride of the Austrian firm, R. Koepp and Co., may advantageously be used in place of the nitrate or acetate commonly employed. The authors also recommend it as a substitute for potassium chromate for boiling, since by its use a precipitate of chromium oxide is obtained on the fibre, imparting to it a clear green colour; whereas the chromate gives a greenish or yellow shade, according to the duration of the boil; and the occurrence of the green shade indicates a reduction of chromic acid at the expense of the wool, which is thus rendered coarser and more harsh. The quantity of colouring matter fixed is in direct relation to the time occupied in boiling, which is not always the case with the chromate. Woollen yarn boiled in the fluoride shows no tendency to felt; it remains soft and takes well the colour subsequently applied. Cloths, moreover, are by the use of this agent dyed with greater uniformity. A further advantage, especially when used in conjunction with indigo, is that the fluoride exerts no oxidising action like that of the alkaline chromate. Thus the chromium fluoride is especially useful in the production of fine and pure shades, and where the chromate cannot be used on account of its oxidising properties. Wooden vessels must be employed for boiling, as the solution attacks copper.—W. G. M.

The Double Salt of Antimony Fluoride and Sulphate of Ammonium. Albert Frey. Bull. Soc. Ind. Mulhouse, 1888, 301.

This new commercial product, known as "antimony salts," has the formula $SbF_3 + (NH_4)_2SO_4$. It dissolves very readily in water, imparting a strongly acid reaction. It attacks glass as well as metals, and wood alone is suitable as material for storing-vessels, &c. If saturated with carbonate of soda, it works very well. A good bath is, 100 litres water, 400 grms. antimony salts, 200 grms. soda crystals. The temperature is best at 50°. The printed goods are much brighter than when treated with tartar-emetic, the whites especially being very pure. In dyeing equally favourable results were obtained. 4 grms. of this double fluoride are as effective as 5 grms. of tartar-emetic. The price of the latter product being much higher, there can be no doubt that this new salt will be very generally employed.—A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

Sulphuric Acid Manufacture. F. W. Chappell. Chem. Zeit. Rep. **12**, 152.

The author gives the following tables as a check on the progress of the manufacture :—

Degrees (Baumé) at 60° F.	SO_3.	Maximum Yield from 1 Part pure Sulphur.	Average (Yearly) Product obtainable per 1 Part Commercial Sulphur.
°	Per Cent.		
40	39·5	6·33	6·08
41	40·7	6·14	5·89
42	41·8	5·98	5·74
43	42·9	5·82	5·59
44	44·1	5·67	5·44
45	45·2	5·53	5·31
46	46·4	5·39	5·17
47	47·6	5·25	5·04
48	48·7	5·13	4·92
49	49·8	5·02	4·82
50	51·0	4·90	4·70
51	52·2	4·79	4·60
52	53·5	4·67	4·48
53	54·9	4·55	4·37
54	56·0	4·46	4·28
55	57·1	4·38	4·20
56	58·4	4·28	4·11
57	59·7	4·19	4·02
58	61·0	4·10	3·94
59	62·4	4·01	3·85
60	63·8	3·92	3·76
H_2SO_4	81·8	3·06	2·99

The chamber gases, acid compounds being separated, consist of nitrogen (in quantity corresponding to that of sulphur burnt) and an excess of atmospheric air. If the percentage of oxygen in the gases be x, and that in atmospheric air = 20·8 by volume, then when using sulphur the following equations are obtainable—

I.

Amount of such gas in cub. ft. at 0° and 760 mm. produced per 1 lb. S $= 63\cdot837 + \left(63\cdot837 \times \frac{x}{20\cdot8 - x}\right)$.

II.

Amount of sulphur per cub. ft. of such gas if no sulphur compounds be removed $= 0\cdot341658\,(20\cdot8 - x)$.

From these equations the percentage of sulphur lost may readily be calculated. Thus, assuming that in 24 hours 5,000 lbs. of sulphur have been burnt, and that the gases after condensation still contained 0·63 grms. S per cub. ft. and 8 per cent. of oxygen. Then :—

I.

$$63\cdot837 + \left(63\cdot837 \times \frac{8}{20\cdot8 - 8}\right) = 103\cdot735 \text{ cub. ft. per lb. S.}$$

$103\cdot735 \times 5{,}000 = 518{,}675$ cub. ft. (total gas).

$518{,}675 \times 0\cdot639 = 326\cdot765$ kilos. S in total volume of gas.

$326\cdot765 \times 2\cdot2046 = 720\cdot39$ lbs. S = 14·41 per cent. loss.

II.

0·341658 (20·8 − 8) = 4·3732 grms. S = possible amount of S per cub. ft. in a gas containing 8 per cent. of oxygen.

But 0·63 grms. is the actual amount.

Hence actual loss = 14·41 per cent.

If pyrites be used in place of sulphur, equation I. would stand $79·797 + \left(79·797 \times \frac{x}{20·8 - x}\right)$ = cub. ft. from 1 lb. S in form of pyrites; and equation II. would be—

0·273109 (20·8 − x) = grms. S per cub. ft. uncondensed gas after complete oxidation.

These formulæ are all calculated at 0° and 760 mm.

—W. G. M.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Chemical Reactions between Solids under Pressure. W. Spring. Bull. Soc. Chim. **44**, 166.

The author has shown that a mixture of barium sulphate and sodium carbonate act upon each other under strong pressure just as they do on fusion, only to a less degree. If a pressure of some 6,000 atmospheres be allowed to act for only a few instants on an intimate mixture of one part of barium sulphate and three parts of sodium carbonate, about 1 per cent. of the barium sulphate is converted into carbonate. If the cylindrical lump obtained by the compression be powdered and again pressed, the quantity of barium carbonate after three compressions will have risen to 4·78, and after six compressions to 9 per cent. If the cylindrical mass obtained after one, three, or six compressions be left to itself for a long time, it will be found that the chemical action does not cease with the cessation of pressure, but proceeds for about 14 days.

If the cylinder be heated to 120°, the quantity of barium carbonate obtained will be less than when no heat is applied.

Thus, the heat exerts an action opposed, as to effect, to that exerted by the pressure.

Spring thinks the results of these experiments tend to establish the following principles:—

(1.) Diffusion may take place in solid as well as in fluid bodies.

(2.) Matter assumes, under pressure, a condition relative to the volume it is obliged to occupy.

(3.) For the solid state, as for the gaseous, there is a critical temperature above or below which changes by simple pressure are no longer possible.—W. S.

Some Calcium Salts entering into the Composition of Hydraulic Cements. H. Le Chatelier. Annales des Mines, 1887, 388—412.

The author first enters very fully into the slaking of lime, and explains the many influences which affect it. Calcium hydroxide, according to the author's experiments, when heated rapidly, decomposes at between 530°—540°. When slowly heated below 100° the decomposition is too slow to be observed; at 360° the tension of decomposition is only equal to 100 mm. of mercury, and only attains atmospheric pressure at 450°. Calcium hydroxide is, hence, quite stable at ordinary temperatures, and moreover is only slowly attacked by carbonic anhydride, although its solution absorbs that gas rapidly.

Passing on to the silicates, the author shows that the silicate $CaSiO_3$, does not set in water alone, although it does harden when mixed with water saturated with carbonic anhydride and exposed to an atmosphere of that gas. The silicate Ca_2SiO_4, prepared by fusing the proper proportions of lime and silica, forms, while hot, a solid compact mass difficult to break with a hammer, but on cooling it swells, cracks, and finally falls to a white powder, which under the microscope appears to consist of prismatic fragments with feeble double refraction, and at times with fine striations in the direction of their greatest length. This substance is suggested as the cause of spontaneous pulverisation observed in some slags and sometimes in dry cements. The admixture of magnesium to form $MgCaSiO_4$ entirely prevents the pulverisation, whilst smaller quantities of magnesia or iron oxide or alumina diminish it; hence, in slags the pulverisation frequently extends over several days. The phenomenon is shown to be due to the dimorphism of this salt and the spontaneous transformation from one form to the other, similar to that exhibited by fused potassium sulphate. Compared with the monocalcium silicate (wollastonite), this dicalcium silicate is more readily attacked by acids generally and by carbonic anhydride, and is moreover easily decomposed by ammonia or its salts. It is scarcely at all attacked by water, and therefore is of little or no value for cement purposes. The substance $Ca_3Si_2O_7$ is no compound, but simply a mixture of the mono- and dicalcium silicates. The compound Ca_3SiO_5 is presumably obtained in an amorphous form by decomposing, by means of steam at 450°, calcium chlorosilicate, Ca_2SiO_4, $CaCl_2$; the pulverised mass sets in boiling water to a hard durable briquette, and neither swells nor cracks; it is very different to the other two calcium silicates. It cannot be prepared by direct combination of lime and silica, either by heat alone or by the use of a flux, such as calcium chloride or fluoride; in fact, with the first of these the above chloro-silicate is obtained.

Mixtures of lime and silica containing less than 1 mol. CaO to 1 mol. SiO_2 yield fewer crystals of wollastonite as the proportion of lime diminishes, and in fact they ultimately form mixtures behaving like inferior pouzzolanas. The only hydrated silicate obtained was $CaSiO_3$ + aq. (possibly 2·5 H_2O); this forms a bulky precipitate, 1 grm. occupying 2 litres, when excess of lime water is added to a solution of silica. It is decomposed by water.

The following aluminates were prepared by fusing together alumina and lime in various proportions, and sections were examined under the microscope, to determine their crystalline character. $CaAl_2O_4$, forms scarcely fusible and very hard cubical crystals; and when pulverised and mixed with water it sets rapidly, but with large excess of water it decomposes. $Ca_3Al_4O_9$ (?) is easily fusible, and forms orthorhombic crystals with very strong double refraction; powdered and mixed with water it sets as well as plaster of Paris, but the hydrates formed are only slightly stable, and become pulpy when heated to 100° in presence of water. When the powder is treated with large excess of water, both alumina and lime pass into solution in variable proportions, and part of the alumina is deposited as a crystalline hydrated calcium aluminate; if lime-water be added, the whole of the alumina is immediately precipitated in this form. When lumps are immersed in water a shell of the hydrated aluminate forms and perfectly protects the interior portion. If, however, the lumps are exposed to moist air, they gradually crack, and ultimately fall to powder. $Ca_3Al_2O_6$ is the most fusible of these salts, and forms cubical crystals. It sets like the other aluminates, and also dissolves in water. Aluminates containing higher proportions of lime than Al_2O_3, 4 CaO behave like mixtures of the aluminates with free lime. Of the various hydrated aluminates of calcium, the author only takes into consideration the most basic, $Ca_4Al_2O_7$, 12 H_2O, the only one stable in presence of excess of lime, and likely to be met with in cements. This is best prepared by adding an equal volume of lime-water to the filtered solution of the anhydrous aluminate containing least lime. The solution deposits spheroidal aggregations of attenuated needles. It is decomposed by water. The substitution of magnesia for part of the lime in the aluminates at first causes the fusibility of the salts to increase with the quantity of magnesia, until a maximum is reached, after which the fusibility again decreases, until ultimately infusible magnesium aluminate is obtained. The sensibility to the action of water decreases with the substitution of magnesia for lime; apparently double salts, similar to the carbonates in dolomite, are formed.

Calcium ferrates.—With these salts no satisfactory results have been obtained. Mixtures of equivalent proportions of ferric oxide and lime require such a high temperature for fusion that the former decomposes. With lower proportions of iron oxide, highly-coloured substances form, which swell and slake with water. A white hydrated ferrate is known, which is coloured brown by carbonic anhydride, owing to the separation of ferric hydroxide, and is decomposed by water. A compound, Al_2O_3, Fe_2O_3, 3 CaO, has been prepared by synthetical fusion, crystallising in well-defined long needles of a beautiful red colour. It is much more fusible than the corresponding aluminate or ferrate. When calcium aluminates are fused with calcium chloride, a very fusible vitreous mass is obtained, from which water dissolves out the calcium chloride, leaving a gelatinous residue containing alumina. With the ferrates, however, a calcium chloro-ferrate, Fe_2O_3, CaO, $CaCl_2$, is obtained under similar circumstances. It forms beautiful brown crystals with distinct cleavage. It is not acted on by water or acetic acid, and can therefore be easily separated from the excess of calcium chloride and lime. Many of the numerous double silicates of iron, of alumina, and of lime play only a secondary part in cements, and many are useless for such purposes. No detailed account is given of them.—D. A. L.

PATENTS.

Improvements in the Continuous Manufacture and Burning of Cement. F. W. S. Stokes, London. Eng. Pat. 9694, July 11, 1887. 8*d.*

According to this invention, the slurry is burnt while in the forms of strips, sticks or sheets of regular or uniform transverse sectional area, a revolving cylinder or furnace being employed, so that the strips are kept relatively in motion. The apparatus employed is described in considerable detail in the specification.—E. G. C.

Improvements in the Manufacture of Slag Cement and in the Preparation of Raw Materials used therefor. E. Larsen, London. Eng. Pat. 10,385, July 26, 1887. 6*d.*

The slags to be used are collected and brought in a fluid state to a convenient place, where such materials as may be desirably eliminated are removed by the oxidising effect of a strong current of air, preferably superheated, or substances may be added with the view to rendering the slags more cementatious.—E. G. C.

A new Description of Metallic Cement and Processes for its Manufacture. C. P. Tabary, Paris. Eng. Pat. 10,443, July 27, 1887. 6*d.*

This cement consists of the following ingredients:—Stone of trachytic origin or stone of Lorraine, 75 per cent.; oxide of zinc, 10 per cent.; and magnesia, 15 per cent. The stone employed is previously immersed in a bath of hydrochloric acid or chloride of zinc, to which have been added about 8 per cent. of borax and about 8 per cent. of ammonium chloride.—E. G. C.

Improvements in the Treatment of Lime Mud and like Substances to obtain Whiting and Cement, and in Apparatus therefor. J. S. Rigby, Holywell. Eng. Pat. 11,274, August 18, 1887. 6*d.*

The inventor carbonates lime mud and pulverises the carbonated mud, after washing, filtering, and drying it. The mud so treated is mixed with clay or suitable aluminous material, and the mixture is calcined. The combinations of carbonators, filters, and drying and calcining apparatus described in the specification are also claimed.
—E. G. C.

X.—METALLURGY, MINING, Etc.

Chemical Reactions between Solids under Pressure. W. Spring. Bull. Soc. Chim. **44**, 166.

(See page 567.)

The Netto Process for the Manufacture of Sodium and Aluminium. The Eng. and Min. Journ. **45**, [25], 449—450.

Netto's process has been adopted by the Alliance Aluminium Company, and experiments have been made at Essen with encouraging results. The new company is offering aluminium at 27*s.* 6*d.* per lb. Sodium, it is stated, can by the Netto process be produced at less than 1*s.* per lb.

Netto's process is one of sodium-reduction, the cheapness of which, as in the case of Castner's important discovery, depends upon the cheap manufacture of the metallic sodium. The process for making the sodium is thus described. Pure caustic soda is fused in a pan and then ground coke stirred into it; 100 lbs. of the mixture are ladled at a time into a long narrow retort lying in a furnace. The carbon reduces a part of the soda, metallic sodium distils off and is caught in a condenser, whilst sodium carbonate is left in the retort. For the manufacture of the aluminium, pulverised cryolite is mixed with common salt and melted in a reverberatory furnace. When liquid it is run into a ladle, and ingots of solid sodium are forced to the bottom and held there until completely volatilised, which is effected in a few moments. The reduction follows by the action of the gaseous sodium displacing a part of the aluminium in the molten cryolite. The slag is skimmed off and the remainder poured into an iron crucible to cool. When the mass is turned out a solid ingot of aluminium is found at the bottom. As it requires about 3½ lbs. of sodium to reduce 1 lb. of aluminium, the entire cost of making the metal is reckoned at 6*s.* a pound.—W. S.

Some Curiosities of Iron Manufacture. A. E. Tucker. Iron, 1888, 378—382.

The author first draws attention to the beneficial use of *slaked* lime in the puddling furnace, and gives details of bars and rods of good composition and properties obtained from extremely bad cinder pig.

Illustrations of the extraordinary hardening power possessed by chromium are given. In one case the addition of 0·2 per cent. of chromium raised the elastic limit of normal steel from 20 to 28·5 tons per square inch; in another, 0·3 per cent. raised the elastic limit from 25 to 31 tons. In the puddling furnace, however, chromium is not to be recommended on account of the extreme difficulty in fusing chromium iron ore. It is not slagged away and invariably produces red-shortness, which is really due to lamination.

The author is making experiments on the use of chromium as a hardening for surfaces.

Some extraordinary cases of segregation of impurities, which occurs during the cooling of castings or ingots, are described. An 18-cwt. ingot (steel) was slotted through the centre, and the top and bottom of the interior sides contained respectively the following percentages:—

——	Top.	Bottom.
	Per Cent.	Per Cent.
Phosphorus	0·197	0·04
Carbon	0·326	0·316
Sulphur	0·132	0·04

This phenomenon, which is not confined to steel, occurs frequently in the casting of pig iron from the blast furnace, and in cast iron generally. In the case of chilled rolls, and indeed of ordinary castings, the "git" and head are frequently of excessive impurity. The author once found the "git" of a casting to contain — silicon, 12·34; sulphur, 0·97; manganese, 2·43, and states that he has seen excrescences on castings which could be knocked off with a slight tap, and which, on examination, proved to be nearly pure sulphide of iron. The explanation applies to all these cases. In consequence of the greater fusibility of these compounds they have been ejected out of the mass of iron during the solidification of the castings, thus giving an example of the well-known Pattinson's process, in which advantage is taken of this phenomenon for the separation of silver from lead.

A phosphide of iron containing :—

	Per Cent.
Carbon	0·07
Silicon	0·028
Phosphorus	1·0
Manganese	0·3

was obtained by blowing a phosphoric pig in the Bessemer converter, and it is said to work perfectly at a red heat. In appearance it resembles spiegeleisen, and when cold it is extremely brittle and has very definite cleavage planes. It would have have been thought that a metal containing that amount of phosphorus would have been perfectly unmalleable under any condition whatever.

As regards the high (1 per cent.) percentage of silicon which sometimes occurs in finished steel, it is explained that "in consequence of the very extraordinary elevation of temperature in the Bessemer converter it is quite possible to obtain a temperature at which all chemical action ceases," and though the blowing may be continued, neither the silicon nor anything else will be burnt out. The remedy lies in the reduction of the extreme temperature by slower blowing or by scrapping, and when the latter is done sufficiently the silicon is burnt out in the usual way.—O. H.

Silicon and Sulphur in Cast Iron. T. Turner. Iron, 1888, 401—403.

In the first part of the paper, which is devoted to laboratory experiments, the author arrives at the following conclusions:—"Under certain conditions compounds may be obtained from cast iron which contain very considerable quantities both of sulphur and silicon. Such compounds, however, are unstable, tending to decompose on melting. The silicon, with the greater part of the iron, remains, whilst most of the sulphur is eliminated. Part of the sulphur passes away in the gaseous form, much of it is found either in the condition of graphitic matter rich in sulphur or of sulphur balls. In the presence of a slag much of the eliminated sulphur is met with in the slag in the form of sulphide. It appears probable that with a certain percentage of silicon there is a definite amount of sulphur which cannot be exceeded under given furnace conditions."

Part II.—Silicon and Sulphur in the Blast Furnace.

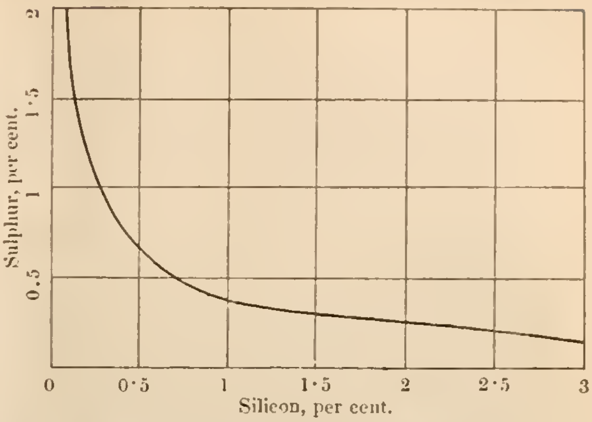
"*Conclusions.*—In the blast-furnace there are three chief agencies at work tending to eliminate sulphur, of which in Cleveland practice not more than one-twentieth passes into the iron, viz. :—

"1. A high temperature tends to prevent the absorption of sulphur by iron.

"2. A slag rich in lime readily combines with sulphur.

"3. The amount of sulphur actually retained by the metal is influenced by the proportion of silicon, and probably certain other elements present in the iron. For every proportion of silicon there is, with given furnace conditions, a corresponding maximum proportion of sulphur (*see* Figure). In the blast furnace, under normal conditions, this maximum is not exceeded, and is very seldom reached. If by any means an excessive amount of sulphur should be present, re-melting eliminates sulphur, and tends to produce a condition of equilibrium."—O. H.

Maximum Sulphur Curve (Cleveland Iron).



The Testing of Cast Iron. A. Ledebur. Stahl und Eisen, **8**, 223.

When castings are run direct from blast furnaces, especially where the latter are sensitive towards accidental alterations in conditions, as in the case of small charcoal furnaces, it is essential that tests of the metal should be made at least daily. One of the simplest guides, and in experienced hands a very reliable one, is the appearance of the surface of a cooling mass of liquid iron. After skimming in the ladle, a portion of the metal is run into an open sand mould about 20 cm. in diameter and 7 to 8 cm. deep. With iron rich in silicon and carbon the surface is soon covered with a dead film of oxidised bodies; and this would indicate a metal too rich in graphitic carbon, while a long and lively "play" on the surface shows an iron generally useful for foundry work. It will be found to solidify in thin sections without separation of graphite. If after a short, active play, wart-like excrescences are formed, or many "jumpers" are produced in pouring, the metal is poor in silicon, hard, and with a tendency to become white. North American foundries apply a special test for fluidity by pouring into a sand mould, which is but 1½ mm. in width at one end; the extent to which it is filled gives the required indication. By examining similar bars cast with a rib on one side, any tendency to distortion during cooling will be observed. Tests where the load is applied gradually and by impact, the extent of flexure being in either case measured, are especially useful for metals which may be required to withstand shocks. The hardness and grain of the iron may also be noted; and the application of all these tests will be found useful in selecting new iron for foundry use.—W. G. M.

The Stripping of Tin Plates. R. Lucion. L'industrie Moderne, **2**, 113.

The author gives a review of the principal patents for treating tin scraps which have appeared since 1849. The preference is given to the new process of A. Lambotte, which is at work on the large scale at Brussels. Lambotte treats tin scraps with air containing a little chlorine, and heated to a temperature above the boiling point of stannic chloride, which is formed and volatilised before the iron can exercise a reducing action upon it. The tin scraps are filled into a blast furnace, through which is passed a stream of chlorinated air previously heated by its passage through hot tubes. For the condensation of the stannic chloride vapours from the large excess of inert gas, chambers of large condensing surface are employed, fed with stannic chloride solution of moderate concentration, which absorb the vapours to saturation. The inventor has also patented the employment of the exact quantity of water required to form the crystallised stannic chloride in the condensing chamber. The scrap iron obtained by this process is said to be free from tin, and to yield iron of the best quality. According to a report of Dewalque, one ironworks has already worked up hundreds of tons of iron scraps so recovered, and Lambotte has recently enlarged the plant so as to treat 2,000 tons of tin scraps yearly. Negotiations are taking place for carrying out the process in England, France, and Germany.—G. H. B.

The Desilverisation of Speiss at the Eureka Consolidated Works, Eureka, Nevada. T. Rickard. Eng. and Min. Journ. **45**, 474.

In smelting the ores of the Eureka district much argentiferous speiss is produced, which hitherto has not admitted of economical desilverisation, so that at the works in question some hundred thousand tons of the material, worth about a million and a half dollars, have accumulated. At the Richmond Works the molten speiss is tapped into pots lined with lime or cryolite, and there mixed with lead or litharge (preferably 25 per cent.), with which it becomes agitated by the carbon dioxide dissociated by heat from the calcareous lining. In this way, by the alloying of the gold and silver with the lead, some 67 per cent. at most of the precious metals are extracted. It is found, however, that where the speiss is mixed with cold lead it tends to become chilled; and, moreover, the lead is liable thus to take up more arsenic (10 per cent.) than when it is melted before admixture, in which case it absorbs only 5 per cent., with the result that more time is lost in softening the lead previous to desilverisation. Bryan, in 1885, patented the use of an air blast to remove the arsenic, but no practicable material has been found to withstand the action of the melted speiss together with that of the blast. The speiss obtained in treating the Ruby Hill ores has the following composition :—

	Per Cent.
Arsenic	32·95
Antimony	0·13
Molybdenum	2·31
Sulphur	3·34
Lead	2·18
Copper	1·06
Iron	57·02
Zinc	0·07
Lime	0·34
Silica	0·23
Silver and gold	0·029
	99·659
Silver in oz., per ton	8·01
Gold „ „	0·43

At the Eureka Works the speiss in lumps is melted with coke in a Rachette furnace, by which a concentration of over 30 per cent. may be effected. It is then run on to a small quantity of lead contained in a fire-brick-lined sheet-iron cylindrical converter, 36 ins. high by 27 ins. diameter externally. From 20 to 25 per cent. of melted lead are now added to the charge, which usually weighs about 800 lbs., and air is let on at about 17 lbs. pressure. Much commotion is thus caused, arsenic burns with a blue flame, and dense fumes of the trioxide are evolved. The lining is at first somewhat attacked, but is soon protected by a film of basic slag, so that one lining may last out 1,000 blows. The lead produced should contain 40 oz. silver per ton; if it hold more, its power of extracting the precious metal will be decreased; if less, the full efficiency of the lead does not result; the quantity added is therefore regulated accordingly. A hot blast gives somewhat better, but not commensurately, higher results. The time should not normally exceed three minutes unless the charge is pasty, when the blow must be prolonged. The contents of the converter are finally tipped into a kind of slag pot in which the lead rapidly gravitates to the bottom, so that it may be run out after the speiss has cooled, and be desilverised by the Parkes process. The loss of lead may be estimated at from 5 to 8 per cent. The labour of two men only is required to conduct the operation. The following statement shows the result of one month's work :—

—	Silver.	Gold.
	Ounces.	Dollars.
760 tons speiss charged into the Rachette furnace gave 570 tons, containing	7053·05	10211·88
The lead bullion obtained contained	5889·03	9114·06
Loss =	1164·02	1097·82
	Per Cent.	Per Cent.
Percentage of extraction	83·5	89·28

—W. G. M.

PATENTS.

An Improved Process for Extracting Metals from their Ores, and Apparatus therefor. H. C. Bull and Co. and H. C. Bull, London. Eng. Pat. 10,206, July 21, 1887. 11*d*.

Into a central shaft is fed through a bell-hopper a charge of iron ore and limestone, previously calcined by the waste heat of the furnace gases, with coal briquettes in the proportion of about 5 cwt. of the latter per ton of iron. Here the ore is reduced and melted by gases which have been originally supplied by water-gas producers, and which have passed through one or two open-hearth furnaces placed at the base of the shaft, into which the liquid metal flows. When sufficient metal has collected in one of these furnaces, the connecting channel is dammed up, and the second furnace is put in connexion instead. The metal being sufficiently treated in the former by the addition of lime and iron peroxide and the like, is mixed with spiegel or ferro-manganese, tapped into a ladle and run into ingot moulds as usual. The gases, which are drawn through the shaft by a fan, are utilised for heating the air heaters and the steam generators, passing finally to the stack. Hot air is thus supplied to the gas producers and to the open-hearth furnaces, thus accomplishing its object better in each case than would otherwise be possible. The open-hearth furnaces are made with moveable top and bottom, and have a basic lining; they are also provided with the usual tap-hole and working doors. Spiegel cupolas and lime calciners for the open-hearth furnaces also form part of the arrangement. The calcining ovens, air-heating stoves, and the gas producers are preferably those protected by Eng. Pats. 10,203, 10,204, and 10,205, of 1887, respectively. Other metals besides iron may be similarly smelted.—W. G. M.

Improvements in the Process of Separating Precious Metals from their Ores, and in Apparatus to be employed therein. A. N. Contarini, London. Eng. Pat. 15,504, November 12, 1887. 8*d*.

A liquid is chosen, the specific gravity of which shall be less than that of the metals to be obtained, but greater than that of the matter from which they are to be separated. Thus for gold and platinum mixed with gangue stuff, mercury is used; for other substances, a fusible alloy of bismuth, tin, and lead, in proportions suitable to the density required, is taken. The fine crushed ore is slowly fed by means of an arrangement of rotating pistons into a pump, with an eccentric cylinder and sliding radial blades within. Into this pump a small portion of the liquid-separating agent is automatically admitted at intervals by a valve actuated by a tappet wheel; thence, mixed with the ore charge, it is urged forward by the eccentric through a valve opening upwards into a cylinder containing the mercury or other medium. Here it is thoroughly distributed by a series of revolving arms, the lighter material floating to the top, whence it is constantly removed by an automatic skimmer; the heavier insoluble matter subsiding through a valve to the bottom into a counterbalanced receiver which, when sufficiently charged, itself closes the valve, tips out the contents, and, resuming its original position, reopens the valve. Other matter may be dissolved in the mercury, and the extent of this solution is indicated by a needle on a dial, the movement of which is actuated by the difference in weight of two vessels, both originally filled with the fresh liquid and in equilibrium, but one of which only is in connexion with the cylinder, and therefore alters in weight as the liquid takes up the fresh material. When fusible alloy is used the whole chamber is heated, and the ore is also heated previous to admission.—W. G. M.

Improvements in the Treatment of Ores containing Gold, for the purpose of Extracting the Gold therefrom. J. B. Spence, London. Eng. Pat. 16,183, November 24, 1887. 6*d*.

The ore is crushed fine, and, if containing much arsenic or sulphur, it should be first calcined. It is then treated with a solution of ferric chloride of sp. gr. 1·150 (30° Tw.), saturated in the cold with common salt. This operation is best conducted in a wooden vat with wicker false-bottom carrying a layer of fine sand, then of coarse sand, and finally of pebbles, protected by laths, and provided below with a pendent draw-off pipe, trapped by a bend, to aid the filtration of the liquors from the fine ore. The process is conducted at a temperature of 160°—200° F., and with constant agitation, preferably by steam. If the ore has been roasted, it may be treated with hydrochloric acid, which will form the ferric chloride by solution.—W. G. M.

Improvements in the Extraction of Gold and other Precious Metals from Minerals and Ores containing them. C. D. Abel, London. From M. M. Rotten, Berlin. Eng. Pat. 4418, March 22, 1888. 6*d*.

The chlorination process being wasteful, owing to the chlorine attacking other substances before the gold, and to the ready decomposability of the gold chloride, the inventor attacks the finely divided ore with alkaline or neutral potassium cyanide solution. This solution is used repeatedly until saturated with gold, when the latter is extracted, preferably by electrolysis, using carbon or iron anodes. The cyanide, after making good the cyanogen expended, may be used over again until the quantity of metals non-recoverable by electrolysis is too considerable, when the cyanogen may be regained by chemical means. The process is equally applicable to ores of platinum, silver, or mercury.—W. G. M.

Improvements in the Treatment of Auriferous Ores and in the Revivification of the Materials used in such Treatment. W. Crookes, London. Eng. Pat. 7867, May 29, 1888. 6*d*.

This process is especially suitable to ores in the amalgamation of which the mercury flours or sickens. It may be used to treat any ore in its original condition, provided it has been fine-crushed; but when the ore is rich in sulphurets a previous roasting is advantageous, and the more complete this calcination the better will be the result, although it is not essential that it should be roasted sweet. When the ores contain but little sulphuret or other matter acted on by ferric chloride, they are operated upon by a solution of that salt of sp. gr. 1·15 (30° Tw.), saturated in the cold with common salt if silver be present in the ore, and mixed with one-third part of well-washed manganese peroxide (Weldon mud) or one-fifth part of sodium nitrate or its equivalent. The ferric chloride solution should not be neutral. The mixture is heated with the ore in suitable tanks to a temperature of 95°—100° C., with continuous stirring. In this way the ferric chloride becomes reduced, and the gold and silver are converted into chlorides which are both soluble in the saline liquid. When the ores are almost free from sulphurets, a less soluble manganese peroxide may be employed, but the action will be proportionately slower. If other valuable metals are present with the gold and silver, an excess of the chloride is added, and the solution is heated nearly to boiling; but if the precious metals are associated only with metals of little commercial value, and acted on by the ferric solution, the latter is made as nearly neutral as possible, and of sp. gr. 1·1, cold-saturated with sodium chloride, and containing the Weldon mud, the action being continued at 50° C. only.

When the action has proceeded sufficiently far, the mixture is allowed to settle, the clear liquor is drawn off or filtered, and the residue washed. The precious metals are then precipitated by means of copper, and the latter by iron. If the ferric chloride be made *in situ* by attacking the ore with hydrochloric acid, excess of the latter is avoided by heating it with the ore after gradual addition. The spent solutions containing ferrous chloride are revivified by boiling with a nitrate or with manganese peroxide, sodium chloride, and a little free mineral acid, the manganese being subsequently recovered as peroxide by the addition of lime or chalk accompanied by an application of air under pressure. —W. G. M.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Moebius Electrical Process for Refining Silver. Courtenay De Kalb. Eng. and Min. Journ. **45**, [25], 452.

B. Moebius's process has for its object the electrical separation of gold and silver, and it has now been put into practical operation and with excellent results. A small plant has been erected in Kansas City and another in the works of the Pennsylvania Lead Company near Pittsburgh, which company has secured the right for the State of Pennsylvania. As to results, 20,000 oz. of silver bullion are being refined daily, and the product is said to be the best ever offered to the United States Mint in Philadelphia, the bars running from 999 to 999·5 fine. H. G. Torrey has secured the patent right for New York City. The success of the method has received here fresh demonstration, one lot of 1,000 oz. having turned out 1,000 fine. Refining by this method, it is said, can be done in New York for three-fourths of a cent per oz. whilst the minimum charge that will leave a profit to the refiner using other methods is one cent. per oz.

The principle upon which the process depends is, that when silver to be refined is made the anode in a weak nitric acid bath, the silver will pass into solution as nitrate through the action of an electric current from a dynamo, and will be redeposited in the metallic state upon a silver plate which constitutes the cathode. In practice the base bullion is cast in plates $\frac{1}{2}$ inch thick and about 14 inches square. These plates are inserted in muslin bags intended to retain the gold, platinum, lead (as peroxide), and other metals remaining after the silver is dissolved out, and are suspended in the tank of acid from copper rods. Alternating with these are the silver plates for the deposition of the refined silver. The current is 150 ampères, and one volt to each tank. The tanks can be arranged in "series" or in "multiple arc" at will. Mr. Torrey is using an Eddy dynamo of the Mather type. In each tank is a tray for catching the silver as it is scraped from the cathodes by automatic brushes, which move constantly back and forth across the plates, thus preventing the silver from accumulating and forming a connexion with the anodes. For convenience in cleaning out the trays, they are arranged so as to admit of being hoisted out of the tanks, and the bottom of each is divided in the middle and hinged to the sides of the frame so that upon removing a silver pin these sections swing down and outwards, dropping the silver into tubs placed underneath. The bath contains no more than one per cent. of nitric acid, and will not, for a very considerable period, produce any noticeable effect upon the muslin bags. Under the influence of the electric current the silver rapidly dissolves, and any copper in the bullion is dissolved also, but remains in solution. The process is said to be peculiarly adapted to refining Doré silver, which contains about 800 silver and 100 of gold.—W. S.

Electro Chlorination of Zinc-Lead Ores. Eng. and Min. Journ. **46**, 24. From the Leadville "Herald Democrat."

The ores used contain about 25 per cent. of zinc, 20 per cent. of iron, 15 per cent. of lead, 28 per cent. of silica, and 12 per cent. of sulphur, with 12 oz. of silver per ton, and could never before be profitably worked. Experiments made by A. Du Bois showed that after concentration the ore should be calcined, but not necessarily "dead roasted;" for at a certain point a portion of the zinc remains as soluble sulphate, available directly for electrolytic deposition of metallic zinc; but if the roasting be prolonged the proportion of zinc sulphate is diminished and a loss of zinc occurs. This zinc sulphate is to be extracted with water, and the residue is then chlorinated to complete the extracting of the zinc, or the roasted ore may be at once chlorinated without such extraction. The quality of the zinc oxide produced by the process is very high, and figures quoted show a profit of 31·78 dollars per ton of ore.

—W. G. M.

PATENTS.

Improvements in Galvanic Batteries. J. R. Hard and T. Wilson, New York, U.S.A. Eng. Pat. 8240, June 8, 1887. 8*d.*

This invention relates to the construction of battery cells, especially in connexion with medico-electrical apparatus. One part relates to a holder for the zinc, another to a stripper to remove surplus liquid and débris therefrom, another to a hinged plate to cover the filling aperture in the cell cover, and another to a protecting covering to the end of the carbon. These contrivances are chiefly in hard or soft rubber. There are 17 claims.—E. T.

Improvements in the Manufacture or Treatment of Porous Pots, Plates, or Partitions for Electric Batteries. E. Q. Mayer and H. Liepmann, London. Eng. Pat. 10,177, July 20, 1887. 6*d.*

A defect exists in porous pots, plates, or divisions, because of the want of uniformity of structure and composition, thus varying the resistance they offer to the passage of electrolytes. To overcome this defect, and to bring the pots, plates, or divisions to the requisite resistance, bodies of a neutral character are precipitated or deposited in their pores and upon their surfaces by chemical or thermal decomposition. Of the first, silicate of soda solution decomposed, after soaking the pots, &c. by weak acids; of the second, saturation with solution of sugar, and subsequent carbonisation in closed vessels—afford examples.

—E. T.

Improvements in Electro-metallurgical Processes and Apparatus therefor. H. C. Bull, London. Eng. Pat. 10,199, July 21, 1887. 11*d.*

This process is for the economical production of that class of metals which have hitherto been produced by the agency of reducing agents, like potassium and sodium—such metals as aluminium, magnesium, barium, calcium, or chromium.

There are 13 claims connected with the decomposition of the chlorides of the required metals in the vaporous state by the alkali metals produced in a nascent condition by electrolysis, and with the obtaining of hydrogen in the nascent condition by treating the excess of sodium or potassium with steam under pressure, using the hydrogen in the reduction of the chloride of the metal desired. The claims cover the apparatus for producing the metals.—E. T.

Improvements in Electrical Batteries. C. P. Elieson, Leytonstone. Eng. Pat. 10,555, July 29, 1887. 8*d.*

The inventor claims the combination in an electric secondary battery of two hollow electrodes, each of which comprises a series of layers of metal separated by alternating pieces or strips of asbestos, or other suitable porous material, clamped or secured together. Also in an electric primary battery, the combination of a hollow electrode placed within a second hollow electrode, one of the electrodes being built up of a series of material suitable for a positive electrode, and the other of a series of material suitable for a negative electrode.—E. T.

Improvements in the Manufacture of the Elements or Plates for Secondary Batteries or Electrical Accumulators. J. S. Stevenson, Jarrow. Eng. Pat. 11,390, August 20, 1887. 8*d.*

This invention is applied to the manufacture of plates for secondary batteries or accumulators, whereby the lead or alloy support or framing is cast round the active material in moulds, with the intervention of yielding material between the active material and the faces of the mould. Disintegration and the formation of imperfect castings is practically obviated.—E. T.

Improvements in Means or Apparatus to be employed in the Production of Sheet Copper by Electro Deposition. B. J. B. Mills. From E. Emerson, Providence, U.S.A. Eng. Pat. 14,270, October 20, 1887. 8*d.*

The apparatus consists of a revolving cylindrical cathode having a smooth surface to which the deposit will not cohere. The claims include the vat and its partitions and the combination of rotating cathode.—E. T.

Improvements in Galvanic Batteries. A. A. Fortin, Chalette, France. Eng. Pat 1128, January 25, 1888. 11*d.*

The invention is applied to a galvanic battery having an internal circulation of liquid and consequently producing a constant current, which, when employed for electric lighting, would produce a light of increased duration. The battery can be easily arranged for tension or quantity, and consists essentially of elements, each in a tray just deep enough to contain the electrodes, placed horizontally at small intervals one above the other, and just sufficiently apart to allow the liquid to flow between them. The claims are for the interposition of conducting studs, overflow pipes or lips so placed as to prevent contact of the liquid with the under surfaces of the trays, the employment of terminals of paraffin-coated carbon, and the means of supporting the column of elements by extensions of the top bar of the clamps, the parts being insulated with rubber.—E. T.

Improved Secondary Battery or Accumulator for the Storage of Electricity. W. Tilley, Brighton. Eng. Pat. 1968, February 9, 1888. 8*d.*

The inventor claims the use of perforated metal whose perforations are indented, so as to form distance pieces to separate the plates. The combination of lead or lead compound and zinc in the negative element. And the use of vulcanised tissue for porous diaphragm and insulator.

—E. T.

A Mode of preparing Carbons for Electric Arc-lighting. C. A. J. H. Schroeder, Upper Tooting. Eng. Pat. 6191, April 26, 1888. 4*d.*

The inventor claims the preparation of carbons of any kind of structure, from the densest to the loosest, and of any degree of hardness, so that they will furnish a useful electric light, under less favourable conditions of strength and tension and current, than any carbons hitherto employed; for instance, with a current of 20 volts E.M.F. and a strength of seven ampères. Dense carbon is dipped in a dilute solution of calcium chloride and dried. Loose structured carbon is similarly treated and then allowed to remain for a time in a solution of potassium chlorate, potassium nitrate, or sodium nitrate, or any composition of such solutions; after drying, the said carbon is placed in a bath of any of the fused salts just above-named, until the amount of penetration required for the electro-motive force and current, for which the carbon is intended, is attained.—E. T.

Improvements in Galvanic Batteries. B. Willcox, London. From T. P. Whittier, East Saginau, U.S.A. Eng. Pat. 7536, May 22, 1888. 4*d.*

This invention claims as an improvement the use as an excitant of the residual liquor of the salt manufacturer.
—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

PATENT.

An Improved Waterproofing Composition. K. McLea and R. Punshon, London. Eng. Pat. 12,911, September 23, 1887. 4*d.*

"Stearic acid or Stearine," with or without a small quantity of vegetable oil, is used to saturate the fabric to be waterproofed.—B. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

The Manufacture of Artificial Ultramarine. J. Pichot and P. Grangier. "Les Grandes Usines."

Authoritative evidence is given that the discovery of the manufacture of artificial ultramarine was made by J. B. Guimet; he first obtained it on a small scale in 1826, in 1828 he was awarded the prize of 6,000 fr., offered by the French "Société d'Encouragement" for his discovery, and in 1831 he founded the still existing manufactory for this product at Fleurien-sur-Saône. Gmelin recognised the possibility of producing artificial ultramarine in 1827, and in 1828 succeeded in obtaining it on a laboratory scale. From Guimet's own notes it is shown that he had already tried making it on the large scale in October 1826, so that the priority of his claim to the discovery is clearly established.

In the account given by the authors of the manufacture of artificial ultramarine the following points are of interest:—

The chemical composition of the green and blue varieties appears to be identical; the change from green to blue is due to oxidation, and there is not as much as 1 per cent. difference in the proportions of any of the constituents of the two products. In the transformation from blue to red, which is effected by prolonged burning, a change in chemical composition takes place. The lye extracted from the colouring matter contains alumina in a soluble form, whilst the proportions of sulphur and of soda contained in the lyes appear almost constant. The formation of red ultramarine is not due to the presence of an excess of silica as often supposed, for if the red product, when it contains an excess of silica, be lixiviated and then heated with carbon, it is transformed into the blue variety, and the two products contain the same proportions both of silica and of alumina. The change is due to oxidation, and whilst sulphurous acid is first formed in the burning, sulphuric acid results afterwards, and this acid favours the production of the red ultramarine. The proportion of alumina employed in making ultramarine determines the shade of blue obtained; the proportions of soda and of silica are practically constant, about 20 per cent. of the former and 37—38 per cent. of the latter. It appears that varying amounts of alumina and of sulphur do not prevent the formation of ultramarine as a product of definite composition. A series of ultramarines has been obtained by E. Guimet by substituting selenium and tellurium for sulphur on the one hand, and by replacing the soda by other alkalis, and by the alkaline earths on the other. The products thus obtained present the same reactions as ordinary ultramarine; the colours obtained by using selenium are brown, purple-red, rose-colour, and finally white; with tellurium yellow, green, grey, and white are successively formed. Potash, lime, &c., yield colourless ultramarines. A description of the manufactory at Fleurien is given, where as much as one-tenth of the total annual production in Europe is said to be made.—C. A. K.

On the Wax of Caoutchouc Varnish. A. Gascard. Journ. Pharm. Chim. **17**, 596.

According to Hatchett caoutchouc varnish contains 4—6 per cent. of a certain wax, which the author has further investigated. This wax is dark yellow and brittle, melts at 76°, and oxidises on heating in air. Treatment with alcohol and acetic acid splits it up into a soluble and insoluble portion. The latter has the composition $C_{30}H_{59}O-OC_{26}H_{53}$, and is insoluble in alcohol, acetic acid, acetone and cold benzene, but separates from its solution in hot benzene in well-formed crystals melting at 92°. 500 grms. of the wax yielded about 40 grms. of this body. It gave, on saponification, a crystalline alcohol of the composition $C_{26}H_{54}O$, melting at 88°, and a crystalline acid, $C_{30}H_{60}O_2$, melting at 91°. The original compound is reformed on heating its constituents to 150° in vacuo.—G. H. B.

PATENTS.

Improvements in Treating Resins, Oleo Resins, Gums, Pitches, Varnishes, Bitumens, and other like Substances. S. Banner, Liverpool. Eng. Pat. 11,805, August 31, 1887. 8*d.*

The present specification is confined to resins, balsams, and gums. Caustic lime has hitherto been used for hardening such bodies, but the inventor claims that hydrate and carbonate of lime, and calcium sulphide can be substituted for it if the combination be effected at a somewhat higher temperature than usual, and the oily vapours given off be removed as fast as formed by any convenient means, such as a chimney draught. The proportion of hydrate of lime used varies from 3 to 15 per cent., the quantity absorbed by the resin being greater the higher the temperature. Three to seven per cent. of sulphur may also be added, in which case the quantity of lime required is smaller; the transparency of the product is increased by the addition of a little boiled linseed oil just before solidification. The product can be dissolved in light hydrocarbon or linseed oil, to form a "varnish or vehicle for paint."—B. B.

An Improved Black Varnish or Enamel. T. Garton and W. Barkley, London. Eng. Pat. 7929, May 30, 1888. 4*d.*

Tar is boiled until a test-piece taken from it becomes hard on cooling. 25 per cent. of pulverised asphaltum are then added, followed by 10 per cent. of gum animé previously melted in a separate vessel. The whole is incorporated, and, if need be, thinned with boiled linseed oil, while hot. 10 per cent. of litharge are finally added. The product is said to be possessed of considerable elasticity and to be little affected by comparatively high temperatures, and can be used on stoves, furnace doors, &c.—B. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS

Improvements in the Manufacture of Gelatinous Substances and in the Apparatus to be used therein. G. P. Swinborne, London. Eng. Pat. 11,975, May 24, 1848. 2nd Ed. 6*d.*

Hides or skins or parts thereof, such as are usually known as glue pieces free from hair, are reduced to shavings or thin slices by a suitable instrument. These shavings or films are then soaked for five or six hours in cold water, at the end of which time the water is changed for fresh, and so on for some days, until no smell or taste is to be detected either in the water or in the shavings; if intended for soup these shavings are dried, and are then ready for market, but if gelatin is to be extracted, after the soaking just described, they are subjected to heat, with a quantity of water just sufficient to cover them when pressed down in any suitable vessel, taking care that the heat applied should not exceed that of boiling water. The gelatin thus extracted is strained through filter cloths and run in thin films on to a smooth surface of slate or other material to be dried, then cut up into shreds for market. By a similar process gelatin may be prepared from cod sounds or other fishy matters capable of yielding it. A disclaimer is made to that part of the title which is contained in the words "and in the apparatus to be used therein."—J. H.

Improvements in Machines for Working Hides, Skins, and other like Goods. G. Barnelle fils, Nièvre, France. Eng. Pat. 9364, July 1, 1887. 8*d.*

By the improved machine hides and skins are unhaired and fleshed mechanically with the aid of a suitable tool. The characteristic features of the machine are:—A combination of rods and bars, giving a practically rectilinear motion of the tool during its passage over the hide under treatment; an arrangement for holding the hide while under treatment; an arrangement to raise or lower the work-table so as to allow the tool to exercise greater or less pressure; an arrangement holding the table fixed horizontally but allowing it to yield vertically; a multiple tool holder. For details, the specification must be consulted. Drawings are given.—B. H.

Improvements in Compounds for use in Tanning and in the Manufacture of the same. W. P. Thompson, Liverpool. From J. P. N. Bidron, Havre, France. Eng. Pat. 9353, July 1, 1887. 6*d.*

This invention is one dealing with the decolourising of quebracho extract either alone or in admixture. When quebracho extract is employed alone two per cent. of alum is introduced into it while it is boiling in the evaporating apparatus and the evaporation is completed. A mixture of equal parts quebracho and chestnut extract can be decolourised in the same way, using one per cent. of alum. The following titles are used to designate the products: "Extrait de quebracho décoloré" and "Extrait tannant composé et décoloré."—B. H.

The Manufacture of Leather from Rabbit Skins. Jean Pujos, Paris. Eng. Pat. 12,396, September 13, 1887. 6*d.*

This invention is connected with the manufacture of leather from rabbit skins for gloves, &c. in place of kid and lambskin. Selected skins are first soaked in cold water till thoroughly softened. The skins are unhaired in a bath composed of two parts caustic soda to one of alum, which bath is prepared by adding the alum solution to the caustic soda solution and stirring till the precipitated alumina redissolves. After unhairing, the skins are subjected to the action of milk of lime for three to four days. The skins are then fulled in clear water and afterwards immersed in water acidulated with oxalic acid. The skins are worked and fulled in water, and can then be either tanned or tawed in the ordinary way.—B. H.

The Preparation and Application of an Oil from Birch Tree Bark for Tanning and Preserving Hides. E. Tuthill, London. Eng. Pat. 2870, February 25, 1888. 4*d.*

The bark, as stripped from the birch tree, is placed in a suitable vessel and subjected to heat for the production of a tar or oil which is to be rubbed into the hide during the tanning process. The oil is inimical to the life of moths or insects, and preserves the skin from their ravages.
—G. H. B.

XV.—AGRICULTURE, MANURES, Etc.

Experiments with Artificial Manure on Sandy Soils. Landw. Zeit. Regierungsbezirk Stade **7**, No. 2.

A paper showing the profit per acre ensuing from the application of artificial manures to a sandy soil, which was marled in 1882—83.—A. G. B.

Thomas-Slag as a Manure for Vineyards. Alexandre de Chambrier. Jour. de l'Agric. **929**, 179—181.

The author has compared the yield of vineyards manured with Thomas-slag and phosphorite respectively, with the result that the juice from the Thomas-slag-manured grapes was most plentiful when the grapes were ripe; it contained a little less sugar and less acid (expressed as tartaric acid). Grapes that were not quite ripe gave more juice from the phosphorite manure.

The season was bad and the mildew very plentiful, only those plots whose young plants had been treated with copper sulphate and the slag-manured plots succeeded well. It would seem from this that the Thomas slag was as effectual in preventing the mildew as the copper sulphate was.—A. G. B.

The Pods of Medicago Lupulina (Hop Clover). A Petermann. Bull. de la Station Agric. exp. à Gembloux, **38**, 11.

The analysis of these is as follows:—

	Per Cent.
Water	12·50
Albuminoids	13·21
Fat	3·49
Nitrogenous extractive matter	39·06
Cellulose	18·30
Ash	13·44
	100·00

Their nutritious value is, from this, very nearly that of good hay.

Ash (pure) contains:—

	Per Cent.
Lime	32·06
Magnesia	2·63
Potash	14·17
Soda	2·49
Ferric oxide	13·84
Silica	6·97
Phosphoric acid	1·93
Sulphuric acid	1·93
Carbonic acid	23·89
Chlorine	0·90
	100·81
Deduct oxygen for chlorine	0·81
	100·00

Raw ash contains 7 per cent. of sand.—A. G. B.

Calcium Oxalate in Leaves. A. F. W. Schimper. Botanische Zeitung, 1888, 81—89, &c.

The author classifies the calcium oxalate which occurs in leaves into primary, formed independently of light and chlorophyll; secondary, formed only in the presence of light and chlorophyll; and tertiary, formed in autumn when the leaves are decaying.

The secondary oxalate is independent of assimilation, and not a secondary product of that process, as it is equally abundant in leaves that can and cannot assimilate.

The author's experiments show that calcium is necessary for the translocation of carbohydrates, the calcium in the cell walls very probably influencing the osmose of sugar; moreover, the calcium may form easily transferred compounds with the carbohydrates.

Calcium serves as a vehicle for N, S, and P, for it is taken into the plant as nitrate, sulphate, and phosphate; these are split up, chiefly in the leaves of the plant, with the formation of amides and albuminoids, which move towards the stem, and calcium oxalate and carbonate remaining in the leaves. The author has observed that nitrates are decomposed in green leaves in the light, but accumulate in the dark; it would thus seem that chlorophyll is necessary for the assimilation of N, S, and P, as well as C.—A. G. B.

The Cultivation of Ramie in Provence. Naudin. Comp. Rend. **107**, 12.

Describes experiments in the cultivation of ramie undertaken by the author at Antibes. The kind experimented with was the white ramie *Bœhmeria nivea*, the seeds of which were obtained from China. The young plants having survived the winter without any protection whatever, were then transplanted; in another year the stems will be ready to cut.

An account is also given of another species of ramie, viz., green ramie (*B. utilis or tenacissima*), which had been growing for some time. It is as hardy as the white ramie. It has yielded a number of vigorous stems from one to two metres in height, although it has not been watered. M. Naudin fully expects a second and even third crop this season. He believes that the cultivation of both species of ramie can be made profitable in Provence, and even more certainly in Corsica and Algeria. The fibre can be readily stripped from the stems by women or children. The leaves form an excellent fodder for cattle.—E. J. B.

Application of Potassium Chloride for the Cultivation of Sugar-beet on Heavy Land. A. Petermann. Bull. de la stat. agric. de l'Etat à Gembloux, **41**, 1—13.

An average crop of sugar-beet, weighing 40,000 kilos., contains about 64 kilos. of nitrogen, 32 kilos. of phosphoric acid, and 1·56 kilos. of potash. It is therefore reasonable to suppose, considering the comparative poorness of most soils in potash, that manuring with that substance would yield profitable results. Experiments have been conducted by various experiments on different soils with most contradictory results; the author has therefore made these series of experiments in different years on the same field with different varieties of sugar-beet (Vilmorin's last Silesian beet in the first year, "Klein Wanzleben" from Rabbethge and Giesecker in the second year, and "White Imperial" in the third year) in order to ascertain the value of potash manuring in the neighbourhood of Gembloux, in Belgium. The experiments were made in duplicate on plots measuring 93·44 metres, with 928 plants to the plot, unmanured and manured with a chief manure consisting of 1,500 kilos. of Chili saltpetre (15·53 per cent. of nitrogen) and 800 kilos. of superphosphate (14·51 per cent. of citrate soluble phosphoric acid), and with auxiliary manuring consisting of 75 kilos. potash per hectare as potassium chloride and 150 kilos. potash in the same form. In 1883 the roots were planted on 25th April and pulled on 10th October; duration of vegetation 155 days and rainfall 404·5 mm. In 1884 these figures were 21st April; 27th October; 174 days; and 401 mm. In 1887, 19th April; 24th October; 175 days; and 360 mm. During the intermediate years the field had grown horse-beans in 1885 and wheat in 1886 without manure. In each year the weights of the roots, leaves, and percentage of sugar were determined, and full details of the results are tabulated in the original. The increase in crops harvested and in the percentage of sugar are given in the following table, in column (a.) by the nitrate and superphosphate; (b.) by the addition of 75 kilos. potash; (c.) by the addition of 150 kilos. of potash:

Years.	(a.)		(b.)		(c.)	
	Crop.	Sugar.	Crop.	Sugar.	Crop.	Sugar.
1883	14,640	1·12	1,364	..	2,360	..
1884	16,491	0·76	1,719	..	3,261	..
1887 (dry)	4,133	0·47	1,000	..	..	..

The increase due to potash is so small as to almost come within experimental error. The percentage of sugar was even reduced by the potash, as will be seen from the following results:—

—	Sugar, per Cent.		
	1883.	1884.	1887.
Unmanured	11·47	11·68	14·53
Nitrate and superphosphate	12·59	12·44	15·00
Nitrate, superphosphate, and small potash	11·69	11·86	14·03
Nitrate, superphosphate, and large potash	10·51	11·47	..

Whilst the mean yields of sugar is given in the following table:—

—	Sugar, Kilos.		
	1883.	1884.	1887.
Unmanured	5,656	5,959	6,384
Nitrate and superphosphate	8,051	8,398	7,210
Nitrate, superphosphate, and 75 potash	7,635	8,209	6,884
Nitrate, superphosphate, and 150 potash	6,969	8,117	..

From these results it is evident that in the sandy clay soil of Gembloux, containing 0·78 per 1,000 of potash soluble in hydrochloric acid, dressings of potassium chloride in the quantities indicated, in conjunction with sodium nitrate and superphosphate, have produced a very small increase in the crops, but with such considerable reductions in the percentage of sugar as to cause a financial loss, whereas the nitre and superphosphate alone proved of great manurial value, especially in the relatively wet seasons 1883, 1884.—D. A. L.

Influence of Magnesium Chloride and of Calcium Chloride on the Germination and early Development of the most important Farm Plants. R. Hindorf. Bied. Centr. **17**, 461—462.

Experiments with magnesium and calcium chlorides show that in moderate quantities these salts exert a beneficial action on the germination and early growth of wheat, rye, barley, oats, peas, red-clover, and rape plants. They commence to be injurious only when applied to the plants in quantities in excess of those ever employed in agricultural practice. The injurious action appears to be due to the chlorine of the salt, inasmuch as any chloride will behave in the same manner: even potassium chloride in excess is hurtful to plants. Sulphates in large quantities are also injurious to vegetation, but not to such a great extent as chlorides.—D. A. L.

Peat Manure. A. Petermann. Bull. de la stat. agric. de l'Etat de Gembloux, **41.**

Peat, and in particular the variety known as peat-moss, forms, as is well known, an excellent litter, chiefly on account of its great absorbing power for excrementitious matter, which exceeds that of straw. In fact it is economical to purchase it to replace straw sold off a farm or used as fodder, inasmuch as 100 kilos. of peat is equal to about 210 to 225 kilos. straw when used as litter, and it may subsequently be used as manure anywhere except on heavy undrained soils. Its manurial value, as compared with ordinary farmyard manure, will be seen from the following analyses by the author. Figures per 1,000 :—

— —	Peat Manure (Mean of 7 Analyses).	Farmyard Manure (Mean of 2 Analyses).
Water	684·7	764·31
Organic matter	254·1	182·35
(Containing nitrogen	6·1	6·75)
Ash	61·2	53·34
(Containing potash	5·7	5·28)
(„ phosphoric acid	3·5	4·62)

—D. A. L.

Comparative Manurial Experiments with Stable and Artificial Manures. L. Müller. Landw. Zeit. für d. Reg.-Bez. Stat, 1887, No. 6.

The experimental field had been 20 years before heath land; it was loamy and had been dressed with marl. The experimental crop was oats following vetches. The mean results obtained were :—

—	Yield, Kilos. per Hectare.	
	Grain.	Straw.
1. Unmanured plots	2,083	3,867
2. Field dressing of stable manure	3,517	6,617
3. Half stable manure, 300 kilos. kainite and 300 kilos. Thomas-slag	2,500	4,800
4. Same as 3, without kainite	2,075	4,275
5. 600 kilos. kainite and 600 kilos. Thomas-slag	2,417	4,500
6. 250 kilos. Chili saltpetre	2,250	5,850

—D. A. L.

Values of Commercial Fertilisers. Eng. and Min. Journ. **46,** 23. C. A. Goessmann, Massachusetts State Inspector of Fertilisers.

The usual commercial valuation of manurial substances is based upon the average trade value of the fertilising constituents determined by analysis, and thus principally on the amount and particular forms of phosphoric acid, nitrogen, and potash contained in them. The market value of different fertilisers does not express their respective agricultural or crop-producing value, nor does it indicate their comparative absolute merits without reference to the soil or the requirements of the crops to be treated. Care should be taken to ensure that the manure contains the amount of fertilising substances advertised, and that it contains them in the best possible form for the purpose required. The manufacturer has only to sell at a reasonable rate that which he professes to supply, while the farmer is responsible for determining the quantity and quality of the fertilisers he needs, and for selecting his manures accordingly.

Trade Values of Fertilising Ingredients in Raw Materials and Chemicals, 1888.

	Cents per lb.
Nitrogen in ammoniates	17·5
„ „ nitrates	16·0
Organic N in dry and fine ground fish, meat, blood, cotton-seed meal, and castor pomace	16·5
„ „ fine ground bone and tankage	16·5
„ „ „ medium bone and tankage	13·0
„ „ medium bone and tankage	10·5
„ „ coarser „ „	8·5
„ „ hair, horn shavings, coarse fish scrap	8·0
Phosphoric acid, soluble in water	8·0
„ „ „ ammonium citrate	7·5
„ „ in dry ground fish, fine bone, and tankage	7·0
„ „ in fine medium bone and tankage	6·0
„ „ in medium bone and tankage	5·0
„ „ in coarser „ „	4·0
„ „ in fine ground rock phosphate	2·0
Potash as high-grade sulphate and in forms free from Cl	5·5
„ kainite	4·25
„ muriate	4·25

In superphosphates, special manures and fixed high-grade fertilisers, the organic nitrogen is reckoned at its highest value of 16·5 cents per lb., it being taken for granted that it is from animal matter and not from any inferior source; while the insoluble phosphoric acid is valued at 3 cents, it being assumed that it is not from rock phosphate, which is worth only 2 cents; this of course in each case if an inferior quality be not detected.—W. G. M.

Comparative Cultivation with six Varieties of Potatoes. Nowacki. Schweizer. landw. Centralb. 1888, 31—32.

The potatoes were cultivated on a heavy loamy soil in good agricultural condition; in the previous year it had carried a crop of oats, and for 10 years before that fodder crops consisting of an artificial clover and grass mixture. The season was favourable for the potato crop. The various agricultural operations are detailed in the paper. The results were as follows :—

Variety of Potato.	Kilos. per Hectare.			Starch, per Cent.
	Large Tubers.	Small Tubers.	Bad Tubers.	
Richter's Imperator	15,495	3,834	629	18·42
Flour ball	14,671	2,070	180	16·75
Champion	7,587	3,336	549	16·20
Schoolmaster	19,609	2,320	364	20·13
Fidelio	13,847	2,322	290	19·53
Magnum bonum	13,192	2,379	43	18·42

The three varieties yielding the worst results were all low in the haulm, the others were very high haulms. Schoolmaster is the best in yield with moderate power of resistance against disease. Champion proved the worst.—D. A. L.

Influence of the Manuring on the Composition of Barley. Krandauer. Allg. Brauer. u. Hopfenzeit, 1888, 560—561.

Three sorts of barley were cultivated, Chevalier, Franken, and Hallet, on a limey loam :—I. without manure; II. with 260 lbs. Chili saltpetre and 520 lbs. guano superphosphate per hectare; and III. with 260 lbs. Chili saltpetre and

780 lbs. guano superphosphate. The total yields and composition are given in the following table :—

Description of Barley.	Yield Centners per Hectare.	Per Cent.					
		Dry Matter.	N.	Nitrogenous Matter.	Starch.	Ash.	P_2O_5.
Chevalier I. .	154·5	87·48	1·69	10·55	64·80	2·51	1·00
„ II.	164·8	87·46	1·68	10·40	65·64	2·44	0·85
„ III.	174·5	87·63	1·64	10·05	68·30	2·35	0·93
Franken I. . .	132·2	87·92	1·50	9·37	64·06	2·58	0·97
„ II. .	154·8	87·33	1·47	9·18	65·88	2·59	0·95
„ III.	166·0	87·54	1·47	9·18	64·68	2·49	0·92
Hallet I.	130·0	87·51	1·61	10·06	66·18	2·53	1·01
„ II. . . .	153·0	87·29	1·78	11·12	65·15	2·67	0·99
„ III. . .	154·0	87·43	1·58	9·87	65·46	2·52	0·91

The increase in yield over the unmanured was principally due to straw. It is interesting to note how slight the variation in composition is with the different manuring. The season was dry.—D. A. L.

Production of Farmyard Manure. A. Müntz and C. Girard. Annales agronomiques, 1886, 429.

In certain experiments sheep were fed on either green or dry food, as fresh lucerne or lucerne hay, and they were kept in asphalted stalls without litter, or they were littered with straw or with a layer of earth 20—25 cm. in depth. In the latter case the earth after the experiment was found to consist of two layers, the lower one being unaltered. In one experiment two cows were fed on lucerne, 53·5 kilos. per head per day and 49 kilos. of water, in asphalted stalls without litter. In all cases the nitrogen consumed in the food, fixed as increase of flesh, and recovered as manure was determined. The results are given in the appended table :—

——	Kilos. of Nitrogen.				Loss of Nitrogen Per Cent.
	Given in Food.	Recovered.		Lost.	
		By Assimilation.	As Manure.		
Sheep, without litter.	21·817	4·300	5·588	12·139	55·6
Sheep, fed with lucerne on earth	13·710	1·380	9·040	2·380	24·0
Sheep, fed with lucerne on straw litter	14·550	1·090	6·350	7·110	43·6
Sheep, fed with lucerne hay on straw litter .	23·010	1·670	8·900	12·140	51·0
Cows, fed with lucerne without litter	14·146	3·104	7·464	3·584	25·3

The quantity, 3·104, in the case of the cows is made up of 0·544 flesh nitrogen and 2·560 kilos. of milk nitrogen. It will be seen that loss of nitrogen occurs whether the fodder is green or dry, but that it is greatly diminished by the employment of earth instead of straw. In all cases examined the phosphoric acid and potash of the food was recovered in the manure in nearly its original quantities. Analysis of the air in the sheep shed indicated an average of about 0·008 grm. ammonia per cubic meter, or about 400 times as much as that in ordinary atmospheric air.

In connexion with the above experiments P. P. Dehérain (Ibid, 436) suggests that the authors employed too little straw as litter; moreover, supposing the earth to save a larger quantity of nitrogen, it is questionable whether it is in such a useful condition as the nitrogen in straw litter, and therefore whether the use of earth is really as economical as it appears from the above figures.—D. A. L.

The Conversion of Nitrates in the Soil. Berthelot. Compt. Rend. **106**, 638—641.

Two lots of earth, one with plants of *Amaranthus pyramidalis*, the other without vegetation, were treated with water and potassium nitrate and left to themselves, protected from rain from the 15th April until the 25th of September. At the termination of this period a large increase of organic nitrogen was found in the soil in both cases. The author infers that nitrates are converted into nitrogenous organic substances by reducing agents partly by chemical means and partly by the intervention of microbes; moreover that both nitrification and denitrification take place in the soil. A similar struggle seems to exist between the aerobic microbes which fix nitrogen from the air and anaerobic microbes that act as putrefactive ferments and cause the evolution of combined nitrogen from organic substances.—D. A. L.

XVI.—SUGAR, STARCH, GUM, Etc.

Crystallisation of Sugar. Dingl. Polyt. J. **268**, 416.

L. Wulff, in a paper which appeared originally in the Zeitschrift des Vereins für Rübenzuckerindustrie **38**, 226, draws attention to some of the phenomena attending the crystallisation of sugar. It is usual in valuing sugar solutions to depend almost exclusively on the results of chemical analysis, without taking into consideration the quantity of each substance present and the way in which the constituents are combined; these factors being, however, undoubtedly of great importance. Sugar solutions of the same percentage composition behave very differently on crystallisation. For example, sodium chloride and sugar combine in equal molecules; 5 per cent. of common salt added to a solution of cane sugar may therefore attach itself to 30 per cent. of it chemically, and so prevent its crystallisation. If now, 32 per cent. glucose be added, this will act on the remaining free cane sugar and retard its rate of crystallisation. If the salt be, however, combined with the glucose previously ($2\ C_6H_{12}O_6 + NaCl$) and then added to the sugar solution, the mixture only retards but does not prevent crystallisation. The rate of crystallisation is also influenced by viscous impurities in the liquid. The author also draws attention to the fact that when sugar crystallises out of solution, it must necessarily pass from the amorphous into the crystallised condition; and the latter change must have considerable bearing on the subject. Change of temperature also greatly influences crystallisation, and a syrup which seems very crystallisable at a boiling temperature may give bad results on cooling. Combinations of molecules take place more easily in strong than in weak solutions. By observing the rate of cooling of a sugar solution, the author finds that heat is evolved at the moment of crystallisation.

Diffusion is generally represented as a purely physical operation, by means of which the more readily crystallisable bodies, owing to their greater rate of diffusion, are separated from those crystallising less readily. Were this the case the non-sugars ought to be separated into two portions by diffusion; the free salts accompanying the waste liquid and the salts combined with sugar remaining behind; and thus would leave in the sugar those compounds which exert the greatest influence on its crystallisation. The process of diffusion has, however, a favourable influence on sugar solutions, which may be explained in two ways.

1st. That the high temperature and dilution of the solutions employed in the diffusion process cause the compounds of salts with sugar to split up, and thus allow the salts to diffuse out.

2nd. That the heat and dilution only partially split up these compounds, the completed splitting up being due to the membrane which exerts varying degrees of attraction on the constituents.—H. T. P.

The Purification of the Waste Water of Factories. R. Hornberger, Versuchs. Stat. **35**, 29—34.

In the manufacture of rice-starch the gluten, which has been dissolved in soda lye, is reprecipitated with sulphuric acid, washed, dried, and used as feeding-stuff. The author has experimented with Nahnsen's method for purifying the acid liquid from this process.

A preparation, probably made by mixing clay with sulphuric acid and drying up the mass, is stirred into the water (2 kilos. to 5 cb. meters), and then lime added till the liquid is alkaline; the resulting precipitate of aluminium hydrate exerts the purifying action. Analysis of the water before and after purification showed that the organic matter is decreased by 25 per cent., the lime and sulphuric acid increased, and half the added alumina left in solution; the phosphoric acid is decreased by one-third. After standing, both waters have a bad smell and give a strong ammoniacal reaction with Nessler. To test the action of the purified water on fish, it was allowed to run in a thin stream, to aërate it, into a basin containing fish; after four weeks some of the fish were affected, but they all lived. The conclusion is that the purified water will not cause any great harm in a watercourse, if considerably diluted.—A. G. B.

The Sugar Industry in Brazil. Zeits. f. Zuckerind. **38**, 379.

The Brazilian Commission on the diffusion process issues a report in which the conclusion is drawn that the cane of Rio de Janeiro contains about 90 per cent. of juice and 13 to 20 per cent. of sugar, the richness and purity of which is chiefly dependent on the suitability of the soil and the dryness of the weather during ripening. The problems of the culture of the cane are still unsolved, and await experimental elucidation. The liquor obtained by diffusion is purer than the expressed juice, and leaves only 1 per cent. sugar in the exhausted cane against 3 per cent. by the old process, besides which the sugar obtained is freer from inverted sugar and better adapted for transportation by sea. If only a yield of 12 per cent. sugar has been hitherto obtainable by the diffusion process, this percentage can without doubt be quickly and considerably increased. The Commission is of opinion that the cost of production in Brazil may be reduced to such a degree as to defy competition, "and the struggle between cane and beet-root must become ominous to the latter, which thrives only by the artificial advantages which the European countries have devised."—G. H. B.

The Sugar Industry in Pernambuco. Deutsche Zuckerind. **13**, 486.

This industry, according to Nitzsch, is in a very languishing condition; the works are antiquated, badly built, badly equipped, and badly managed, resulting in a loss of 50 to 75 per cent. of the sugar obtainable from the cane; and the product ultimately obtained is rich in water and invert sugar, so that much syrup is lost in transport. Two small French works have, however, been recently opened, with good results.—W. G. M.

Rhamnose (Isodulcite). B. Rayman. Ber. **21**, 2046—2052.

Quercitron sugar (rhamnose), in concentrated aqueous solution, is readily oxidised by bromine water yielding a saccharin, $C_6H_{10}O_5$, which softens at 135°, and melts at 140°—142°. This saccharin is readily soluble in water and alcohol; its specific rotatory power in aqueous solutions is $\alpha_D = -39\cdot06$. All alcoholic solutions of crystalline rhamnose are laevo-rotatory, but on adding water the rotatory power is diminished.—F. S. K.

Influence of Ammonia in the "Elution" Process. J. Seyffart. Zeits. d. Ver. f. Rubenzucker Ind. **38**, 356.

Recent patents sufficiently show that it is recognised as a practical desideratum to eliminate the ammonia which accumulates in the elution liquors, but the author is the first to publish the results of an investigation of its influence on the processes. His conclusions are as follow:—

(1.) The presence of ammonia increases the loss of spirit.

(2.) The proportion of alcohol remaining the same, it does not increase the loss of sugar in the liquors; but

(3.) impedes the purification of the "melassekalk," chiefly in regard to the removal of lime salts.—C. F. C.

Deposits from, and some Organic Constituents of Beet Juice. E. v. Lippmann and P. Degener. Bied. Centr. **17**, 479—481.

v. Lippmann has found in the froth from "frothy fermentation" of molasses, after washing out sugar, &c., free fatty acids, calcium salts of fatty acids, and phytosterin (isomer of cholestrin), $C_{26}H_{44}O_1$, melting at 133°, and with a specific rotation $\alpha_D = -35\cdot1°$, resembling the phytosterin present in beans, almonds, other seeds, foreign oils, butter, &c. Degener remarks that this porous froth constitutes an excellent hatching and breeding place for many kinds of organisms. v. Lippmann, in a previous communication (this Journal, 1888, 223), has called attention to the deposition of fatty and mineral matters from beet extract. He now states that the fatty matters of beet contain phosphorus, and also betaïn. He is of opinion that beets contain bodies analogous to lecithin, but containing betaïn in place of cholin. In one case he obtained cholin from beet fat, and therefore in this case lecithin was most likely present. He has also extracted xanthine compounds and bodies containing phosphorus, and resembling nucleïn. Scheibler has called attention to the presence of lecithin-like bodies in beet. v. Lippmann notes the following distinction between cholin and betaïn, the sulphate and chloride of the former are highly hygroscopic masses, whilst the corresponding betaïn salts are perfectly crystalline and stable in the air.
—D. A. L.

Alcoholic Fermentation of Galactose. E. v. Lippmann and others. Bied. Centr. **17**, 483—484.

Herzfeld, Hayduck, Kiliani, Koch, and Bourquelot (this Journal, 1888, 336), have not succeeded in fermenting galactose with yeast, whereas Pasteur, Fudakowski, v. Lippmann, and Stone and Tollens have obtained alcohol by its fermentation. Tollens attributes the failure of the first-named investigators to their working in solution with no nutrition for the yeast or with unsuitable nutritive material. A repetition of his own experiments confirms his previous results, inasmuch as pure galactose yielded 45 per cent. of its weight in alcohol when fermented with yeast and yeast extract as nutritive solution; but without nutrition it yielded only 15 per cent. of alcohol. It is, therefore, important to remember, when testing the fermentative capabilities of a sugar, to have sufficient and proper nutrition present for the yeast. Pasteur suggests a filtered extract of 5 grms. of yeast in 5 cc. of water.—D. A. L.

(*a.*) *On the Employment of certain Artificial Gums.* (*b*) *The Employment of Indian Gum.* J. Meyer. Bull. Soc. Ind. Mulhouse, 1888, 303—306.

(*a.*) All artificial gums have the disadvantage that their solutions are very unstable. On cooling down they change in consistency, and after some time—more rapidly in winter—they gradually lose their viscosity, grow thicker, and become, in fact, very unsuitable for printing purposes. After mixing with the colour it is customary to slightly heat the gum, in order to bring it back to its original consistency; but this method must obviously be condemned. Some colours, such as soluble Alizarin blue, are decomposed by the treatment.

The best method to prevent the above changes is to boil the artificial gums with about 1½ their weight of caustic lime under atmospheric pressure. Such solutions keep weeks without changing sensibly.

(*b.*) Indian gum is very insoluble in water, even when hot. It is best dissolved by boiling half an hour under atmospheric pressure. Indian gum is more advantageous than Senegal gum, 100 grms. of the former thicken to the same extent as 190 grms. of the latter.—A. R.

Inosol. L. Maquenne. Bull. Soc. Chim. **47**, 291 ; **48**, 162.

Dambose proves to be identical with inosol, and the latter yields aromatic derivatives when exposed to the action of hydriodic acid. Moreover, the first products of the action of nitric acid are also aromatic, and are the cause of the red colouration in Scheerer's reaction. They are derivatives of quinol, and inosol is a hexahydric alcohol with aromatic nucleus.—D. A. L.

The Extraction of Pure Grape Sugar by the Method of Cords-Virneisel. E. O. von Lippmann. Chem. Zeit. 1888, 787.

By this method pure crystallised grape sugar can be obtained from starch, or direct from potatoes or other starch-bearing bodies. But at the time when the author examined into the working of the process on a large scale, the direct treatment of potatoes, although yielding quantitative results equivalent to the starch contained, yet gave a sugar which contained certain extractive matter dark in colour, of an unpleasant taste, and not removable without considerable loss; at present, therefore, it is more satisfactory to extract the starch first, and then convert the purified product into sugar. The sugar produced at the time of the author's visit was a clear yellow anhydrous dextrose in small granular crystals resembling beet sugar; it could be safely dried at 110° C., and the normal rotation observed in the polariscope proved the absence of bodies possessing a high rotatory power. When refined by filtering over 60 per cent. of good bone charcoal, the liquor was a pure colourless syrup of pleasant flavour, yielding crystals (hexagonal plates) when evaporated in vacuo. Considerable care is necessary in boiling to prevent the deterioration of the juice by heat; and it may be more advantageous to produce only the raw dextrose, which, by this process, is of exceptional purity. Analyses of the raw sugar, and of the white finished product, showed respectively :—sugar, 95·74 and 99·64 per cent.; water, 3·32 and 0·19 per cent.; ash (consisting largely of MgO), 0·29 and 0·04 per cent.: and organic bodies, 0·65 and 0·13; which is equivalent to a purity of 99·02 and 99·83 per cent. As the use of added grape sugar in fermenting wines is likely to increase, the author quotes the following comparative analyses of crystallised raw sugar (Product III. of the process in question) and of the white soap-like starch sugar produced by a well-known firm. In the former, the sugar, as determined by reduction, by fermentation, and by polarisation, was 81·24, 81, and 75·44 per cent. respectively; while in the latter it was 68·36, 68·58, and 119·84 respectively. Or, taking the lowest number of the one, and the mean of the first two of the other, the proximate analysis would be :—

—	Dextrose.	Starch Sugar.
Sugar.	75·44	68·47
Water	16·69	22·67
Ash	0·82	0·19
Organic bodies, non-fermentable	1·37	8·67
„ „ fermentable	5·68	..
100 parts of dry substance would give of fermentable bodies	97·39	88·54

—W. G. M.

Action of Dilute Mineral Acids on Saccharic Acid. H. Schrötter. Monatsh. Chem. **9**, 442—445.

The investigations of the author are similar to those of Sohst and Tollens (Ann. **245**, 18). They show that the same results are obtained from saccharic acid and from mucic acid, pyromucic acid being formed in each case. —T. L. B.

PATENTS.

Improvements relating to the Purification of Molasses and other Saccharine Solutions. C. Leuchtenbeyer, Berlin, and B. Moiske, Frankfort-on-the-Oder, Prussia. Eng. Pat. 9690, July 9, 1887.

This invention has for its purpose the separation of molasses and other impure saccharine solutions in so perfect a manner from all their noxious matter, such as salts, acids, and colouring matter, that a pure treacle is obtained.

The molasses to be purified are mixed with a suitable quantity of sulphuric acid in such proportion to the amount of salts contained in the said molasses as will set free the organic acids, which in turn under vacuo bring about the inversion of the whole of the crystallisable sugar in the molasses, while at the same time the volatile acids present are evaporated.

The inversion process being completed a concentrated solution of sulphate of alumina is added in proportion of two parts by weight to one part of salt: the mass is then stirred and cooled down, and alcohol of 90 per cent. added until a complete purification of the salts in the form of alum has taken place. The alcoholic syrup entirely freed by this means of the salts, will still contain, besides colouring matter, non-volatile organic acids, and a small excess of sulphate of alumina. The removal of these bodies is effected by heating the syrup in a closed condensing vessel and adding at the boiling temperature carbonate of barium. The neutralised syrup is now cooled and filtered, and being thus completely purified, is freed of the alcohol, refined by means of bone black, and boiled for market. The organic acids and the greater part of the colouring matter may, however, be removed by subjecting the molasses to a preliminary treatment, as follows :—

Liquid ammonia, containing 35 per cent. of alcohol, is added to the molasses contained in a closed vessel of wrought iron, and while being well stirred a quantity of powder of zinc (1 to 2 per cent.) is added to this mixture, and the whole raised for 15 to 20 minutes to a temperature of about 105 degrees; by this means the colouring matter is caused to disappear, whilst the organic acids at the same time are converted into aldehyde. The temperature of the mixture is now raised, so as to expel all volatile matters carbonic acid passed through the residual liquid, which is then forced through a filter press. The resulting liquid constitutes a saccharine solution of a deep yellow colour, and an agreeable taste, but still containing the salts of soda and potash in the form of carbonates, which are then precipitated in accordance with the method already described. —J. H.

Improvements in the Manufacture of Sugar and in the Apparatus to be Employed therefor. Louis E. A. Prangey, Paris. Eng. Pat. 10,842, August 8, 1887. 11*d.*

The raw sugar which may be in the form of "masse cuite" of refineries, either in hot or cold condition, arranged in a comparatively thin layer, is conducted between perforated or open moveable surfaces which cause it to advance with them continuously or intermittently in order to present it in this form to openings through which are projected the respective purifying or bleaching agents, which then pass in succession through the layer of sugar, under the influence of their pressure and in addition thereto when advisable under the action of a vacuum created on the side of the layer on which the agents are to leave. After being subjected in this manner to such agents, the sugar is next dried by forcing hot air upon one side of the layer of sugar and causing a suction upon the other side. This injection of dry air may be preceded, if necessary, by an injection of dry steam; the layer is then cooled, when a hard compact sheet of "loaf" sugar is formed which may be broken up into small pieces, or sawn or cut into tablets or bars by the usual appliances.

It is claimed that this process may be applied in sugar factories proper as well as in refineries, and that thus, by means of this invention, the problem of the production of "white sugar" directly from the raw material, *i.e.*, from cane juice on the plantation, is solved. Illustrative drawings of the machinery employed accompany the text.—J. H.

New or Improved Filtering Substance for Filtering or Decolouring Liquids, applicable for Treating Sugar Juices and Method of Preparing the same. W. P. Thompson, Liverpool. Eng. Pat. 7640, May 24, 1888. *6d.*

THIS consists essentially of a finely divided ligneous carbonised material, preferably sawdust, which may be impregnated with various chemical substances either previous or subsequent to the carbonising operation. Thus for the purpose of removing sulphate of lime from the liquid to be filtered, a saturated solution of chloride of barium is poured over the sawdust, either previous or subsequent to the carbonising operation. After standing some time, it is thoroughly mixed with a concentrated solution of carbonate of soda until the baryta is completely precipitated; the carbonate of barium adheres firmly to the particles of sawdust, which are then lixiviated and dried.

If it be desired to remove carbonate of lime from the liquid to be filtered, a warm solution of sulphate of magnesia is poured on the sawdust previous to carbonisation and let stand until the magnesia solution has penetrated the pores of the wood; a warm solution of caustic soda is then added, the substance meanwhile being kept stirred until the liquid begins to show an alkaline reaction, whereupon the sawdust is carbonised and finally lixiviated.

For the purpose of decolouring liquids, hydrate of alumina is in a similar manner precipitated on the carbonised sawdust.—J. H.

Improvements in Adhesive Mucilage. E. Keirby, Birkdale, Lancaster. Eng. Pat. 8248, June 6, 1888. *4d.*

ADHESIVE mucilage or gum is prepared from farina or a starchy substance by treating the same with acid, and adding, after neutralisation of any excess of acid, sufficient glycerol to obtain the required consistency, or chloride of calcium or of magnesium may in some cases be added, instead of the glycerol, if preferred.—J. H.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Mildew of Grapes. H. Müller. Landwirts. Jahrbücher 17, 83—160.

A FUNGUS, called by the author the mildew (*Edelfäule*), has a very favourable influence on the production of the best German wines.

In the over-ripe grape there is more sugar and less acid, and its nitrogenous matter has undergone a favourable change, so that these grapes give the best must. Wet weather or the attacks of insects weaken the development of the grape, by causing less sugar production in the leaves; under these circumstances the fungus attacks the grapes at an earlier stage of their development than in fine dry weather, when the grapes are not attacked till they are over-ripe. In the latter case the condition, called by the author mildewy, is produced, and is most favourable to the wine.

The fungus has been known for a long time as *Botrytis acinorum*, and the author has proved it identical with another known as *Botrytis cinerea*. Its life history is given, especially with regard to the changes it produces in the grapes. These are partly the direct work of the fungus and partly due to the easier access of atmospheric oxygen to the interior of the grape, and the more rapid evaporation of water, produced by the death of the cells of the skin. White grapes become brown, blue and black become red. The mildewed grapes do not suffer from frost bite. Valuable matter, from which the bouquet of the wine is formed during fermentation, is lost from the skins.

The author has examined why the must of mildewed grapes is better for producing wine, and has come to the following conclusions:—

The fungus causes in the grape (1) a diminution in weight, due to loss of water and small quantities of organic matter; (2) a diminution of insoluble matter; (3) a loss of sugar and acid, the loss of the valuable sugar being compensated by the better quality of the wine; (4) a diminution of soluble nitrogenous matter, hence the nitrogen in the grape refuse is greater.

The quantity of the must is increased by the mildew. Some of the acid which disappears from the must by its growth is separated as tartar and not consumed by fungus.

The way in which *Botrytis cinerea* improves the grape has been investigated by growing this fungus in must and determining the changes produced by its growth. The sugar, acid, and nitrogen were determined at first, and then again after 27 days' growth of the fungus. The loss of these matters was as follows:—

——	Sugar.	Acid.	N.
Loss per cent. of that in the original must	34·6	94·6	82·8

The N which has disappeared from the must is found in the fungus; the sugar and acid are assimilated by the fungus, and the C finally evolved as CO_2. A microscopical investigation showed that *Botrytis cinerea* alone was causing these changes.

Experiments were made to compare the action of *Botrytis cinerea* and *Penicillium glaucum* on the must. Several flasks containing equal quantities of must were sown with pure cultivations of each fungus separately, and analysed after the lapse of different periods, being first filtered and the loss by evaporation made good. The author tabulates his results, the following being the decrease, after 30 days' growth, per 100 contained in the original must.

——	Sugar.	Acid.	N.
By growth of *Botrytis*	47·1	91·6	84·0
" " *Penicillium* ..	93·2	73·3	91·4

It thus appears that *Botrytis* prefers the acid for its growth, while *Penicillium* prefers the sugar.

A good wine was made from the must in which the *Botrytis* had grown, but that in which the *Penicillium* had grown was useless for this purpose.

It is known that the growth of yeast in, and fermentation of, juice of sound grapes, differs from the same processes in juice of mildewed grapes. This fact has been investigated by growing the same weight of yeast in 100 cc. of the original must, and of some in which Botrytis had been cultivated and been afterwards filtered. The wines obtained were analysed when the yeast ceased to grow.

	Wine from	
	Original Must.	*Botrytis* Changed Must.
Alcohol	5·8100	5·5690
Sugar (approx.)	0·2600	0·2800
Acid	1·2150	0·7760
Glycerol	0·4770	0·5880
Nitrogen	0·0972	0·0177
Weight of Yeast after fermentation (dried at 100°)	0·2290	0·1551

The fermentation was much faster in the original must (completed in 19 days) than in that changed by *Botrytis* (completed in 30 days): thus the latter must have less capability for nourishing yeast. The wine produced by the fermentation of the original juice had a very acid taste.

The author regards glycerol as a secondary product not necessary for the production of alcohol, as other fungi, which cannot produce alcohol (e.g., *mycoderma vini*) produce glycerol.

The *Botrytis* grows better in must which is poorer in sugar; this bears out the practical observation that grapes rich in sugar check the growth of the fungus.

In a limited supply of air the *Botrytis* was of slower growth but was richer in nitrogen, the must being less improved.

The dextrose in the must is more rapidly diminished by the Botrytis than the levulose is.

The original paper contains investigations concerning the modifications of the colour and bouquet of the wine produced from the must changed by the *Botrytis cinerea*.

—A. G. B.

The Physical Properties of Methyl Alcohol. W. Dittmar and C. A Fawsitt. (*See this Journal,* 1888, 510--511.)

THE following table, giving the specific gravities of aqueous methyl alcohol at 0° and 15°·5 C., has been prepared and compiled by the authors :—

TABLE GIVING THE SPECIFIC GRAVITIES of AQUEOUS METHYL-ALCOHOL at 0°· and 15°·56 C.; WATER of 4° = 100,000.

I.—From 0 to 30 per cent. of CH_4O.

Percentage of CH_4O.	Specific Gravity at 0°.	Specific Gravity at 15°·56.	Percentage of CH_4O.	Specific Gravity at 0°.	Specific Gravity at 15°·56.
0	999·87	999·07	16	976·89	973·79
1	998·06	997·29	17	975·73	972·35
2	996·31	995·54	18	974·59	970·93
3	994·62	993·82	19	973·46	969·50
4	992·99	992·14	20	972·33	968·08
5	991·42	990·48	21	971·20	966·66
6	989·90	988·93	22	970·07	965·24
7	988·43	987·26	23	968·94	963·81
8	987·01	985·61	24	967·80	962·38
9	985·63	984·14	25	966·65	969·93
10	984·29	982·62	26	965·49	959·49
11	982·99	981·11	27	964·30	958·02
12	981·71	979·62	28	963·10	956·55
13	980·48	978·14	29	961·87	955·06
14	979·26	976·68	30	960·57	953·55
15	978·06	975·23			

II.—From 30 to 100 per cent.

Percentage of CH_4O.	Specific Gravity at 0°.	Specific Gravity at 15°·56.	Percentage of CH_4O.	Specific Gravity at 0°.	Specific Gravity at 15°·56.
30	960·57	953·67	66	896·11	884·43
31	959·21	952·11	67	893·84	882·08
32	957·83	950·53	68	891·54	879·70
33	956·43	948·94	69	889·22	877·14
34	955·00	947·32	70	886·87	874·87
35	953·54	945·67	71	884·70	872·62
36	952·04	943·99	72	882·37	870·21
37	950·51	942·28	73	880·03	867·79
38	948·95	940·55	74	877·67	865·35
39	947·34	938·77	75	875·30	862·90
40	945·71	936·97	76	872·90	860·42
41	944·00	935·10	77	870·49	857·93
42	942·39	933·35	78	868·06	855·42
43	940·76	931·55	79	865·61	852·90
44	939·11	929·75	80	863·14	850·35
45	937·44	927·93	81	860·66	847·79
46	935·75	926·10	82	858·16	845·21
47	934·03	924·24	83	855·64	842·62
48	932·29	922·37	84	853·10	840·01
49	930·52	920·47	85	850·55	837·38
50	928·73	918·55	86	847·98	834·73
51	926·91	916·61	87	845·39	832·07
52	925·07	914·65	88	842·78	829·38
53	923·20	912·67	89	840·15	826·68
54	921·30	910·66	90	837·51	823·96
55	919·38	908·63	91	834·85	821·23
56	917·42	906·57	92	832·18	818·49
57	915·44	904·50	93	829·48	815·72
58	913·43	902·39	94	826·77	812·93
59	911·39	900·26	95	824·04	810·13
60	909·17	897·98	96	821·29	807·31
61	907·06	895·80	97	818·53	804·48
62	904·92	893·58	98	815·76	801·64
63	902·76	891·33	99	812·95	798·76
64	900·56	889·05	100	810·15	795·89
65	898·35	886·76			

—W. S.

Influence of Temperature of Fermentation on the Production of Higher Alcohols. L. Lindet. Compt. Rend. **107**, 182—183.

IN the author's experiments the same worts from grains obtained in saccharification of maize and rye by means of barley malt, were fermented at different temperatures with the same yeast—a mixture of equal parts high and low yeast as obtained pure from the factory but not scientifically pure; however, no foreign organisms entered during fermentation. The acidity was adjusted at the outset in each experiment by adding 0·3 per cent. of sulphuric acid. The higher alcohols were separated by fractional distillation, and their quantity determined with the following results; they consisted almost entirely of amyl alcohol.

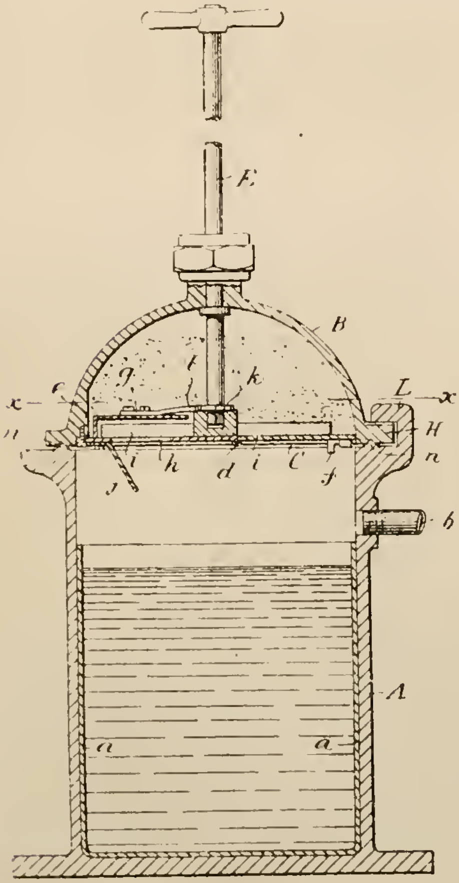
Temperature of Fermentation.	Crude Alcohol.	Higher Alcohol.	
°	cc.	cc.	Per Cent.
32–35	675	3·9	0·58
25–27	1,697	9·6	0·59
19–21	1,834	9·9	0·54
8–10	1,877	9·7	0·52

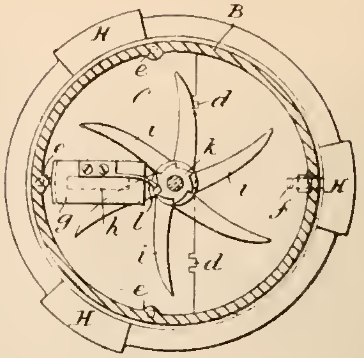
It will be observed that the temperature of the fermentation does not affect the proportion of higher alcohols formed, as was supposed to be the case by H. Schwarz (Dingl. Polyt. J. **172**, 239) and Le Bel (Bull. Soc. Chim. 1882, 98).—D. A. L.

PATENT.

Improved Apparatus for Generating Carbonic Acid Gas for Forcing or Raising Beer and other Liquids, or for other Purposes. W. H. Knowles, London. From P. R. Pohl, Philadelphia, U.S.A. Eng. Pat. 10,168, July 20, 1887. 8*d.*

A is a metal casing, with a lining of lead *a*, charged with sulphuric acid. It is provided with a cover B, closed by a plate C, having an opening *h*, covered by a small shield *g*, underneath which the ratchet wheel *i* can pass. The cover B contains a carbonate in a fine state of division.





By rotating *i* by means of handle E, a small portion of the carbonate is introduced into A, and the carbonic anhydride produced passes away through *b*.—C. C. H.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

Effects of Food Preservatives. On the Action of Diastase, Pancreatic Extract, and Pepsin. By H. Leffmann and W. Beam. Analyst, 1888, 103–105.

The use of antiseptics in food stuffs has become general in recent years, and has been to some extent the subject of legislation.

The authors had the question prominently introduced to them by some analyses of beers and malt extracts, in which salicylic acid had been made free use of. The method of determination followed to estimate the retarding action in the conversion of starch into glucose of such so-called "preservatives," was that indicated by Drs. Duggan and Coale, based on the estimation of the sugar formed in presence of a large excess of starch. Arrowroot starch was selected as experimental basis. To avoid error from the varying action of the dilute solutions of malt required for the experiments, a blank experiment was made in each set, and from this the diastasic value of the pure malt extract was determined. In the first observations "maltine" was employed, this having been proved by previous tests to be by far the most active of the commercial extracts; later Schuchardt's diastase was used. The Fehling's solution was made as directed by Allen, and the determinations made volumetrically.

The antiseptics selected were *salicylic acid, boric acid, sodium hydrogen sulphite, saccharine, β-naphthol,* and *alcohol.* In all the experiments the temperature, time of action, and strength of starch solution (30 grms. to the litre) were the same.

The experiments show that—

Salicylic acid prevents the conversion of starch into sugar under the influence of either diastase or pancreatic extract, but does not very seriously interfere with peptic or pancreatic digestion of albumen.

Saccharine holds about the same relation as salicylic acid.

Sodium hydrogen sulphite and *boric acid* are practically without retarding effect.

β-naphthol interferes decidedly with the formation of sugar by diastase, but not with the action of pancreatic extract on starch. Peptic and pancreatic digestions of albuminoids were almost prevented by this agent.

The authors conclude—

(1.) That the indiscriminate use of these agents in the preservation of food is to be regarded as objectionable and a proper subject for sanitary supervision.

(2.) Their use is scarcely allowable under any circumstances, and certainly only when the nature of the preservative and the amount are distinctly stated.

(3.) The foregoing remarks apply more particularly to salicylic acid, saccharine, and β-naphthol, but the use of boric acid and acid sodium sulphite may be brought under the same restrictions, their actions on the animal functions not as yet having been thoroughly investigated.—W. S.

The Composition of Cacao-husks. A. Petermann. Bull. de la station agric. exp. à Gembloux, **38**, 9.

Two analyses are given :—

—	Petermann.	Boussingault.
Water	13·24	12·18
Albuminoids	11·08	14·25
Fat	2·90	3·90
Nitrogenous extractive matter	46·71	62·78
Cellulose	16·03	
Ash	10·04	6·89
	100·00	100·00

Thus the cacao-husks contain more nourishment than most other husks, but they are very hard and difficult to digest. The damaged husks can be used as manure. The ash contains :—

—	Raw Ash.	Pure Ash.
Lime	12·28	15·60
Magnesia	6·81	8·65
Potash	21·84	27·74
Soda	2·19	2·78
Ferric oxide	8·62	10·95
Silica	10·75	13·65
Phosphoric acid	4·03	5 12
Sulphuric acid	1·41	1·79
Carbonic acid	9·26	11·83
Chlorine	1·93	2·45
Carbon	1·98	..
Sand	19·34	..
	100·44	100·56
Deduct oxygen for Chlorine	0·44	0·56
	100·00	100·90

The ash contains much potash and oxide of iron ; this last is in very small quantity in the ash of the plant. The value of these husks as a manure is, at the most, 13 francs per 1,000 kilogrammes (10*s.* 6*d.* per ton).—A. G. B.

On the Peptonic Fermentation of Meat. V. Marcano. Compt. Rend. **107**, 117.

Reference is made to a former communication in which peptonic fermentation was proposed as the best means of readily obtaining a pure peptone, and since then the method has come into use for the manufacture of peptone for pharmaceutical preparations. Chopped meat treated with Agave juice required 36 hours for complete peptonisation, but if the tissues of the plant, from which the juice has been expressed, be also added, the solution of the fibrin is completed in five or six hours. The compound of fibrin and pepsin which is formed is at first insoluble, but if sufficient water has been added, and the temperature be raised to 70°, the process of solution is very rapid. The author has ascertained by comparative experiments that the plant tissue has an important influence in the formation of the peptone. Attempts to bring about artificial digestion by means of cultivations of the microbes of the mouth and intestines did not give satisfactory results.—G. H. B.

PATENT.

A new or improved Method or Process for the Preservation of Fruit. W. F. Reid, Surrey. Eng. Pat. 10,948, August 10, 1887. 6*d*.

Fruit in good condition and sifted earth or mould are arranged in alternate layers to form a heap, the top and sides of which are then covered with so much of the earth as will afford protection from atmospheric influences.
—G. H. B.

(*B*)—SANITARY CHEMISTRY.

On the Antiseptic Properties of the Cyanide and Oxycyanide of Mercury and of Corrosive Sublimate. Chibret. Compt. Rend. **107**, 119.

Solutions of $HgO\ HgCy_2$ have a feebly alkaline reaction, precipitating albumen only slightly, and are less irritating to the tissues than solutions of the sublimate, being apparently less absorbed. The oxycyanide has six times the antiseptic power of the sublimate when employed on the peptonised fluid used for microbe cultivations. Experiments on cultivations of *Micrococcus aureus* showed that the oxycyanide had a slightly more destructive influence on the microbe than the sublimate. The employment of the oxycyanide on suppurating surfaces is preferable to the sublimate on account of its feeble absorption and its toleration by the tissues.—G. H. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Apiol. G. Ciamician and P. Silber. Ber. **21**, 2129--2133. (This Journal 1838, 399.)

The yield of apiol aldehyde by the oxidation of isapiol with a glacial acetic acid solution of chromic acid is 35—40 per cent.

Bibromapione, $C_9H_8Br_2O_4$, is obtained when apiolic acid (2 grms.) is dissolved in glacial acetic acid (20 cc.) and warmed with an excess of bromine for about five minutes. The mixture is poured into water, and the flocky precipitate, which separates on stirring, filtered off and washed. After crystallising from alcohol, the pure compound is obtained in white needles, which melt at 99°—100°, and are soluble in ordinary solvents, but almost insoluble in cold water. The same compound can be obtained from apiol aldehyde in a similar manner.—F. S. K.

Apiol. By G. Ciamician and P. Silber. Ber. **21**, 1621—1633.

The compound obtained by Ginsberg (this Journal, 1888, 399) by boiling apiol with alcoholic potash is isomeric with apiol and is termed by the authors isapiol.

Isapiol crystallises from alcohol in large leaves or quadratic plates, which melt at 55°—56°, are readily soluble in ether. ethyl acetate, acetone, benzene, hot alcohol, and glacial acetic acid, but insoluble in water. alkalis, and alkaline carbonates. It boils at 303°—304° (at 189°, 33 mm.), gives the characteristic apiol reaction with concentrated sulphuric acid, but, like apiol, does not combine with hydroxylamine or phenylhydrazine. The yield is 70—75 per cent.

The neutral compound melting at 122° which is obtained when apiol (6 grms.) is oxidised with potassium permanganate (24 grms.) (this Journal, loc. cit.), has the composition $C_{12}H_{16}O_6$. It crystallises from benzene in shining leaflets which are sparingly soluble in ether, more readily soluble in hot alcohol, benzene, ethyl acetate, and water. It is insoluble in alkalis, but dissolves in concentrated sulphuric acid with a bright yellow colour which changes to red and finally to a dirty brown on warming gently. The acid melting at 175° which is formed at the same time is named *apiolic* acid. When a larger quantity of potassium permanganate (28 grms. to 4 grms. apiol) is employed the neutral product (m.p. 122°) is not formed, and only very small quantities of impure apiolic acid are produced; with a smaller quantity of potassium permanganate (9 grms. to 6 grms. apiol) the neutral compound is the principal product, and only very small quantities of impure apiolic acid are obtained.

Apiolic acid, $C_{10}H_{10}O_6$, is the principal product when isapiol (8 grms.) is oxidised with potassium permanganate (32 grms.) in alkaline solution, small quantities of the neutral product (m.p. 102°) (this Journal, loc. cit.) being also produced. Apiolic acid crystallises from hot water in small white needles which melt at 175°, are soluble in ether, hot alcohol, hot glacial acetic acid, benzene and ethyl acetate, but sparingly soluble in hot water. It does not combine with phenylhydrazine and it is not acted on by sodium amalgam in alkaline solution. Melted with potash it yields only acetic acid and oxalic acid, and when heated with hydriodic acid at 100° methyl iodide or ethyl iodide is obtained. The *silver* salt, $C_{10}H_9O_6Ag$, and the *calcium* salt, $(C_{10}H_9O_6)_2Ca$, are crystalline compounds.

Methyl apiolate, $C_{10}H_9O_6CH_3$, crystallises from hot water in white needles which melt at 71°—72°, and are soluble in ether, alcohol, and glacial acetic acid. The chlorides of calcium and barium, the sulphates of zinc, cadmium and copper, the nitrates of cobalt and nickel, yield crystalline precipitates with a neutral tolerably concentrated solution of ammonium apiolate.

The neutral compound (m.p. 102°) is *apiolaldehyde*.

Apiolaldehyde, $C_{10}H_{10}O_5$, is also obtained, together with acetic acid, and acetaldehyde when isapiol is oxidised with chromic acid, 3 grms. of isapiol yielding 0·7 grms. of pure aldehyde. It remains unchanged when shaken with a cold concentrated solution of hydrogen sodium sulphite, but when the mixture is warmed combination takes place and apiolaldehyde sodium sulphite separates on cooling in large, broad, striated lamella, which are insoluble in ether and are decomposed by soda with liberation of the aldehyde.

Apiolaldoxim, $C_{10}H_{10}O_4 \cdot NOH$, crystallises from alcohol in large white needles which melt at 160°—161°, are readily soluble in ether, ethyl acetate, hot alcohol and acetic acid, but sparingly soluble in hot, and almost totally insoluble in cold, water. When heated with acetic anhydride large shining crystals, melting at 129°, are obtained; this compound, apiolaldoxim and apoilaldehyde, all give with concentrated sulphuric acid a yellow solution which changes to olive-green on warming.

Apiolaldehyde combines with phenylhydrazine, and when oxidised it yields apiolic acid.

The *nitro-derivative*, $C_7H_7NO_5$, is obtained when an acetic acid solution of apiolaldehyde is added gradually to cold nitric acid (1·35). It crystallises from alcohol in yellow needles, melting at 137°—138°.

The *amido-derivative*, prepared by treating an alcoholic solution of the preceding compound with tin and hydrochloric acid, forms yellow needles which dissolve in mineral acids with a red colouration and yield an insoluble platinochloride.

Apione, $C_9H_{10}O_4$, is obtained when apiolic acid is heated at 130°—140° with dilute sulphuric acid. It has neither acid nor basic properties, and dissolves in ether, ethyl acetate, and boiling alcohol, but is insoluble in water. Its vapour has an aromatic odour. It seems that compounds other than apione are obtained when calcium or barium apiolate is distilled with lime or baryta. Apiolic acid and apiolaldehyde yield the same bromine derivative, which is probably *dibromapione*: it melts at 99°—100°, and when gently warmed with concentrated sulphuric acid gives a fine blue colour which changes to violet and finally to a dirty brown on continued heating.

Apiol and isapiol have probably the constitution—

$$C_9H_9O_4 \cdot C_3H_5.$$

Isapiol exerts a distinct action on the vasomotor system; in doses of 0·2—0·4 grm. it causes exitement of the heart and pulse; in doses of 0·6—0·8 grm. it produces dicrotus and in some cases irregularity of the heart and pulse was observed. Isapiol, like apiol, causes headache and transient intoxication, after repeated doses loss of appetite and even fever set in. In cases of dysmenorrhœa and intermittent fever it is useless.—F. S. K.

Atropine and Hyoscyamine. W. Will. Ber. **21**, 1717—1726.

In the preparation of atropine and hyoscyamine from the roots of belladonna the alkaloids are first liberated by alkali, and it is a well-known fact that the proportion of hyoscyamine to atropine obtained varies very considerably with the method of working. The more carefully the operation is carried out the smaller the quantity of atropine and the larger the quantity of hyoscyamine obtained from the same material. By suitable extraction a well-conserved and properly-treated root yields only hyoscyamine, whilst by less careful treatment, from the same sample an almost equal yield of a product rich in atropine is obtained. A trace of alkali converts hyoscyamine quantitatively into atropine. The same change occurs when hyoscyamine is heated to its melting point (109°) for some time. Ammonia also converts hyoscyamine into atropine but only slowly.

Hyoscyamine forms a series of crystalline salts. The *sulphate* $(C_{17}H_{23}O_3)_2H_2SO_4$ crystallises from alcohol in colourless needles melting at 206°. The *hydrobromide* separates from water in compact crystals. The specific rotatory power of hyoscyamine is $\alpha_D = 20 \cdot 97$.—F. S. K.

Cholesterin. F. Reinitzer. Monatsh. Chem. **9**, 421—441.

The author attempted to determine the relation of benzoic acid to cholesterin by saponifying cholesteryl benzoate, thinking by this means to get a definite result as to the molecular weight of cholesterin.

It was found, however, impossible to entirely free the potassium benzoate from cholesterin, and the method had consequently to be abandoned.

Resort was therefore had to a bromine derivative, and the bromacetate was chosen as being much more difficultly soluble in alcohol than the bromine derivative of cholesterin itself. The experiments were undoubtedly in favour of the formula $C_{27}H_{46}O$ for cholesterin (that of the bromacetate being found to be $C_{27}H_{45}Br_2 . C_2H_3O_2$). The formula $C_{26}H_{44}O$ has also been given to cholesterin and on good evidence. The author therefore concludes that homologues of cholesterin exist, and the formula may thus differ according to the source of the cholesterin.

Cholesteryl acetate, $C_{27}H_{45}—C_2H_3O_2$, was prepared by means of acetic anhydride and gave 114·3°—114·7° (corr.) as melting point.

On cooling cholesteryl acetate just before solidifying (not after, as Raymann asserts) becomes beautifully iridiscent. An examination showed the body to be trimorphic.

Bromocholesteryl acetate is dimorphic, and the two forms are minutely described.

Cholesteryl benzoate was prepared by heating cholesterin with benzoic anhydride for an hour and a half at 150 —

160° C. The cooled mass was twice boiled with methyl alcohol and the residue repeatedly crystallised from a mixture of ether and alcohol. The melting point was 146·6° (corr.), whereas Schulze found 150°—151°. The author noticed, however, that the melted substance was not quite clear, but cleared at 180·6°. After being heated to this point and allowed to cool, iridiscence was noticed. It was found, like the acetate, to be trimorphic.

Sodium cholesterylate, $C_{27}H_{45}O.Na$, was prepared by the action of sodium on cholesterin. An attempt was made, by passing carbon dioxide into a chloroform solution of this body, to obtain an acid, but without success.

Nitrocholesterin was obtained by treating a boiling solution of cholesterin in acetic acid with nitric acid (sp. gr. 1·54). The product poured into cold water gives a dark reddish-yellow body. It melts at 93°—94° C., at the same time swelling up, thus pointing to a probable decomposition.—T. L. B.

On Wrightine and Oxywrightine. H. Warnecke. Arch. Pharm. **26**, 248 and 281.

The alkaloid *wrightine* was obtained by Stenhouse from the seeds and by Haines from the bark of *Wrightia antidysenterica*, but in an impure state. Haines named it conessine. The author prepared the alkaloid from the seeds, after removal of fats by ether, by extracting with alcohol acidified with hydrochloric acid. After boiling off the alcohol, the aqueous solution was precipitated with excess of ammonia. The collected precipitate was dried by pressure, rubbed up with sand, and extracted with petroleum ether. After evaporation of the solvent, the residue was crystallised from aqueous alcohol. Pure wrightine forms a voluminous mass of colourless silky crystalline needles melting at 122°, and of an intensely bitter taste. It is difficultly soluble in water, but easily soluble in alcohol, ether, benzene, chloroform, petroleum, and carbon bisulphide. The author prepared a series of salts, of which the chloride $C_{24}H_{40}N_2(HCl)_2$ is an illustration. It is identical with the alkaloid conessine obtained by Faust from the bark of *Holarrhena africana*, to which the formula $C_{12}H_{20}N$ was assigned. Wrightine gives the following characteristic reactions: — 1. The colourless solution in 8 drops of concentrated sulphuric acid becomes golden yellow on addition of a trace of nitric acid, then dirty yellow, and finally emerald green. 2. If the solution in 8 drops concentrated sulphuric acid be heated to 90°—100° it becomes yellow and then green, and on cooling the mixture and adding 4—5 drops of water, a deep blue colour is obtained. 3. Wrightine in sulphuric acid solution slowly reduces iodic acid to iodine.

Oxywrightine is obtained by treating wrightine with half its weight of potassium iodide in presence of dilute sulphuric acid. It forms colourless needles of bitter taste and strongly alkaline reaction, and appears to consist of two alkaloids, the separation of which was not carried out owing to want of material.—G. H. B.

Boldin; a new Hypnotiser. Guranville. Chem. Centr-Bl **19**, 860.

The glucoside boldin, which is contained in Boldo leaves, possesses hypnotising and narcotic properties far exceeding those of opium, chloral, and similar drugs. Doses of 5—10 grms. were administered daily without injury to the patient. Boldo leaves contain about 3 per cent. boldin.

—G. H. B.

On Sulphonal. L. Scholvien. Pharm. Ztg. **33**, 320.

Pure sulphonal, as prepared by the firm of G. D. Riedel, in Berlin, has a melting point of 125·5°. It dissolves in 15 parts of boiling water and in 500 parts water of 15°, also in 133 parts of ether and 65 parts of alcohol at 15°. Its action as a medicine is said to be very satisfactory.

E. Baumann (this Journal 1888, 451) corrects his former statement as to the melting point of sulphonal, and confirms Scholvien's figure.—G. H. B.

Contributions to the Chemistry of Buko Leaves. Y. Shimoyama. Arch. Pharm. **26**, 403.

Flückiger obtained a peculiar substance from the oil of Buko leaves, which he named diosphenol. It forms colourless monoclinic crystals and sublimes in needles of several centimetres in length. Flückiger assigned to it the formula $C_{10}H_{18}O$, whilst Spica, who obtained the same substance, viewed it as an oxycamphor of the formula $C_{10}H_{16}O_2$. The author finds the latter formula, $C_{10}H_{16}O_2$, to be the correct one, and adduces evidence to show that one atom of oxygen is present as OH, the other belonging to the aldehyde group CHO. Diosphenol is easily soluble in alcohol, less so in ether, and still less in water. Methyldiosphenol, $C_{10}H_{15}O_2.CH_3$, is a colourless liquid boiling at 232° and insoluble in ether. Acetyldiosphenol boils at 269°—272° with decomposition. By treatment with alcoholic potash diosphenol yields diolic acid, which neutralises strong bases and decomposes carbonates. Crystallised diolic acid has the composition $C_{10}H_{18}O_3 + H_2O$, melts at 96°—97°, is soluble in 122 parts of water at 18°, and is easily soluble in alcohol, ether, chloroform, benzol, and carbon disulphide. Diolic alcohol, $C_{10}H_{18}O_2$, is obtained by the action of sodium amalgam on diosphenol in alcoholic solution This alcohol forms prismatic odourless crystals, melting at 159°, and but little soluble in alcohol and ether. It yielded a bromine derivative $C_{10}H_{14}Br_2O_2$.—G. H. B.

On the Ethereal Oil of Eucalyptus Globulus. R. Voiry. Compt. Rend. **106**, 1419.

The author submitted the oil to fractional distillation under the ordinary pressure up to 180° and at higher temperatures under a partial vacuum. The first fractions consisted of water containing formic and acetic acids, then a mixture of aldehydes. Between 158° and 160° a terebentene was obtained of sp. gr. 0·88 at 0°, from which a crystallised monochloride was prepared of the composition $C_{10}H_{17}Cl$, melting at 126°—128°. The fraction distilling at 170°—175° formed two-thirds of the oil and contained the eucalyptol, which was separated in a pure state by repeated crystallisation at a low temperature. Absolutely pure eucalyptol is a mobile liquid crystallising at 0°, melting at 1°, and of the density 0·940 at 0°. Its odour resembles mint and camphor. Its formula is $C_{10}H_{18}O$. By treatment with dry hydrogen chloride it yields the compound $2\,C_{10}H_{18}O, HCl$. Eucalyptol is optically inactive. Schimmel's process for the preparation of eucalyptol (treatment with hydrochloric acid, decomposing the product with water and subsequent rectification) yields a product which always contains traces of chlorine. The further distillation under reduced pressure yielded a terpilene oil, $C_{10}H_{18}O$, and the acetic, butyric, and valerianic ethers of the same. The author has noticed a substance in the oil of *eucalyptus globulus* containing sulphur and evolving sulphuretted hydrogen on heating.

—G. H. B.

On the Alkaloids of Cod Liver Oil. A. Gautier and L. Mourgues. Compt. Rend. **107**, 110.

The authors have obtained a mixture of bases containing several new animal alkaloids or leucomaines. The fawn-coloured oil, which is generally considered to be the most active, gave the largest yield of alkaloids. To obtain the oil, the cod livers are placed in barrels to allow the oil to flow away spontaneously. The oil comes away at first of a pale yellow or greenish colour, but afterwards a fermentative or digestive (not putrefactive) process is set up, by which the oil dissolves the alkaloids from the tissue and assumes a fawn colour. The oil, originally colourless or greenish, contains only traces of alkaloids. To obtain the bases, the oil is extracted with an equal volume of 33 per cent. alcohol containing 4 grms. oxalic acid per litre. The solution is nearly neutralised with lime, filtered, and evaporated at 45°

in vacuo. The residual liquid is digested with precipitated chalk, evaporated to dryness *in vacuo*, and the residue is dissolved in a little water, treated with excess of caustic potash, and shaken with ether. The alkaloids are precipitated from this solution on the addition of oxalic acid in ethereal solution. From 52 to 65 grms. of the oxalates were obtained from 100 kilos. of oil. The alkaloids are obtained by adding potash to the aqueous solution of the oxalates and form a thick brown, very alkaline oil which floats on the water and may be dried over recently-fused caustic potash. The mixture of bases thus obtained was submitted to fractional distillation in an oil bath. About half the quantity came over below 200°, and contained butylamine, amylamine, hexylamine, and a new base, hydrolutidine, boiling at 198°—200°. The residue contained two new bases, named aselline and morrhuine, a little lecithin, and a crystallisable nitrogenous acid named gaduinic acid.—G. H. B.

On Pimelic Acid from Menthol. G. Arth. Comp. Rend. **107**, 107.

The author had previously obtained two acids by the oxidation of menthol with permanganate in acid solution, one being oxymenthylic acid, $C_{10}H_{18}O_3$, the other having the composition $C_7H_{12}O_4$, which he named β-pimelic acid. H. Mehrländer has since obtained the same products by the oxidation of menthol, but considered the acid $C_7H_{12}O_4$ to be not merely isomeric but identical with normal propylsuccinic acid, from the near coincidence of the melting points. In order to test this conclusion the author prepared normal propylsuccinic acid by the method of Waltz, and finds that it differs essentially from the acid obtained from menthol by yielding a diamine melting at 222°, whilst the diamine from the menthol acid melted at 191°. The author concludes that the constitution of the $C_7H_{12}O_4$ acid from menthol has yet to be determined.—G. H. B.

Strophanthine. Arnaud. Compt. Rend. **107**, 179—181.

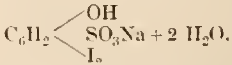
Hardy and Gallois' method of preparing strophanthine is defective, inasmuch as they employ alcohol acidified with hydrochloric acid, and consequently destroy the greater part of the strophanthine. The author employs the following method:—Finely-powdered strophanthus seeds are exhausted by boiling with 70 per cent. alcohol in an apparatus with reflux condenser for some hours. The greater part of the alcohol is then distilled from the extract over a water-bath, but the evaporation is continued in vacuo, leaving some liquid, which is cooled and, after removing the floating oil and resin, is filtered. The filtered liquid is heated in a water-bath, mixed with a small quantity of basic lead acetate and finely-powdered litharge, and filtered again. Any lead in solution is removed by hydrogen sulphide; the clear liquid is then concentrated in a drying chamber, at 50°. In a day or so the strophanthine crystallises out, and is filtered off, keeping the temperature at 50°. If the concentration has not been carried too far, the syrupy liquid runs off gradually, and the crystals have simply to be drained on a porcelain slab and recrystallised several times from boiling water. In this manner 4·5 grms. of the crystalline strophanthine is obtained from each kilo. of seed of *strophanthus kombé*, but some strophanthine is retained by the syrup.

Strophanthine, $C_{31}H_{48}O_{12}$, is a white, very bitter, substance, crystallising in radiating spangles. These crystals soak up and retain water with great facility. Strophanthine forms a hydrate which parts with its water in a dry vacuum or when dried in the air; or if heated in a drying chamber it melts below 100°, and becomes colloidal; but when previously dried in a vacuum it can be heated to 110° without alteration. When strophanthine is heated in the air it burns without leaving a residue. It becomes pasty at 165°, losing its opacity and becoming brown with moderate rapidity. It is dextrogyrate, and with a 2·3 per cent. aqueous solution, $[\alpha]_D = +30°$. It is scarcely soluble in cold water, one part requiring 43 of water at 18°; it is moderately soluble in alcohol, from which it is deposited as a varnish. It is insoluble in ether, benzene, and carbon bisulphide. Tannin precipitates it from the aqueous solutions.

From its composition it appears to be the homologue of ouabaïne, $C_{30}H_{46}O_{12}$, which it resembles in poisonous properties. Both, when heated with dilute acids, decompose like glucosides, yielding a body which reduces Fehling's solution, but does not appear to be glucose.—D. A. L.

Di-iodoparaphenolsulphonic Acid, or Sozoiodol.

Sozoiodol (this Journal, 1888, 227) is a powerful antiseptic, but, owing to its comparative insolubility, its use is superseded by that of its sodium salts, especially the acid sodium salt, having the formula—



$$C_6H_2\begin{cases}OH\\SO_3Na\\I_2\end{cases} + 2\ H_2O.$$

The Sodium Salt forms colourless tabular crystals easily soluble in water or glycerol at the ordinary temperature to the extent of 1 in 12. The glycerol solution remains quite unaltered when exposed to sunlight, but the aqueous solution slowly alters its colour on exposure to light.

The Potassium Salt is only slightly soluble in water and glycerol, only about $\frac{1}{50}$th part being dissolved by these liquids. For this reason the potassium salt is preferable to the sodium salt in the treatment of cases requiring the application of dusting powders, &c., because of the greater duration of their efficacy. The effects, however, of both salts are the same. Various therapeutic preparations have been made, not only as solutions, but with talc, lanolin, sugar of milk.

It has not been shown that sozoidol has any injurious after-effects whatever when used as an antiseptic.

Various chemical compounds of the di-iodo-*p*-phenol sulphonic acid with Al, Mg, Pb, and Zn have been formed, and these are easily soluble. Besides these, other compounds or salts of ammonium, barium, mercury, and silver have been prepared, and these latter are but sparingly soluble.

It is very favourably reported of by Dr. Oscar Lassar, of Berlin (*Therapeutische Monatshefte*, Nov. 1887), especially for skin diseases, ulcers, and as an antiparasitic.—W. S.

Terpenes and Ethereal Oils. O. Wallach and E. Gildemeister. Annalen, **246**, 265—284.

A new acid, which the authors name *Cineolic* acid, $C_{10}H_{16}O_5$, is obtained when cineol (6 cc.) is warmed with potassium permanganate (30 grms.) and water (450 grms.) for about nine hours. The unchanged cineol is distilled with steam, the filtered solution evaporated to dryness and the powdered residue extracted with alcohol. A mixture of potassium carbonate and potassium oxalate remains, and the alcoholic solution yields on evaporation the potassium salt of cineolic acid in the form of a very hygroscopic crystalline mass. It is dissolved in water, precipitated with dilute sulphuric acid, freed from potassium sulphate by dissolving in ether, and finally recrystallised from boiling water. The yield of pure acid is about 45 per cent. of the cineol employed.

Cineolic acid forms well-defined colourless crystals, and is sparingly soluble in cold, but more readily soluble in hot water; it is much more readily soluble in warm alcohol and ether, but sparingly soluble in chloroform. It melts at 196°—197° with decomposition, and the aqueous solution is optically inactive. The calcium salt $C_{10}H_{14}O_5Ca + 4\ H_2O$ is crystalline and soluble in cold, but insoluble in boiling water.

Ethyl cineolate, $C_8H_{14}O(COOC_2H_5)_2$, prepared by repeatedly saturating an alcoholic solution of the acid with gaseous hydrochloric acid, is a colourless liquid and boils at 155° (11—12 mm. pressure).

Cineolic acid is converted principally into oxalic acid and carbonic anhydride when oxidised with potassium permanganate, and it yields chiefly oxalic acid when boiled with nitric acid. Cineolic acid is also obtained when *Cajeput oil* and *Oleum Cinæ* are oxidised with potassium permanganate as described above.

Australian eucalyptus oil from *Eucalyptus amygdalina* contains cineol and yields cineolic acid when oxidised with potassium permanganate. This oil also contains a hydrocarbon which is physically isomeric with phellandrene.

For the detection of cineol the hydrobromide is very suitable, as it is only sparingly soluble; 1 per cent. of cineol mixed with limonene can be readily detected when a few bubbles of hydrobromic acid are passed into a well-cooled solution of the mixture in petroleum spirit.

The eucalyptene contained in *Eucalyptus globulus* is identical with ordinary dextro-rotatory pinene.—F. S. K.

Terpenes and Ethereal Oils. Part 8. O. Wallach, Annalen, **246**, 221—239.

The limonene obtained by the author from pine-needle oil is lævogyrate, but in other respects resembles limonene from orange-peel oil, oil of caraway, &c.

The oils obtained from different kinds of pines appear to be similar in composition, although the proportions of the individual constituents vary in the different products. Lævogyrate pinene (b.p. 160°) is a preponderating constituent, but there is also abundance of laevo-limonene (fraction 170°–180°), frequently accompanied by some dipentene. Limonene prepared by careful fractionation of oil from the needles of *Pinus picea* boils constantly between 175°—176°, has sp. gr. at 20° = 0·846, rotatory power $[\alpha]_D = -105°$, and molecular refraction = 45·23.

On bromination it yields a tetrabromide (m.p. 104°) having the greatest resemblance to the known limonene tetrabromides, but lævo- instead of dextro rotatory. The same character distinguishes other derivatives, including the nitrosochlorides. Comparing the optical activity of the latter compounds, E. Conrady finds the rotatory power of dextro-limonene from dextro-limonene nitrosochloride is $[\alpha]_D = +304·05°$, whereas with laevo-limonene from lævo-limonene nitrosochloride $[\alpha]_D = -273·4°$. These substances may be regarded as chemically identical, but physically isomeric.

In the same manner as lævo- and dextro-rotatory-pinene and camphene respectively unite to form optically inactive modifications, an inactive limonene is formed by the union of the two active limonenes. When equal quantities of dextro- and lævo-limonene are brominated together, or when concentrated solutions of the respective tetrabromides are mixed in equivalent proportions, an inactive tetrabromide is obtained, melting at 124°—125°, and in other characters differing considerably from either of the active limonene tetrabromides, but in all respects identical with dipentene tetrabromide. An analogous distinction has been observed in the carvoximes, for whereas carvoxime prepared from carvole and hydroxylamine has a rotatory power for $[\alpha]_D = +39·71°$, carvoxime obtained by the removal of hydrochloric acid from dextrogyrate limonene nitrosochloride has a rotatory power for $[\alpha]_D = -39·34°$; although they both melt at 72° and are otherwise similar. These observations presumably indicate, *firstly*, that the original substance in the oil of caraway from which the dextro-carvole is obtained must be laevo-limone, and, *secondly*, that the inactive body (m.p. 93°) resulting from the union of the two active modifications of carvoxime must be the same as that obtained by splitting off hydrochloric acid from dipentene nitrosochloride. Both these assumptions have been confirmed, inasmuch as laevo-limonene nitrosochloride yields dextro-carvoxime when heated with alcoholic potash, and by the union of dextro- and lævo-carvoximes inactive nitrosodipentene is obtained. This last substance is insoluble in cold concentrated soda, but dissolves on warming, and separates out again on cooling; it remains dissolved in moderately dilute soda, but can be removed by agitation with ether.

The inactive limonene compounds differ considerably in character from the corresponding compounds of the active modifications. This is very evident in the higher melting points and diminished solubilities of the former. In fact, the limonene isomerism appears to resemble the isomerisms in tartaric acid compounds, and therefore it seems probable that four kinds of limonene compounds may exist, such as derivatives of lævo-, dextro-, and inactive limonene, corresponding to the tartaric acids, and derivatives of dipentene, corresponding to racemic acid. The inactive pinene and camphene derivatives do not differ from the derivatives of their constituent active modifications to the same extent as is observed in the limonenes. It was, therefore, presumed that a different chemical condition existed in the latter case, and that inactive pinene and camphene are only mixtures, whilst inactive limonene is a true compound with a molecule double the size of the molecules of the laevo- and dextro-limonenes; however experiments with isonitrosodipentene (m.p. 93°) and dextro-carvoxime (m.p. 72°), by Raoult's method, indicate that the molecules of these bodies are the same size.

The author has obtained a laevogyrate phellandrene from Australian eucalyptus oil, otherwise identical with the known phellandrenes. By combination with nitrous acid, two phellandrene nitrites are obtained, both melting at 103°, but in which the rotatory power is the reverse of that of the original hydrocarbon, as is the case with the limonene nitrites (carvoximes); so that dextro-phellandrene yields a laevogyrate nitrite, and laevo-phellandrene a dextrogyrate nitrite. The author comments on this reversal of the direction of rotation in these instances, and in the case of the limonenes where their rotation is increased by the addition of the group NOCl, then suddenly reversed by the abstraction of a molecule of hydrochloric acid from the molecule of increased optical activity.

The two active phellandrenes yield by their union an inactive modification with other properties, exactly the same as those of the individual constituents.

Considering now the relation of terpenes to one another, and their occurrence and formation in nature, the author has previously described the conversion of pinene into dipentene, and the present results show that this is equivalent to converting it into the two limonenes. Recently, by the action of alcoholic sulphuric acid on pinene, and subsequent dehydration of the products, Flavitzky obtained what he called dextro- and lævo-isoterpenes, boiling at about 175°; it seems very likely that these substances will turn out to be the corresponding limonenes.

The occurence of pinene in the stems, and the simultaneous presence of limonene and dipentene in the acid needles of pines will hence be quite comprehensible and comparatively simple phenomena.—D. A. L.

PATENT.

Improvements in the Manufactre of Salicylic Esters called "Salols." C. Kolbe, Saxony. Eng. Pat. 10,260, July 22, 1887. 6*d*.

Salol has been before obtained by treating salicylic acid and phenol, or their sodium salts, with phosphoric oxychloride or pentachloride. The present specification extends to the use of phosphorous chloride, PCl_3, sulphonic chloride, SO_2Cl_2, and acid sulphates of the alkalis. Also, instead of using salicylic acid and phenol, other similar compounds may be used for the production of other salols, of which the following list is claimed:—α-naphthylsalicylate; β-naphthylsalicylate; resorcinolmonosalicylate; resorcinoldisalicylate; gaultheriesalol; pyrogallol salicylate; phenyl-α-hydroxynaphthol; phenylorthonitrosalicylate; phenylparanitrosalicylate; *p*-nitrophenylsalicylate; thymol salicylate; disalol; β-naphthyl-α-hydroxynaphthoic acid; β-naphthohydroquinonesalicylate; phenylresorcinolcarboxylate.—G. H. B.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Toning with Platinum Chloride. Phot. Corr. 25, 260.

0·13 grm. platinum chloride in 500 cc. water is neutralised by sodium carbonate, and to this is added a solution of 0·5 grm. borax, 1·3 grm. oxalic acid, and 30 drops of formic acid in a little hot water. The albuminised prints are first washed.—G. H. B.

Linography. Phot. Corr. 25, 269.

This is a name given to photographing on linen or calico, to serve as a basis for painting in oil. It is very essential to remove all starch dressing by washing with hot water, and after drying the material is drawn through the baths, which should be of the same width as the fabric; a rod fixed in the bath serves to secure immersion. The bromide bath consists of 10 grms. potassium bromide and 3 grms. cadmium bromide in 720 cc. water. The silver bath consists of 15 grms. silver nitrate and 5 grms. citric acid in 720 cc. water. In copying, the exposure is sufficient when the picture is feebly visible and development is effected by a solution of 2 grms. pyrogallol and 5 grms. citric acid in 720 cc. water. The normal exposure required for copying is eight minutes. For toning the following bath is used: 10 grms. potassium sulphocyanide and eight to ten drops of a one per cent. solution of potassium auric chloride in 600 cc. water. The pictures are finally stretched on frames, soaked in a solution of wax, and after drying are coated with mastic varnish.—G. H. B.

Expresstype. Phot. Arch. 29, 166.

The principal objection to the ordinary method of autotypes or photozinctypes for high pressure reproduction lies in the expensive and complicated manufacture. W. Cronenberg has invented a process under the above name, by which a printer can furnish his own zinc plates. The troublesome copying with asphaltum is done away with; the desired amount of grain is given to the cleaned zinc plate, which is then covered with a rubber chromate film, exposed for a few minutes under the negative, developed with water, dried, dredged with resin colour and etched. Negatives, positives, and outline drawings may be thus copied, the latter even without a camera. F. Schreivogel is a co-inventor of this process.—G. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

Improvements in the Explosives Industry. O. Guttmann. Dingl. Polyt. J. 268, 516—526.

A *Method for the production and cooling of charcoal powder* has been patented by H. Güttler, of Reichenstein, in Silesia. Usually the cooling of the freshly-made charcoal is effected in the retorts themselves or in separate vessels to which it is rapidly withdrawn. In any case cooling takes place slowly, and it is, moreover, difficult to ensure uniformity in the product; while the charcoal, being unsaturated with gas, tends to absorb much oxygen during the process of crushing, with the result that spontaneous ignition is of frequent occurrence. In the new arrangement, in the larger division of a double fire-brick chamber is set a muffle with perforated end doors, the apertures being regulated at will; within this is a second cylindrical vessel, also fitted with moveable doors, one of which carries an outlet for gas, and within this again is the actual carbonising chamber, having a tube passing into it, and with escape vents for gases. The other division is fitted with a grate and a gas-heating coil; the burnt gases from the grate are led over a fire-bridge into the adjoining compartment, whence, after circulating around the muffle, they pass into a flue beneath. Carbon dioxide, or combustion products free from oxygen, lime-kiln gases, and the like, are passed into the heating coil, and are thence conveyed into the carbonising chamber; and from this, carrying with them the gaseous products of carbonisation, they pass into the space between the two inner vessels. The conversion is thus effected rapidly to a very large extent by the heated carbon dioxide forced into the slip; when the action has proceeded sufficiently far the fires are drawn, and cold carbon dioxide is caused to replace the hot gas, while the apertures between the outer muffle and the intermediate vessel are opened for the purpose of air-cooling the space. The result of all this is rapidity of work and uniformity of product, combined with entire absence of any tendency to spontaneous ignition, since the charcoal is saturated, while in its most porous condition, with the inert carbon dioxide.

In carrying out the *heat-test for guncotton* it is frequently observed that one sample will yield entirely discordant results in the hands of different experimenters. Her Majesty's Inspectors of Explosives, in their report for 1886, recommend the use of 15 grms. of pure potassium iodide, recrystallised from alcohol; and a sample of well prepared guncotton, to which the usual test was applied, allowing 15 minutes as the lowest limit of stability, was returned by one operator as stable for 32 minutes, by another for only 8 minutes, while with the pure iodide it was good for over 100 minutes. Potassium iodide starch paper was known to suffer in regard to sensitiveness by exposure to light and by long storage; it is now questioned whether this may not also be true for the pure iodide.

Borland and Reid's carbo-dynamite is to be made by a newly-formed company in London. This explosive consists of 90 parts of nitroglycerol absorbed by 10 parts of charcoal, with or without sodium or ammonium carbonate, and added water. The charcoal is derived from cork, and is extremely bulky and very porous, enabling a large amount of the nitro compound to be taken up, with a consequent increase of value as a blasting agent: as, moreover, the nitroglycerol is not in any degree removed by soaking in water, water may be added at once, and thus render the explosive less dangerous for transport and storage. When mixed with water, however, it explodes more suddenly (like wet guncotton), the incompressible liquid communicating the explosive wave simultaneously throughout the mass. A further quantity of the absorbent, together with nitre, may be added, but in this case the resistance of the body to the action of water is of course removed. A further advantage secured by the use of cork charcoal is its rapid and complete combustion when fired. A comparative experiment showed that a quarter of an ounce of Kieselguhr dynamite produced a cavity of 347 cc. capacity in a lead block, while the same weight of carbo-dynamite produced one of 599 cc.

Meganite is an explosive introduced by W. Schückher and Co., consisting of—

—	Nitro-Glycerol.	Nitro-Cellulose, from—		Added Powder.
		Wood.	Vegetable Ivory Nuts.	
Meganite, No. 1	60	10	10	20
„ No. 2	38	6	6	50
„ No. 3	7	9	9	75

The added powder for No. 1 was sodium nitrate alone, for Nos. 2 and 3, sodium nitrate = 75 per cent., and soda = 1 per cent., with 24 per cent. of wood meal in the former, and a like quantity of rye meal in the latter. Owing to difficulties with other works in the use of nitro-cellulose from vegetable ivory, another blasting agent was introduced under the name of *oriasite*, in which nitrated woodstuff alone was employed. A series of comparison experiments showed as follows:—

—	Weight = 20 grms.			Weight = 10 grms.			Composition.
	1	2	3	1	2	3	%
Kieselguhr dynamite	1,000	995	1,002·5	500	497·5	502·5	75 nitroglycerol. 25 Kieselguhr.
Gelatin „ I.	1,080	1,095	1,100	505	505	515	65 gelat.-nitroglycerol. 35 added powder.
„ „ II.	800	805	805	400	400	405	45 gelat.-nitroglycerol. 55 added powder.
Dynamite III.	405	400	410	200	205	205	15 nitroglycerol. 85 added powder.
Meganite I.	1,200	1,180	1,195	600	595	595	80 nitro compounds. 20 added powder.
„ II.	840	845	840	417·5	415	420	50 nitro compounds. 50 added powder.
„ III.	455	460	460	230	230	230	25 nitro compounds. 75 added powder.

Bellite, invented by C. Lamm, of Stockholm, consists of 1 part of nitrobenzene with 1·9 ammonium nitrate, or 1 of trinitrobenzene, with 2·57 of the nitrate, mixed by melting in a steam-heated cylinder; before completely cooling it is pressed into cartridges, which are hard, melting at 90°, and having a specific gravity of 1·25.

The *Securite* of F. Schoeneweg is made by drying at 80°, a solution of ammonium nitrate with potassium or ammonium oxalates, and mixing with 10 parts of nitrobenzene or 20 parts of dinitrobenzene.

Sjöberg's *Romite* (Stockholm) is composed of ammonium nitrate and carbonate, nitronaphthalene, paraffin, and potassium chlorate in varying proportions.

Roth's *Roburite* (Germ. Pat. 39,511 of 1886) is prepared by warming one part of naphthalene with five parts of sodium nitrate and six of concentrated sulphuric acid for three hours, washing and drying the nitronaphthalene produced, and then mixing it with 0·8 parts of potassium chlorate and adding to it gradually five parts of hydrochloric acid, warming it subsequently upon the water-bath. Or five parts of tar are to be mixed gradually with 15 parts of nitric acid (sp. gr. = 1·45) and 12 of hydrochloric acid, maintaining a low temperature at first, then gently warming and adding the resulting plastic mass to a mixture of five parts nitre with 15 of sulphuric acid. The chloro-nitro products obtained in this way are mixed with potassium chlorate or nitre.

R. K. Punsheon (Eng. Pat. 11,140 of 1887) mixes picric acid with potassium chlorate, wood charcoal and nitroglycerol.

Sir F. A. Abel produces a smokeless explosive by admixture of a nitro-compound with ammonium nitrate, and then with petroleum.

E. Green mixes Kieselguhr with charcoal or with carbonised starch sugar or the like; a dynamite made with such a mixture does not lose nitroglycerol when placed in water.

Avoiding the warming of the mixture in the manufacture of gelatin dynamite, the *Deutsche Sprengstoff-Actiengesellschaft,* of Hamburg, propose to dissolve a proportion of picric acid in the nitroglycerol, afterwards mixing into it collodion cotton. Pure tetra-nitro-cellulose will dissolve in two days. An increase in explosive strength will not thus be brought about, and it is questionable whether this addition of picric acid may not give rise to decompositions which would detract from the safety of the material. Moreover the few disadvantages incurred by warming the charge are more than balanced by the gain in speed.

Plom and *Retinne* have patented (Germ. Pat. 40,538, in 1887) a tool for enlarging bore holes radially at the base by means of expanding cutting arms, which are at first sheathed within the tool, but gradually protruded through slots in the walls, and actuated from without. But the idea has little novelty.

For the destruction of iron bridges and the like, the Austrian military authorities have hitherto used the formula $L = \cdot 0063\ bd_2$, or half that amount for closely riveted plates (up to 160 mm. rivet distance). But it is now found by a committee of inquiry that with the present grades of iron the first mentioned formula should be used even for these riveted plates with a parallelopiped charge, while with cylindrical charge the formula $L = 0\cdot 01\ bd_2$ is necessary. With wood baulks also it is found that rectangular charges are better than cylindrical, the formula in this case being $L = 0\cdot 00004\ bd_2$.—W. G. M.

The "Favier" Explosive. Chem. Zeit. Rep. **12,** 153.

This body is said to be free from danger, because when heated in the open air, or submitted to violent mechanical action, it does not detonate. It is unaffected by wide variations of temperature and by atmospheric influences; it detonates without flame, gives as products of combustion chiefly carbon dioxide and water vapour, and surpasses dynamite in power. A charge of 2·8 kilos. of "Favier" gave an effect equal to that of 2 kilos. of dynamite with 5 kilos. of ordinary black powder. A further advantage of the "Favier" explosive is that the rock is broken into larger pieces than by other blasting agents.—W. G. M.

XXIII.—ANALYTICAL CHEMISTRY.

Drying Apparatus. R. Schütze. Chem. Zeit. **12,** 722.

The apparatus consists of a cylinder with flat stopper, which latter is used as base. Into the cylinder are fused a series of tubes, as shown in the figures. The gas enters at *a*, passes down *x*, through the drying material and out at *y*.—T. L. B.

(For Fig. 1, see next page.)

Graduated Flask with Burette. R. Schütze. Chem. Zeit. **12,** 722.

The measured flask K has an outlet at *f*. The cock is so arranged that, if necessary, air may be admitted to, or discharged from, the burette without entrance of any liquid through S. For keeping the air washed, W and *r* are connected by a rubber tube, and *r* is filled with the necessary liquid.—T. L. B.

(For Fig. 2, see next page.)

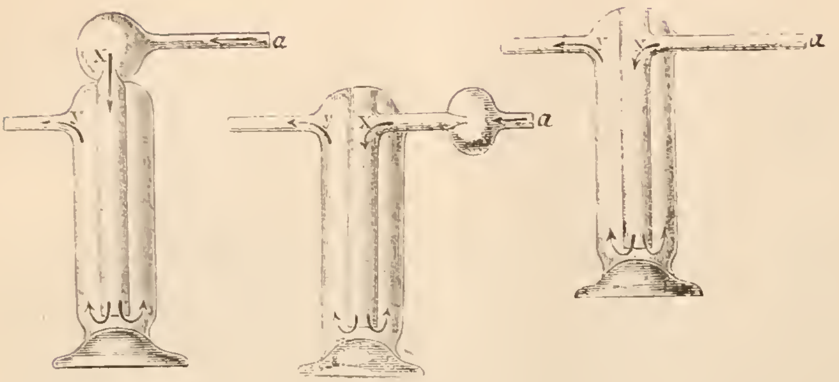


Fig. 1.

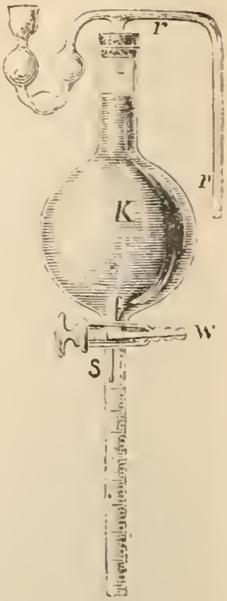


Fig. 2.

Detection of Nitric Acid in Waters and Soils. E. Bréal. Annales agronomiques, 1887, 322—327.

For this purpose the author dips strips of white filter paper, free from nitric acid, into the water or soil leaving one end exposed to the air. The nitrates rise in the paper by capillarity and accumulate in part of the exposed portion of the paper strip, which may then be tested by means of phenol sulphonic acid and ammonia. If the material being tested contains a very small quantity of nitric acid, 12—15 hours will be sufficient to accumulate it in 1—2 mm. of the exposed part of the paper. All the nitrates may be removed from solution in this manner, and 0·00025 grm. of nitric acid in a litre may be detected.—D. A. L.

The Estimation of Titanium and Phosphorus in Iron Ores. E. P. Jennings. Eng. and Min. Journ. **45**, 475.

From 1 to 5 grms. of ore are digested with strong hydrochloric acid; this causes almost complete solution of the titanic acid, leaving a siliceous residue, with perhaps a trace of titanium. The unfiltered solution is diluted and nearly neutralised with sodium carbonate, the iron is next reduced with sulphurous acid, 50 cc. of acetic acid are added, and the whole is diluted to 500 cc., and boiled for an hour. The precipitate contains the whole of the titanium with the insoluble residue, and some phosphorus and iron; it is allowed to settle, is filtered through a ribbed filter, and washed with a 10 per cent. acetic acid solution, which prevents the titanium from passing the filter. It is then dried, ignited and fused with 10 times its weight of sodium carbonate; on treating now with water, the phosphate and silicate of soda dissolve, leaving insoluble acid titanate of soda and iron oxide. This solution is filtered, and the filtrate is added to that first obtained, containing the bulk of the phosphorus. The precipitate is next washed into a beaker, dissolved in dilute sulphuric acid, again nearly neutralised, its iron peroxide reduced with sulphurous acid, mixed with 25 cc. of acetic acid, largely diluted and boiled. The titanic acid now precipitated is pure, and is washed with dilute acetic acid. The mixed iron phosphorus filtrates are peroxidised with nitric acid, precipitated with ammonia, and filtered; the precipitate is re-dissolved in hot dilute nitric acid, evaporated to dryness to separate silica, redissolved in nitric acid, and precipitated with molybdate solution as usual. If more than 2 grms. of ore be taken, the iron precipitate with ammonia will be unmanageably bulky; and in this case the solution is simply neutralised with ammonia, a little ferric chloride is added, and the whole is boiled to precipitate the latter as basic ferric acetate (containing all the phosphorus), which is then treated in the ordinary way. An estimation of P and Ti may be accomplished in eight hours.—W. G. M.

Estimation of Iron and Aluminium in Presence of Calcium and Phosphoric Acid. G. Kennepohl. Chem Zeit. **12**, 923.

This is an examination of the methods in use for the analysis of natural phosphates and derived products, with a view to ascertaining the one least liable to error.

The methods are divided into three groups:—

(*a.*) The iron and aluminium are precipitated, in presence of excess of phosphoric acid, as double phosphate.

(*b.*) Precipitation with ammonium acetate; compounds of iron, aluminium, and calcium with phosphoric acid are formed, and the amount of iron and aluminium is obtained from the weight of this precipitate after ascertaining the quantity of phosphoric acid and calcium.

(*c.*) The iron and aluminium are directly separated.

In order to obtain the precipitate in (*a.*) free from calcium, as a rule, five reprecipitations necessary: the method is also inaccurate; the losses are less in presence of excess of phosphoric acid than where basic phosphate is formed, but they are still too large to be neglected.

In (*b.*) the calcium and phosphoric acid must be determined from the ignited and weighed precipitate, on account of the varying composition of the precipitate of iron and aluminium mixed with calcium. The method is consequently an undesirable one.

The author has attempted to determine the iron and aluminium as oxides after removing the phosphoric acid with magnesium mixture in presence of citric acid. The results were good, but the use of citric acid in presence of magnesium chloride renders the process objectionable.

Determination of the iron and aluminium as phosphates, after removal of the calcium by oxalic acid, gave good results, and was considered satisfactory. A hydrochloric acid solution of the phosphate is made slightly alkaline with ammonia, and slight excess of oxalic acid is then added (no notice being taken of the ammonia precipitate, as soluble iron and aluminium oxalates are afterwards formed). The whole is warmed to about 80° C., allowed to settle and cool, and filtered. An aliquot part is evaporated in a platinum dish, and the oxalic acid driven off by heating gently. A few drops of ammonia are added and evaporated off, and the residue is dissolved in concentrated hydrochloric acid, and the iron and aluminium double phosphate precipitated with ammonia and acetic acid.—T. L. B.

Composition of the Ash of Cotton-seed Husks. C. A. Goessmann Bull. Massachusetts State Agri. Exp. Stat. 1887.

The following are the mean, maximum, and minimum results from six analyses :—

——	Mean.	Max.	Min.
Moisture	7·70	8·23	7·30
Potash	23·72	28·55	17·34
Phosphoric acid	10·02	11·50	8·97
Magnesia	14·81	17·15	10·11
Lime	11·96	18·42	6·71
Insoluble	6·32	12·18	0·00

—D. A. L

The Sulphuric Acid in Grasses which have been Injured by Sulphurous Acid. E. Mach. Versuchs. Stat. 35, 53—54.

The sulphurous acid evolved from a cellulose factory injured the surrounding vegetation. The author gives analyses of a hay crop injured in this way, and of an uninjured crop: these analyses show that the sulphuric acid in the dry substance and in the ash of the injured crop was much greater than in those of the uninjured crop. —A. G. B.

On the Detection of Iron in Oil. B. Emde. Zeits. f. angew. Chem. 362—363.

This is an important point in Turkey-red manufacture. A certain quantity of the oil is shaken up, in a graduated cylinder, with water acidified with sulphuric acid, and containing a few drops of potassium ferrocyanide. A little ether is then added and the whole is shaken up again. The ether dissolves the oil and floats on the water. If iron is present, a more or less dense layer of Prussian blue (containing all the iron) is formed at the border-line between the two liquids. If, in comparative tests, the same quantities of liquids are used, the colour or thickness of the Prussian blue layer will give an idea of the quantity of iron present. —F. W. T. K.

Ihl's new Method for the Detection of Invert Sugar by Means of Methylene Blue. Ding. Polyt. Jour. 268, 413.

Ten grammes of sugar are dissolved in water clarified with basic lead acetate, and the excess of lead removed with sodium carbonate and diluted to 50 cc. One or two drops of a solution of Methylene blue (1 grm. per litre) are added and the mixture boiled. In presence of 0·2 per cent. invert sugar the solution is decolourised in less than one minute, and even 0·01 per cent. causes reduction in about two minutes. The colour gradually reappears on exposure to the air.—H. T. P.

Qualitative Testing for Invert Sugar in the presence of Cane Sugar by Soldaini's Solution. E. Parcus. Chem. Zeit. 12, 741.

Soldaini's solution is preferable to Fehling's for the matter in question, because the former causes inversion of cane sugar after six to seven minutes boiling over the naked flame, while the latter is reduced even after two minutes; nevertheless inversion may commence much earlier, and the author has investigated the conditions favourable to reliable testing by Soldaini's solution. He finds that the reduction of the solution by the sugar is dependent not only on the duration of the boiling but to a greater extent on the relation of sugar to solution. Thus where this ratio exceeds 1 grm. to 8 cc., reduction will occur, but where less than this amount of sugar is used, no reaction will occur before ten minutes boiling. The following scheme for testing is suggested :—5 grms. of the dry sugar (or an equivalent amount of solution) is placed in a flask, 50 cc. of the Soldaini solution is added, and the mixture is warmed until the sugar is completely dissolved; on boiling the liquid now for five minutes any separation of cuprous oxide will indicate the presence of invert sugar. Pure cane sugar so treated will not deposit any precipitate even after 12 hours subsequent standing. It should be noted that invert sugar shows, but in a much lower degree, the same sensitiveness to proportion between sugar and solution, in regard to precipitation, as is evinced by the cane sugar; thus 0·001 grm. of invert sugar gave reduction with 5 cc. of Soldaini's solution, but none with 100 cc.; 0·002 grms., however, sufficed to give a precipitate in all cases. The error from this cause is therefore so small as to be negligible. The dilution of the reagent with half its volume of water increases its sensitiveness towards invert sugar, without increasing its liability to precipitation by cane sugar.—W. G. M.

On the Use of the Diphenyl and Stilbene Tetrazo Dyestuffs as Indicators in Volumetric Analysis. Ludwig Storch. Ber. öst. Ges. zur Förd. der Chem. Ind. 9, 95—102.

After an exhaustive series of trials with the Benzidine and Stilbene tetrazo dyes—(A.) Congo Red, Congo G, Congo G R, Congo 4 R, Congo-Corinth, Benzopurpurin B, Benzopurpurin 4 B, Benzopurpurin 5 B, Hessian Purple N, Hessian Purple B. (B.) Benzoazurin B, Azo Blue, Curcumin S, Curcumin W, Chrysamine, Ethyl Orange, Litmus—the author sums up his results. He finds that *Benzopurpurin B* will be the most useful of the tetrazo-colours. It is in aqueous solution a most excellent reagent for free acids, provided the saline matters in solution are not too abundant, but that papers saturated with the colour offer no advantage at all over other reagent papers. Finally it is stated that as a *general indicator* its use would be accompanied by no advantages on account of its deceptive action under certain circumstances.

A different account is given of its utility for indicating the presence of bodies of alkaline reaction. Benzopurpurin solution just made violet with an acid is one of the most sensitive of all indicators for basic or alkaline substances; it is more general in its utility than phenolphthaleïn, more sensitive than litmus, and more characteristic in its colour-change than Ethyl-orange. The slightest traces of these alkaline or basic bodies produce the change to red, so that it is difficult to keep a violet Benzopurpurin, since the smallest traces of ammonia in the air remove the bluish-violet colour on drying the papers. Thus then it is the free sulphonic acid of the colour basis which is so sensitive in its reaction with basic substances, and the author employed it for the simultaneous determination in a solution of ammonia and pyridine bases. Since the pyridine bases do not react with litmus and tropaölin O O O, whilst ammonia does, it seemed likely that by the aid of Benzopurpurin, ammonia and the pyridine bases could be determined in the same solution. But the author further convinced himself that also *Ethyl-orange* can be used in like manner, and that with this the end reaction can be more sharply discerned than with the Benzopurpurin. It was further found that the estimation of ammonia in admixture with pyridine can be made very well by titration with hydrochloric acid, using litmus, but that the litmus becomes uncertain in its action or quite fails when ammonia occurs along with the higher pyridine bases, Picoline, Lutidine, and Collidine. Then the end-reaction becomes obscure.

Amongst Stilbene colours *Curcumin W*. has been mentioned as an indicator. It dissolves in water with a greenish colour changing to cherry red with the slightest trace of alkali. The sensitiveness in this direction is greater than that of phenolphthaleïn. It is, like phenolphthaleïn, also sensitive to the action of the carbonic acid of the air. Other, however, than its greater sensitiveness and its applicability in presence of ammonium salts, it possesses no advantage over phenolphthaleïn.—W. S.

Alkalimetric Determination of Picric Acid. P. Kay. J. Soc. Dyers and Colourists **4**, 84.

THE following reaction ensues on addition of potash to picric acid, $C_6H_2(NO_2)_3.OH + KHO = C_6H_2(NO_2)_3.OK + H_2O$.

One grm. picric acid was dissolved in water, a drop of phenophthaleïn added, and the solution titrated with $\frac{N}{10}$KHO till the yellow colour of the solution passed into an orange tint.

One cc. $\frac{N}{10}$KHO = 0·0229 grm. picric acid. 43·65 were required, and hence 0·0229 × 43·65 × 100 = 99·96 per cent. The m.pt. of this sample was 120° C. End-reaction very sharply defined.—W. S.

The Assay of Commercial Picric Acid. A. H. Allen. J. Soc. Dyers and Colourists **4**, 84—86.

ACCORDING to Armstrong, bromine converts dinitrophenol into a bromodinitrophenol, and picric acid into the same bromodinitrophenol. It occurred to the author that the reaction with picric acid differed from the other, because nitric acid is formed. Thus—

(1.) Dinitrophenol—

$$C_6H_3(NO_2)_2.OH + 2\ Br = HBr + C_6H_2Br(NO_2)_2.OH.$$

(2.) Trinitrophenol—

$$C_6H_2(NO_2)_3.OH + 2\ Br + H_2O =$$
$$HBr + NO_3H + C_6H_2Br(NO_2)_2.OH.$$

Thus the acidity of the liquid would be greater the larger the proportion of picric acid present, and if the bromodinitrophenol were removed by agitation with ether or similar solvent, the acidity of the aqueous liquid could be ascertained by titration.

However, actual experiment showed that reaction (1.) between bromine and dinitrophenol in aqueous solution occurs instantaneously, but that between picric acid and bromine is very slow. In 12 hours it is complete, but in course of a few minutes it is almost *nil*. On this observation the following method was built up. One grm. of the sample of picric acid to be tested is dissolved in 100 cc. of warm water. A saturated solution of bromine in water is diluted with 2 cc. its measure of water in a large tapped separator, and from this run into a Mohr's burette. From this burette a definite volume of the bromine solution, approximately of 1 per cent. strength, is run into a flask, and an equal volume into another similar flask. The picric acid solution was then poured and rinsed into the latter, and then excess of a solution of KI at once added to the contents of both flasks. The liberated iodine was then determined by titration with decinormal thiosulphate solution in the usual way. Iodine is wholly without action on solutions of either mono-, di-, or trinitrophenol. The results of the titration furnish the amount of bromine entering into reaction with the nitrophenols. Mononitrophenol reacts with 4 Br taking up 2 Br, dinotrophenol with 2 Br taking up Br, and trinitrophenol with 2 Br or none, according to the conditions of the experiment.

In determinations of the melting point of picric acid, the author proposes another modification, by which rather the *solidifying points* are ascertained, as in the case of fatty acids. He operates as follows :—

Melting points.—Minute quantities of the samples are placed on the surface of mercury contained in a porcelain crucible, covered with an inverted funnel. Through the neck of the latter a thermometer is passed, the bulb of which is immersed in the mercury.

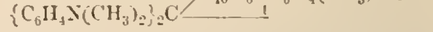
Solidifying points.—Some of the picric acid is melted in a test tube, and the liquid stirred with a thermometer until signs of solidification are observed and the thermometer remains stationary for a considerable time. This point is far more definitely marked than that of melting.—W. S.

A new Method of Determining the Tinctorial Value of Naphthol Yellow and certain other Coal Tar Colours. Chr. Rawson. J. Soc. Dyers and Colourists, **4**, 82.

THE usual method of ascertaining the relative value of colouring-matters consists in making experimental dye trials conducted under identical conditions. It is well known in colour matching that differences in intensity of colour are most difficult to discern and appreciate in pure yellows. Very few persons, for example, could distinguish with certainty between two pieces of cloth, one of which had been dyed with 1 per cent. of naphthol yellow and the other with 1·05 per cent. It is preferable to dye the yellows upon yarn which has previously been dyed a light blue, say with extract of indigo, but even then the results are not satisfactory.

Naphthol yellow occurs in the market under various names and of various degrees of strength. Some qualities are practically pure, others containing more or less sodium sulphate, or chloride.

Naphthol yellow forms, with a solution of Night blue, an insoluble precipitate; on this property is based the new method proposed. Night blue is the hydrochloride of tetramethyltolyltriamidodiphenylnaphthylcarbinol—



$$\{C_6H_4N(CH_3)_2\}_2C\langle^{C_{10}H_6NC_6H_4(CH_3)HCl.}$$

Other basic colours than Night blue do not answer as well. A standard solution is prepared by dissolving 10 grms. of Night blue in 50 cc. of glacial acetic acid and diluting with water to 1 litre. Solutions of the samples of Naphthol yellow are prepared so as contain 1 grm. per litre. The process is carried out as follows:—Ten cubic centimetres of the Night blue solution are measured into a small flask, and then about 30 cc. of the solution of yellow run in from a burette; the mixture is well shaken for about one minute and then poured on to a filter. If the filtrate be of a distinctly yellow colour a second experiment is performed in a similar manner with a smaller quantity of the solution of yellow; if the filtrate be blue or colourless, more of the yellow solution is added. These experiments are repeated with varying quantities of the Naphthol yellow solution till the filtrate possesses a very faint, scarcely perceptible, yellow tint. It is best to collect the filtrate in clear Nessler glasses. With a little practice, the number of experiments for each sample may be reduced to three or four. The value of the samples under examination will be in inverse proportion to the number of cc. required to precipitate 10 cc. of Night blue solution, *e.g.*, if of two samples one requires 28 cc. and the other 35 cc., their relative value will be as 35 : 28, or, centessimally, as 100 : 80. If it be desired to express the percentage of pure colour present in the samples, the night blue solution may be standardised by means of recrystallised Naphthol yellow S (the potassium dinitro-α-naphthol sulphonate). One grm. of *commercial* Night blue precipitates about 0·25 grm. of pure dry Naphthol yellow S. It appears that two mols. of Night blue combine with one mol. of Naphthol yellow S to form the insoluble precipitate. The method described is applicable to the valuation of the azo-dyes, but must be used in discretion in such cases. Colours to be compared must possess similar constitution, and it would not be correct, *e.g.*, to compare a Croceine scarlet with a Xylidine scarlet. But a number of specimens of either of these scarlets containing various proportions of either mineral or organic adulterations can be valued by the night blue process with great precision. Knecht, in conjunction with Kay and Appleyard, has applied this process to the valuation of picric acid, the picrate of Night blue being absolutely insoluble in water (J. Soc. Dyers and Colourists, **4**, 83). They also found that picric acid forms a similar insoluble precipitate with Crystal violet (hexamethyl pararosaniline hydrochloride), the said picrate having the formula—

$$C_{25}H_{31}N_3C_6H_2(NO_2)_3.OH.$$

—W. S.

Estimation of Tannin. C. Collin and L. Benoist. Monit. Scient. 1888, 364—366.

In the methods of Hammer and Löwenthal the tannin is absorbed by hide-powder. The error here is that not only is a portion of the acids absorbed mechanically or chemically derived from the tannin by decomposition, viz., gallic, lactic, butyric, and ellagic, but also the salts most frequently accompanying it: nitrates, chlorides, phosphates, magnesium salts, pectates, malates, and saccharine matters. The new process allows of the correct estimation of tannin in the presence of the acids and salts just mentioned.

The standard solutions are to be very carefully prepared, and they are as follows:—

(1.) *Standard Solution of Tannic Acid.*—Five grms. of absolutely pure tannic acid, dried either in an oven or in vacuô, are dissolved in 1 litre of distilled water; but before making up to the litre, 0·5 cc. of a 10 per cent. solution of mercuric iodide, dissolved in its own weight of KI, is added to preserve the tannic acid solution from fermentation.

(2.) *The Solution of Gelatin.*—Five grms. of gelatin are dissolved in 1 litre of hot distilled water, boiled, and cleared by addition of sufficient egg-albumen. After cooling, 0·5 cc. of the mercuric iodide solution last mentioned is added, and caustic soda to slight alkalinity.

(3.) *The Solution of Acetate of Lime.*—Fifty grms. of pure and dry acetate of lime are dissolved in 1 litre of distilled water and filtered, and a few drops of the mercuric iodide added.

(4.) Solution of pure Methylene Blue, 1 per cent.

(5.) „ „ Nicholson's Blue BB, 4 per cent.

(6.) „ „ Blue Black NBI, 1 per cent.

The Methylene blue may be used in estimating tannins not coloured; the other two solutions may be used at choice in estimating coloured tannins or extracts.

(7.) *The burette* must be graduated very accurately so as to measure the tenth of a cc. easily, and the mouth tapered so as to give at least four drops to the tenth of a cc. (The burettes used by the authors were specially constructed.)

(8.) *A graduated flask* with neck 3 cm. in diameter, and with a capacity for 60 cc.

Estimation of the Solution of Gelatin.—One cc. of the gelatin solution is placed in the flask, two drops of Methylene blue, and 5 cc. of the acetate of lime added, and distilled water at 75° to 80° up to the mark. From the graduated burette a little standard tannic acid solution is allowed to drop into the flask, a precipitate being formed. The flask is closed and shaken, and then let settle. The precipitate coagulates, and quickly rises to the surface of the liquid; the tannic acid is added till the liquid becomes colourless, the vessel being agitated after each addition. Burette read off. Having thus determined the amount of standard tannic acid needed for decolourising the volume of gelatin solution taken, in the second operation any solution of tannin may be substituted for it. The amount of tannin contained in it is found by comparison of the two results. If the solutions contained much tannin, it is advisable to dilute them with four or five times their volume of water, and if they are acid, to make them almost neutral by addition of a few drops of caustic soda. The solutions sterilised by mercuric iodide never change their strength. The method has been tried under various circumstances: Estimation of tannin solutions of different degrees of dilution; estimation in presence of organic matters; of the butyrates, gallates, lactates, gallic acid, and all the salts that accompany tannin as it occurs in commerce. The operation is only injured by the presence of a large proportion of gallic acid, but this difficulty can be overcome by adding a certain quantity of the standard solution of tannic acid so as to reduce the proportion of gallic to tannic acid, and deducting the amount added after the experiment.—W. S.

Determination of the Degree of Adulteration of Olive Oil with Cotton-seed Oil. E. Milliau. Monit. Scient. 1888, 366—367.

Purified cotton-seed oil is much used as an adulterant of olive oil, and it has become important to have a method for the tolerably exact determination of the amount of the former contained in the latter.

The method proposed is based on the reducing power of the fatty acids of cotton-seed oil, a property entirely wanting in the fatty acids of olive oil.

The Method.—In a porcelain basin of about 1 litre capacity, 15 cc. of the oil to be examined are heated to 110° C. At the same time 15 cc. of an aqueous solution of caustic soda at 76° Tw. are slowly added, and 15 cc. of 92 per cent. alcohol. When the mass on boiling becomes homogeneous, a sign that the saponification is complete, about 500 cc. of distilled water are gradually added so as not to lower the temperature of the paste, nor to make it thick. After boiling for a few minutes, the fatty acids are separated by means of a 10 per cent. solution of pure sulphuric acid. When the separation is complete and the sulphuric acid in slight excess, 5 cc. of the hydrated fatty acids are removed with a silver spoon to a test tube of about 3 cm. diameter and 12 cm. long. 20 cc. of 92 per cent. alcohol are now added, and the tube is heated on the water-bath till the fatty acids are dissolved. Then 2 cc. of a solution of pure silver nitrate (30 grms. in 100 cc. of distilled water) are added, and the tube is heated by the water-bath till about one-third of its contents is evaporated.

The operation is now finished. If the olive oil be pure, its fatty acids remain unchanged; if, however, it contains cotton-seed oil, no matter what proportion, the silver, reduced to the metallic state, blackens the fatty acids rising to the surface in a pasty condition. This reaction, similar to that of the aldehydes and very delicate, allows of the detection of cotton-seed oil in olive oil even in the proportion of only 1 to 100. The method avoids ordinary chances of error, since it deals not with the oil itself containing foreign matters, which might reduce too, but simply with the fatty acids extracted and free from every impurity.

Test for Sesame Oil.—On acting directly on an olive oil with hydrochloric acid, rose colourations are obtained with a perfectly pure oil. This tint arises from the colouring matters contained in the aqueous portion flowing out at the same time with the oil, when the pulp of the fruit is submitted to the press. On treating this aqueous portion with HCl, a colouration is obtained either rose or red, according to the proportion taken, answering exactly to the colouration of the sesame oil. Hence new olive oil may sometimes give a rose colour, though pure. On operating on the fatty acids, obtained as described already, taking care to deprive them of water at 110°, then putting them into a test tube with an equal of volume hydrochloric acid, a rose colouration is obtained, no matter what proportion of sesame oil is contained in the olive oil; *if the latter be pure the hydrochloric acid remains absolutely colourless.*—W. S.

Adulteration of Cocoa Powder. Samuelson. Chem. Zeit. 12, 722.

Sugar is frequently used as an adulterant for cocoa. To test for it, 20—30 grms. of the cocoa are shaken with 100 cc. of water for two hours, and after filtration the solution is decolourised with animal charcoal. The quantity of sugar is then estimated by the polariscope.—A. L.

Method for the Quantitative Estimation of Para Nitrotoluene. F. Reverdin and C. de la Harpe. Chem. Zeit. 1888, 787.

This method is based upon the observation that para-nitrotoluene, after treatment with fuming sulphuric acid, is converted by boiling with caustic soda solution into dinitrostilbene disulphonic acid, of which the strongly alkaline solution is dark red; while ortho-nitrotoluene similarly treated is not converted, and thus gives only a yellowish solution. Absolute ortho-nitrotoluene must first be produced by cohobating for 24 hours 100 grms. of the commercial ortho-compound with 25 grms. of caustic soda, 25 grms. of water, and 50 of alcohol, then diluting with water, acidifying slightly and distilling with steam. The para-compound, which is usually present to the extent of four or five per cent. at first, is more readily attacked by the alcoholic soda than is the ortho-compound; so that 70 grms. of purer ortho-nitrotoluene will result from this first purification. This product is then treated again in the same way, four-fifths of the distillate (=40 grms.) being retained and rectified over the open flame.

Two cc. of the pure ortho-compound are treated with 6 cc. of fuming sulphuric acid in a test tube, heated for three hours on a water-bath, poured into water and diluted to 1 litre, thus giving a 0·2 per cent. solution of ortho-nitrotoluene-sulphonic acid. A standard solution for comparison is now made by sulphonating a mixture of 96 per cent. ortho- with 4 per cent. para-nitrotoluene, diluting to 200 cc. and boiling 1 cc. of this solution with 5 cc. of a 10 per cent. caustic soda solution on the water-bath, by which a red colour due to para-nitrotoluene-sulphonic acid is produced. Simultaneously 1 cc. of the solution to be tested is similarly treated, and the colours of the two sulpho products compared. A known volume (20 to 50 cc.) of the para-sulphonic compound is now diluted with the 0·2 per cent. pure ortho solution until 1 cc. of the diluted solution gives the required colour on heating with 5 cc. of caustic soda. From this can be calculated the volume to which the original 200 cc. must have been diluted to give the same result. Supposing that the 200 cc. should have been diluted to 440 cc., then—

$$200:4::440:x=8\cdot8=\left\{\begin{array}{l}\text{Percentage of para-compound}\\ \quad\text{originally present.}\end{array}\right.$$

When the mixture contains less than 20 per cent. para-nitrotoluene, the error should not exceed 0·5 per cent., but with more impure substances the variation may be greater. The heating with soda should be continued at least 15 minutes, and the comparison should be made in tubes of equal diameter. By this method it is found that commercial ortho-nitrotoluene usually contains 4 per cent. of the para-compound.—W. G. M.

The Analysis and Constitution of Various Oils, especially those Used for Mordanting. Benedikt and Ulzer. Bull. Soc. Ind. Mulhouse, 1888, 257—277.

The method employed for determining the quantity of hydroxylated acid in a mixture of fatty acids was to introduce acetyl groups, the former only being transformed into acetyl-derivatives. From the proportion of caustic potash required on the one hand for neutralising, on the other for hydrolising such a body, an insight is gained as to the quantity of hydroxylated acid contained in the mixture. Rape-seed oil and castor oil require less alkali for neutralising than other oils, but no oil contains so large a proportion of hydroxylated acids as castor oil. Soluble castor oil, cotton-seed oil, and others contain considerably less, and an adulteration of castor oil with the former is therefore easily ascertained.

Oxidised oils or blown oils, such as soluble castor oil, which are prepared by passing air into the heated oil, contain a notable quantity of hydroxylated fatty acids. These oils are miscible with mineral oils and such mixtures are sold as lubricants. By the authors' method the quantity of hydroxylated acids and thence approximately the amount of vegetable oil in such a mixture may be determined.

With respect to Turkey-red oil, the sulphonic derivative of castor oil fixes about the same proportion of acetyl as ricinoleic acid. But the acids from olive and cotton-seed oils for Turkey-red combine with much larger proportions of acetyl after sulphonating than previous to this treatment. Moreover, the proportion taken up by the latter oils is far below that taken up by castor oil, whence a method for distinguishing Turkey-red oils of various sources.

When air is passed into heated cotton-seed oil the glycerides of the liquid fatty acids contained in it are converted into the glycerides of hydroxylated fatty acids. Commercial oleic acid treated in the same way is no doubt partly converted into hydroxystearic—possibly dihydroxystearic acid.

For determining the quantity of non-saturated acids in a mixture of fatty acids, Hübl's method of iodine addition is only satisfactory when an excess of alcoholic iodine, about 30 per cent. more than is theoretically required, is added, which excess is titrated back with hyposulphite (thiosulphate).

The authors next draw comparisons between the soluble acid from Turkey-red oil and a sulphonated fatty acid prepared by them by the action of sulphur on oleic acid and oxidation of the thio-compound thus obtained with permanganate. The resulting body has all the characteristics of a true sulphonic acid and is very likely the sulphonic acid of hydroxystearic acid, *i.e.*, the SO_3H is combined directly with a carbon atom. Now this acid greatly resembles the acid from Turkey-red oil. Thus, neither are altered by boiling with caustic alkalis. The only essential difference is that the synthetical acid is not decomposed by HCl, even when heated under pressure to 150°, whereas the other is readily decomposed into sulphuric and hydroxystearic acids by boiling with dilute HCl. The acid from Turkey-red oil is therefore no real sulphonic acid but a sulphuric ether.

With the view of comparing Turkey-red oils made from olive, cotton-seed, and castor oil, and in order to separate out the total quantity of fatty acid, the oils were treated with sulphuric acid, then boiled with KOH, much water added, and the solution boiled with sulphuric acid. On cooling, the fatty acids from cotton-seed oil solidify completely, those from olive oil less so, those from castor oil remain quite liquid, a very slight crystalline deposit forming after standing some time. Each of these portions was heated with acetic anhydride. From the products formed it may be concluded that in the above process, the oleic acid of the cotton-seed oil is finally converted into hydroxystearic acid. Ricinoleic acid is directly converted into an acetyl-derivative by acetic anhydride. The formula of sulpho-ricinoleic acid (soluble Turkey-red oil) is probably $C_{15}H_{31}.CH:C(O.SO_3H).COOH$.—A. R.

Extraction of p-*Toluidine.* G. A. Schoen. Chem. Zeit. 12, 494—495.

First of all the specific gravity of the mixed amides, which must be free from aniline and xylidine, is ascertained, and if more than 8 per cent. of para-toluidine is present, then *o*-toluidine must be added until the proportion is below that limit. One cc. of the oil is then mixed with 2 cc. hydrochloric acid and 30 cc. of water. When solution is complete 1 cc. of a cold saturated solution of potassium bichromate is added and the whole allowed to stand an hour with agitation from time to time. Under these circumstances *o*-toluidine gives a black lake and colourless liquid, both mixtures of *o*- and *p*-toluidine give a light brown precipitate and a red solution, which can be distinctly seen either in the filtered liquid or in the stain left by a drop placed on filter paper. The colour is more or less intense according to the quantity of para-compound present. These operations are then repeated with fast mixtures and the colours are compared; a difference of 1 per cent. is very distinct. When pure aniline is treated in a similar manner it gives rise to a black lake and colourless solution, but mixtures of aniline and *o*- and *p*-toluidine give red solutions the colour of which varies in intensity with the quantity of aniline present. Therefore, if it is desirous to estimate *p*-toluidine in such mixtures the amount of aniline can be judged by the boiling point and specific gravity, and the test solutions of the three amides should be made to contain the same proportion of aniline; then *p*-toluidine may be determined in the manner described.—D. A. L.

Influence of Inactive Substances on the Polaristrobometric Determination of Grape Sugar. R. Pribram. Monatsh. Chem. 9, 395—405.

In the determination of the amount of grape sugar in diabetic urine by means of the polaristrobometer, it is taken for granted that the inactive substances present exert no influence on the result. Acetone is often present; and as Tollens has shown that acetone increases the rotatory power of cane sugar, it seemed probable to the author that grape sugar would likewise be affected by the presence of this inactive substance.

Examination was therefore made of solutions of grape sugar containing varying quantities of acetone, and, as the following table shows, the rotatory power was found to increase with the amount of acetone. The amount of glucose in each solution was 15·68 grms. per 100 cc. The length of the tube was 20 cm.

Per Cent. of Acetone.	Angular Rotation (α D)	Difference.
0	16·587	..
4	16·711	+ 0·124
8	16·810	+ 0·223
12	16·915	+ 0·323
20	17·100	+ 0·513
40	17·622	+ 1·035

Thus it may be seen that—

$$\alpha D = 16{\cdot}587 + 0{\cdot}026x$$

where x represents the percentage of acetone.

The presence of acetone in diabetic urine need, however, only be taken into account when the percentage of sugar exceeds 5 and that of acetone 1 per cent.

On account of the increase in the quantity of urea, solutions of sugar, containing various amounts of urea, were examined. 100 cc. of each solution contained 15·797 grms. grape sugar.

Percentage of Urea.	α D	Difference.
0	16·714	..
4	16·693	− 0·021
8	16·621	− 0·072
12	16·590	− 0·121

Urea has thus the reverse effect on the results that acetone has, and the difference requires notice, especially in cases poor in sugar.

Ammonium salts decrease the rotatory power, as may be seen from the following table (100 cc. solution contained 16·46 grms. grape sugar):—

Percentage of Ammonium Carbonate.	α D	Difference.
0	17·392	..
2	17·249	− 0·143
4	17·194	− 0·198
6	16·908	− 0·484

Phosphates decrease the rotatory power very slightly.

A large number of determinations of grape sugar in urine were made by Worm-Müller, and results obtained by polarisation were, on the average, 0·35 per cent. less than those obtained by titration. The latter method is considered the more correct.—T. L. B.

Estimation of the Sugar in Beet. Bied. Centr. **17**, 408—412.

Petermann (Bullet. de l'Acad. Royale de Belgique **13**, 3—48) reviews the various processes for extracting the sugar, and quotes experiments of his own from which he concludes that extraction by alcohol of 25—50 grms. of the well-mixed pulp gives the best results, and is to be recommended for scientific laboratories, but digestion with alcohol is the quicker and simpler process for laboratories of sugar factories.

Pellet (Neue Zeits. f. Rübenzucker Ind. **19**, 315) recommends digestion with water as follows:—52·1 grms. of the pulp (for the German polariscope, for the French instrument 32·4 grms.) are brought into a graduated flask, 175 cc. of water and 5 cc. of lead acetate are added, and the whole made up to 200 cc. with water; the flask is closed with a rubber cork with a long condenser tube, heated for half an hour on the water-bath, cooled, and made up to 201·5 cc. If the liquid be alkaline a little acetic acid is added, and it is then polarised in a 400 cc. tube: if the reading be halved the percentage of sugar will be obtained.

Burkhard (Neue Zeits. f. Rübenzucker Ind. **18**, 181) discusses the different apparatus for the extraction with alcohol and recommends the following method:—52·1 grms. of pulp are brought into a 201·2 cc. flask, 10—15 drops of lead acetate added, made up with alcohol, digested for three-quarters of an hour at 75°, cooled, made up to the mark with alcohol, filtered, and examined in the saccharimeter.—A. G. B.

Distinction of Natural from Artificial Butter. C. J. v. Lookeren and H. Gerlins. Milch. Zeit. 1888, 164.

A small quantity of butter, sufficient to form one drop, is heated over a flame in a teaspoon until it gives off steam. It is then dropped carefully into some boiling hot water in a watch glass. Pure butter spreads out and forms a thin layer, suddenly breaking up with great rapidity into hundreds of little drops which quickly disperse to the edges of the water. On the other hand margarin, oleomargarin, vegetable oils, &c., form a fatty layer, dividing into large drops, which remain scattered over the water. With impure water the effect is different; for example, if ammonium chloride is present then pure butter gives much larger drops which go to the edge very slowly, whilst the margarin drops form quickly. Mixtures of butter with foreign fats behave as mixtures, the properties depending on the proportion.—D. A. L.

Formation of Saccharic Acid as a Reaction for Dextrose in Raffinose and other Carbohydrates; and of Furfurol as a Reaction for Arabinose. R. Gans, W. E. Stone, and B. Tollens. Ber. **21**, 2148—2152.

The authors give the following methods for the detection of various carbohydrates where the processes already known are either of doubtful value or unsuitable.

Dextrose can be detected by treating 5 grms of the carbohydrate with a suitable proportion of nitric acid sp. gr. 1·15 (generally 1:6). Saccharic acid is thus formed (Ann. **245**, 1), and can be identified by analysing the silver salt. Levulose, galactose, sorbose, and arabinose do not yield saccharic acid by this treatment.

Silver saccharate was obtained from 5 grms. of raffinose and larger quantities (200 grms.) yielded a crystalline acid having the same composition as saccharo-lactone, and so similar in properties that the acids may be identical. The same acid was also obtained from milk sugar.

Salep mucus contains dextrose. *Quince mucus* does not contain dextrose but arabinose (*see* below). Arabinose and all substances from which arabinose has up to the present been obtained do not yield levulinic acid when treated with sulphuric acid or hydrochloric acid. Arabinose, cherry-gum, traganth, and substances which are employed for the preparation of arabinose, yield considerable quantities of furfurol when 5 grms. of the substance is distilled with sulphuric acid of a certain concentration, whereas other carbohydrates yield distillates which only contain small quantities of furfurol as shown by the reaction with aniline acetate. To estimate the quantity of furfurol produced, the distillate is partially redistilled several times with common salt, the concentrated solution treated with ammonia, and the resulting furfuramide weighed. Arabinose yields about 20 per cent., and the gums, &c. from 5 to 9 per cent. of furfuramide. The quantity of furfuramide obtained from 5 grms. of dextrose, cane sugar, galactose, sorbose, and other carbohydrates is unappreciable, and the reaction of the distillate with aniline acetate is much feebler than in the case of arabinose, &c. Koch's wood-sugar, or xylose, yields however, a large quantity of furfurol. The authors have obtained crystalline carbohydrates from wheat-bran, and especially from the undissolved portions of the malt remaining in the manufacture of beer. These carbohydrates are nearly related to arabinose, one crystallises in needles and has the specific rotatory power $\alpha_D = 103^\circ$.

Carragheen moss gives no appreciable quantity of furfuramide.—F. S. K.

PATENT.

Improvements in Filtering Funnels. B. Nickels, London. Eng. Pat. 4831, March 29, 1888. *6d.*

The specification describes an improvement on the filtering funnel patented by W. C. Nickels (Eng. Pat. 8375, 1886), consisting of an outer jacket or casing which can be heated by steam, hot water, &c. The jacket is provided with an inlet, outlet, and a tube for the insertion of a thermometer.—C. C. H.

New Books.

PRAKTISCHES HANDBUCH DES ZEUGDRUCKS. Herausgegeben von Dr. Eduard Lauber, unter Mitwirkung von Dr. Josef Langer und Maryan Zelazowski. Fabrikations-Band (zugleich Supplement zu Band II.) zu Lauber's praktischem Handbuch des Zeugdrucks. Moskau: Im Selbstverlage des Herausgebers. 1887. Leipsic: Fur den Buchhandel in Commission bei Gustav Weigel. Bureau der Färberei-Muster-Zeitung. London: H. Grevel and Co., 33, King Street, Covent Garden.

OCTAVO volume, in paper cover, with Preface, 178 pages of Subject-matter, interspersed with some 74 specimens of dyed and printed patterns illustrating the various styles of work treated of. The work ends with an Alphabetical Index.

A further volume treating entirely of dyeing is promised in the course of this year.

ADRESSBUCH UND WAARENVERZEICHNISS DER CHEMISCHEN INDUSTRIE DES DEUTSCHEN REICHS NEBST DEN ZOLLTARIFEN ALLER LÄNDER FÜR CHEMIKALIEN. Herausgegeben von Otto Wenzel. Gen. Sekret. des Ver. zur Wahrung der Int. der Chem. Ind. Deutschlands. 1888. I. Jahrgang. Berlin: Verlag von Rudolf Mückenberger, Dessauerstr. 13. London: Sampson Low, Marston, Searle and Rivington.

LARGE 8vo volume, bound in cloth, and consisting of a Directory and List of Products of the Chemical Industries of the German Empire. It is divided into three principal parts, designated A, B, and C. That classified as A covers 453 pages, B covering 184 pages, and C 33 pages. A represents a List of the Chemical Manufactories and Laboratories, followed by a Geographical review. Next comes a List of Chemicals, with names of the Manufactures, and further, a List of Agencies, Wholesale Houses, Export and Import Houses in Germany and other countries. It closes with a List of the Directors of Unions and Associations connected with Chemical Industry, followed by some Literary Notices. Under B is given the Customs Duties on Chemicals in all countries, and the Import and Export Duties on Chemicals in the German territory. C is a business advertiser for articles required in chemical works, (1) giving information as to markets of supply, and (2) advertisements.

Trade Report.

(From the Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

CUSTOMS TARIFF OF NEW ZEALAND.

Articles.	Rates of Duty.	£	s.	d.
Spirits, methylated	Gallon	0	15	0
Spirits and strong waters mixed with any ingredient, in any proportion exceeding 33 per cent. of proof spirit, and although thereby coming under the designation of patent or proprietary medicines, or under any other designation	„	0	15	0
Lime or lemon juice, sweetened or aërated	20 % *ad val.*			
Syrups	20 % *ad val.*			
Glucose	Lb.	0	0	1
Blue	„	0	0	2
Paints and colours mixed ready for use	Cwt.	0	4	0
„ „ ground in oil	„	0	2	0
Soap, common	„	0	5	0
Soap powder, extract of soap, dry soap, and soft soap	20 % *ad val.*			
Starch	Lb.	0	0	2
Stearine	„	0	0	1½
Varnish	Gallon	0	1	0
Washing powder	20 % *ad val.*			
Acetic acid	Lb.	0	0	3
Filters	20 % *ad val.*			
Glycerin, refined	15 % *ad val.*			
Patent and proprietary medicines and medicinal preparations	25 % *ad val.*			
Pearl ash, potash, and caustic potash	15 % *ad val.*			
Sarsaparilla	25 % *ad val.*			
Soda ash and soda carbonate	Cwt.	0	1	0
Ink, writing	20 % *ad val.*			
Firebricks and fireclay goods	20 % *ad val.*			
Cement	Barrel	0	2	0
Photographic chemicals	15 % *ad val.*			

The following additional articles are now free of duty:—

Cochineal, gum arabic, and tragacanth, shale waste or unrefined mineral oil, strychnine, and crude tanning materials.

SWITZERLAND.

Customs Decisions.

Quintal = 220·4 lbs. avoirdupois. Franc = 9$\frac{1}{2}$d.

Bromide of sodium.—Category 17. Duty, 1 franc per quintal.

All combinations of bromine (with the exception of bromide of sodium), such as bromide of ethyl, of ammonium, baryum, calcium, lithium, &c.—Category 18. Duty, 2 francs per quintal.

UNITED STATES.

Customs Decisions.

Certain paper in rolls, commercially known as "ferro-prussiate paper," which is intended to be specially used for solar photograph printing, is held to be dutiable at the rate of 15 per cent. *ad* *valorem*, as "manufactures of paper," under Schedule M. (T. I., 388), inasmuch as it appears that the paper proper, after manufacture, has been subjected to a further process by having one of its surfaces treated with a preparation composed of prussiate of potash and ammonia citrate of iron, which fits it for the special use above-mentioned.

Certain so-called "clarifying-powder," which is reported to consist of a preparation for clarifying white and red wines, and to be a compound of tannic acid and the sulphate of potash and alumina, is held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 92) for "all chemical compounds and salts, by whatever name known," &c.

MISCELLANEOUS TRADE NOTICES.

TRADE OF PARAGUAY.

The *Handels-Archiv*, in an article on the trade of Paraguay, states that the articles which are imported with the greatest success into that country are sugar, coffee, furniture, glass, hats, clothes, drugs, and spirituous liquors. The most important articles of export are the *yerba mate* or Paraguay tea, tobacco, cedar planks, building wood, skins of cattle, trunks of palm trees, and essence of orange leaves. The last-mentioned article is at present that which is most in request from Paraguay. The German merchants have discovered that it is cheaper to import orange-leaf essence directly than to give three times the price for it in France. The manufacture increases every year, and as Paraguay is covered with forests full of bitter oranges, there is no reason why it should not continue to supply the markets of the world with this essence.

COMMERCIAL MUSEUM AT TANGIERS.

The *Recueil Consulaire Belge* states that in the course of the month of October an International Commercial Museum will be opened in the city of Tangiers, in Morocco, for the purpose of encouraging trade between that Empire and foreign countries, and of familiarising the Morocco merchants with articles imported from Europe. It is expected that the opening of this museum will exercise an extraordinary influence on the commercial future of Morocco.

COMMERCIAL MUSEUM AT MILAN.

The *Schweizerisches Handelsamtblatt* states that, although opened so recently as June 1886, the Milan Commercial Museum has already rendered important services to Italian industry. During 1887 a great deal of business was effected entirely through the museum, and the Italian Government is beginning to awaken to the value of this institution. It has lately shown this by an increase in the subsidy. The museum publishes a bulletin twice a month, describing all specimens received since the last publication, and adding all such facts and general information as can be deemed important in the interests of Italian export trade.

COMMERCIAL MUSEUM AT BUDA-PESTH.

According to the French *Journal Officiel* for the 12th July last, the Belgian Consul-General at Buda-Pesth reports very favourably of the usefulness of the Commercial Museum of Buda-Pesth. This museum has been established by the Austro-Hungarian Ministry of Commerce, and its budget is covered by a subsidy from the Government, augmented by contributions from the Chamber of Commerce, from the Austrian Lloyds, and from various societies.

The object of the Buda-Pesth museum is not, like that of Brussels, to show to producers specimens of the articles in demand in foreign markets, but solely to exhibit whatever is manufactured in Hungary, and thus to place the Hungarian nation in a position to know what its own products consist of. It is not merely an exhibition, but a vast market as well, and it occupies the large spaces engaged for the Pesth Exhibition of 1885. The only articles excluded are those which are excessively cumbrous or dangerous, as locomotives on the one hand, and explosives on the other.

COMMERCIAL MUSEUM AT OPORTO.

The *Recueil Consulaire Belge* says that the Commercial Museum opened at Oporto on the 21st of March of last year has proved a great success. It contains very numerous specimens of all the small domestic trades of Portugal. From January to April of the present year 8,251 persons visited it. Most of the articles exhibited are Portuguese, for very few foreign manufacturers have made any response to the invitation to send their products to the Oporto Museum.

COMMERCIAL MUSEUM AT FRANKFORT.

The French *Journal Officiel* for the 25th July last states that, according to the annual report of the Frankfort Chamber of Commerce, 6,536 persons visited the Commercial Museum in that town during 1887. The condition of the museum is in every way satisfactory, and its collections are being rapidly added to.

BUREAU OF COMMERCIAL INFORMATION AT VIENNA.

The *Bulletin du Musée Commercial* for the 30th June last says that the Vienna Chamber of Commerce established, two years ago, a Bureau of Commercial Information respecting Russia, Italy, Turkey, the Danubian countries, Spain, Portugal, South America, Africa, and Australia. This bureau was instructed to centralise all information respecting trade and industry in these several countries received from the various Austro-Hungarian Consulates.

This step has produced the most satisfactory results to Austrian commerce, which has thus been able to work on accurate data.

The Minister of Foreign Affairs has recently proposed to the Vienna Chamber of Commerce to extend to Germany, France, England, Belgium, and the United States the system of this information, and thereby widen its sphere of usefulness.

THE COMMERCIAL INFORMATION OFFICE AT BELGRADE.

The *Revue de l'Orient* for the 24th June last contains the following information respecting the Commercial Information Office at Belgrade, the establishment of which was notified on p. 55 of the July number of the *Board of Trade Journal* :—

The Servian Minister of Commerce is now making every effort to increase the export trade, to give confidence to the commercial world abroad, and to furnish every guarantee to capital employed in Servia.

In order to achieve this result, the Minister has founded, at Belgrade, a commercial agency in the interests of Servian exportation. The principal object of this institution is to place the foreign consumer in direct relation with the home producer. Foreign traders and merchants intending to make wholesale purchases of Servian produce have only to address themselves, orally or by letter, to the Belgrade agency, which will supply gratuitously every information in respect to the purchase and sale of any kind of merchandise and produce. The reply will give the details required respecting the state of production, price, means of transport, import, and Customs duties. The agency also engages to act as an intermediary between foreign producers and home consumers. It will further endeavour to facilitate transports and to obtain reductions in tariffs of native and foreign railways.

The Government has given instructions to préfets, sous-préfets, and mayors, requesting them to assist in any case foreign merchants and manufacturers; the latter will thus be informed of the commercial laws and customs in vogue in Servia, of the manner in which bargains are made, of the method of drawing up contracts, and of giving them the force of law, &c. The agency will reply to letters written not only in Servian but in all European languages.

BELGIAN GLASS WORKS.

A letter from the French Vice-Consul at Charleroi, printed in the French *Moniteur Officiel du Commerce* for the 12th July, states that the condition of the Belgian glass manufactories is growing worse and worse. There is some increase in the exportation of the rougher sorts of glass, especially in that of bottles, to France, but the prices continue to fall steadily, and there is even less demand for the finer kinds of cut and gilt glass. The exportation of this latter class of goods, which amounted to 2,130 tons in 1885, was only 1,620 tons in 1886, and sank to 775 tons in 1887. The export trade in Belgian window glass is still very large. Great Britain and the United States are the principal consumers, China and Japan and the Argentine Republic come next, followed at a considerable distance by France, Italy, and Switzerland. The Vice-Consul reports, from the Charleroi district, a great improvement in the mutual attitude of masters and men.

LIGNIN: A PRIZE OFFER.

The Union for the Advancement of Industry in Germany offers a prize of 80 dollars to any technical chemist who will find out all the facts about lignin, and an additional 40 dollars for facts in the problem of its sulphite treatment. The Union of Cellular Snuff Manufacturers also adds 40 dollars more as a second prize. Lignin is well known to cause the yellowing of paper made from wood pulp, and the removal of this property would remove the chief problem in the use of wood in cellular-stuff manufacture.—*British and Colonial Druggist.*

RUSSIAN TRADE IN DRUGS AND DYESTUFFS.

The following figures refer to the imports and exports of pharmaceutical articles and drysalteries from and into Russia in the years 1886 and 1887. The weight unit given is the pood (36·1 lbs.), and the value is expressed in roubles.

Imports.

—	1886.	1887.	1886.	1887.
	Poods.	Poods.	Roubles.	Roubles.
Caustic soda and potash	860	790	1,880,000	1,892,000
Chemical and pharmaceutical preparations, unenumerated	144	126	3,586,000	3,067,000
Hydrochloric acid	481	604	1,047,000	1,238,000
Cocoanut oil, palm oil, and glycerin	174	199	966,000	1,100,000
Dyestuffs..............	3,208	2,887	12,935,000	12,973,000
Glassware	..	..	1,716,000	2,387,000
Olive oil	689	913	8,040,000	8,976,000
Soda, pearl ashes, potashes ..	750	1,140	1,078,000	1,871,000

Exports.

—	1886.	1887.	1886.	1887.
	Poods.	Poods.	Roubles.	Roubles.
Hemp seed	796	1,030	988,000	1,184,000
Linseed	10,209	19,720	14,545,000	26,871,000
Oils (illuminating)	9,195	11,820	..	..
Rape seed	4,478	6,531	3,479,000	6,617,000
Crude petroleum	1,257	1,078	..	..
Oils (lubricating)	2,229	2,801	..	..
	Degrees	Trall.		
Alcohol	616,125	650,650	8,985,000	8,775,000

EXTRACTS FROM BRITISH AND FOREIGN CONSULAR REPORTS.

China.

Aniline Dyes at Chinkiang.

The imports of aniline dyes at Chinkiang have increased in value from 8,657*l.* in 1886 to 9,945*l.* in 1887, and are used to dye the finer kinds of cotton cloth. The colours derived from them soon fade, and they compare unfavourably in this respect with native dyes. Indigo is still grown here in increasing quantities every year, and hardly suffices to supply the demand for dyeing the larger imports of foreign shirtings. The aniline dyes come chiefly from Germany—Lembke, Gipferich, Baumfeldt, and Offenbach being the chief names. English manufacturers who could impart more permanency to their dyes would obtain a large sale in Chinkiang.

Soap, Foreign and Native.

Among other imports, foreign soap (21,259 boxes) is for the first time recorded as having arrived. This is very gratifying, and there are ample opportunities in China for a further extension of this import. The Chinese only use of their own manufacture an alkaline earth and soap beans. The imports of native soap have increased from 357,497 lbs. in 1886 to 1,318,094 lbs. in 1887. It is made from an efflorescence which appears on the ground in the early morning, and comes from the country in the vicinity of the Yellow River breach. Rain destroys it; and the unusually dry weather of this autumn has been favourable to its production. The sun also melts it, and it must be gathered in the very early morning. It is, after collection, boiled for some time, the scum removed, the useful part sinking to the bottom; the water is then drained off, and the residue mixed with alkali. This is then placed in boxes, and is ready for sale. It is chiefly used to wash clothes; soap beans, the pods of the tsao-ko tree, being preferred for the hands.

Vegetable Tallow and White Wax.

Vegetable tallow has also increased from 6,731,600 lbs. to 7,106,748 lbs., and white wax from 85,066 lbs. to 118,599 lbs. The former costs 26*s.* to 27*s.* a picul, and comes from Hu-pei and An-Hui; the latter, costing 175*s.* a picul, comes from Sze-Chuan. These two articles are used to make the large candles used in temples and the dips used by the poor and by the boating population. The body of the candle is made from the tallow, and a layer of wax is placed outside to prevent rapid melting. These candles are also placed in lanterns for illuminating purposes.

Varnish.

Varnish, used to polish furniture and the interior of houses, takes the place with the rich of wood-oil among the poor. It costs 146*s.* a picul, and the imports have increased from 181,000 lbs. to 210,577 lbs. Prices have been high this year, as it has been largely in demand for coffins, which the Chinese think it lucky to make in a year with an intercalary month. It is produced in Yunnan, Kwei-Chow, Shensi, and Sze-Chuan, and is made from the sap of Huai trees. The sap exudes at the rate of a picul a day per tree. The best comes from Yunnan. It will not keep over a year, when it becomes too liquid for use.

Germany.

The Chemical Trade at Frankfort-on-Maine.

The chemical business showed an increase during 1887, though prices continued depressed. Ammonia preparations were in demand, whilst in the manufacture of soda the situation appeared rather unfavourable, the ammonia process of manufacturing soda having almost superseded the process adopted by Leblanc, so that the makers show a marked preference for the former system. Aniline dyes were more in demand. Although foreign competition is felt more every day, the advantages which the German industry enjoys appear to be up to all requirements.

Frankfort Soap and Perfumery.

The manufacture of perfumery and soaps is very considerable in this city, and the results obtained in 1887 are satisfactory. It is to be mentioned that Paris and London manufactures are preferred in Germany, although experts maintain that the superiority of German makes was acknowledged long ago. The export to England, considerable as it was, is much affected by the new Merchandise Act.

Italy.

Manures.

The British Consul at Florence reports that artificial manures have begun to be used in the province of Florence, but not as yet to any large extent, as their effect not being immediate, impatient proprietors lose faith in the beneficial result. There are three artificial manure factories in the neighbourhood of Florence, but one will probably soon be closed.

Morocco.

Candles.

There has been a marked increase in the value of candles imported at the ports of this district during the past year, viz., 15,485*l.*, as against 10,095*l.* in 1886, and it is satisfactory to note that English paraffin candles are now in great demand, and have firmly established themselves in this market, whereas, two years ago, they had scarcely any sale. England has, however, in this trade a dangerous rival in Germany, whose manufacturers generally make up their candles in imitation of the English, wrapping and packing them in the same manner; they also offer facilities to importers by making them in any size and weight required, and it has been found that there is a readier sale for thinner candles made up in packets resembling the English pound packets, but lighter, and consequently sold at an apparently cheaper rate, though really at a greater profit.

Chemicals and Drugs.

The principal chemicals and drugs imported are nitre from England and arsenic from France.

Roumania.

Drugs and Chemicals.

The imports of drugs, chemicals, and drysalteries into Roumania during the years 1886 and 1887 have been as follows:—

—	1886.		1887.	
	Tons.	£	Tons.	£
Vegetable essences and drugs	1,572	57,177	1,909	72,772
Perfumery	37	9,300	29	6,988
Chemical products	3,476	125,388	2,237	148,591
Dyes, varnish, &c.	1,177	57,357	1,708	73,061
Oil, tallow, wax, &c.	2,830	140,209	2,358	104,770

Spain.

Hints to British Traders.

The practice of German manufacturers to send young men to find out the needs of the people, to learn their language and industrial powers, is not being followed by English manufacturers, though no doubt the latter would be able, with English goods, to compete with Spanish manufacturers. Of course we must expect imitation and competition from the industrious and intelligent Catalan people; but we have something worse than that now; they do not imitate for the sake of imitating English goods, for their colours, designs, &c. are produced from the brain and the natural taste of the people; but they put up the native wares for sale as English, and no patents or trade-mark will protect our goods, or prevent the Catalans from imposing their wares as English make and English production. High-class goods have found good sales during the year, and they will no doubt continue to find an excellent market; but this success may be short-lived, because foreign manufacturers come here and manufacture for themselves what the Catalans may not have yet learnt to make. It is a mistake to suppose that Barcelona is not able to absorb the finest articles manufactured in England; wealth and pride do it, and the rich will go to any expense to obtain the finest articles made.

Imports and Exports.

The countries from which Barcelona imports most are, in order of importance, the United States, Germany, France, and the United Kingdom. The exports of Barcelona mostly go to Mexico, the Argentine Republic, Italy, the United Kingdom, and France. The imports included, in 1887, 57,364 tons of drugs and chemicals and 108 tons of mineral waters.

The Alcohol Question.

There has been a good deal of trouble in Barcelona last year about the question of the importation of foreign alcohol. Those who desired the introduction declared that it was necessary to the fortifying of their wines, as they could not distil, for many reasons, Spanish wines into spirits to elaborate the weaker and deteriorated wine. Those who opposed the introduction denounced the German alcohol as poisonous and deleterious to health and morals, but all agreed that the stuff introduced generally was rubbish, and unfit for drinking purposes. The controversy continued for months, when a Royal order was promulgated that all spirits imported into Spain were to be subjected to strict examination, and that those found not properly rectified should be rendered unfit for mixing with wines.

Quicksilver.

The British Vice-Consul at Seville says:—Although there is a decrease in the quantity of quicksilver shipped, it does not mean that less is produced at the mines of Almaden, but that other ports get a larger share of the supply. This is because only comparatively small steamers come here, and, as quicksilver is an article of great value, it will not be trusted to boats that have not Lloyd's highest classification, on account of increased insurance.

Drugs and Chemicals.

The British Consul at Cadiz reports that drugs and chemicals show an increase to the value of 16,710*l*. as compared with 1886, during which year the imports were to the value of 44,830*l*. Great Britain supplies about half the quantity of these articles.

TURKEY.

Drugs, Perfumery, Soap, &c.

The French Consul at Salonica says that the annual value of drugs imported from France is between 6,000*l*. and 8,000*l*. The public here attach considerable importance to good pharmaceutical products, and as a rule give the preference to French goods, though England, Austria, Italy, and Belgium are competitors. There is a good sale for sulphate of quinine, owing to the prevalence of fever. Bottles containing 18 grammes (4·63 drachms) are sold at about 3*s*. 7*d*. each. He adds that there is room for a large trade in ordinary toilet soaps in small sizes, of different shapes and colours, and also advocates the sending of small perfume bottles in the form of fruit, animals, &c. The expensive kinds have only a very small sale. According to the French Consul at Adrianople, the following goods are ready sale in the country:—Colonial products, drugs, medicines prepared, perfumery, soaps, essences, and pomades.

UNITED STATES.

Drugs, Soap, and Perfumery.

According to the German official *Handels-Archiv*, drugs are only imported into San Francisco direct from Germany to a small extent, being chiefly brought through New York. One of the largest firms here has an agent in London, who buys all the goods needed from Europe. Soap and perfumery are almost entirely bought from home manufacturers.

CHILI.

Drug Exports.

The following are values of the principal articles of pharmaceutical interest exported from Chili during 1885 and 1886 in Chilian silver dollars, equal to 3*s*. 2*d*. sterling:—

—		United Kingdom.	Germany.	France.	United States.
Beeswax	1885	20,865	36,258	5,694	..
	1886	23,238	42,712	15,068	..
Honey	1885	32,251	40,571	29,569	..
	1886	45,470	45,011	24,805	..
Iodine	1885	1,352,050	606,120	..	609,150
	1886	1,070,760	274,550	..	401,080
Quillaya	1885	12,600	24,695	10,964	..
	1886	19,479	28,851	32,154	3,727

ITALY.

Tartar Materials at Barletta.

The dregs left in the boilers in which grapes have been treated for the manufacture of alcohol are pressed, and the watery substance thus gained is led into wood reservoirs, where it forms, by cooling, another important article of commerce, viz., half-refined tartar, of which about 450 tons, worth 1,000,000 francs, are produced every year, and exported to Germany, France, the United States, and also, though in very small quantities, to England. A limited company with a capital of 500,000 francs has been formed, with the intention of working these tartars into cream of tartar and tartaric acid, and it is expected that they will begin work during the coming autumn. Wine lees are also prepared in this district by pressing, and then drying up the residues of wine which form in the casks where the wine is kept. About 500 tons yearly of this stuff, to the value of 300,600 francs, is exported to Germany and France. The exports were as follows:—

—	1887.		1886.	
	Tons.	Francs.	Tons.	Francs.
Tartar	450	1,000,000	500	1,200,000
Wine lees	500	333,333⅓	600	300,600

Drug Imports into Naples.

During the year 1887 Naples imported from abroad 242,387*l*. worth of drugs, colonial produce, and tobacco, against 553,795*l*. in the preceding year. Of chemicals, medicines, and perfumery, 90,727*l*. were imported in 1887, and 149,468*l*. in 1886.

TURKEY IN ASIA.

The Drug Trade.

The consumption of drugs and chemicals in Smyrna is very considerable, and in 1887 alone over 1,500 packages were landed, not counting a large number of cases containing quinine preparations, mostly of inferior quality. London, Paris, Vienna, Stuttgart, and Milan have most of the Smyrna trade. The importation of German drugs, especially febrifuges (a very large article of consumption in the Levant), has much increased since 1885. Among chemicals, which are mostly procured from England, France, and Italy, and lately also from Germany, sulphur, soda, and potash salts are the principal ones. Sicilian sulphur is much used to combat the oidium or blight in the vines, while English soda finds a continually increasing employment in the flourishing local soap industry. The use of potash for drying grapes is also increasing. This article is procured from England (*viâ* Amsterdam, the cheapest route), Austria, and very largely from Cologne.

TURKEY IN EUROPE.

Chemicals for Salonica.

A noteworthy feature in British trade at Salonica is the increasing demand for chemicals from England, caused by the development of native industries in Monastir and other districts in Macedonia. The importers, however, complain that most of these chemicals, copperas in particular, are packed in barrels made of thin staves, badly jointed and hooped, and not fit for inland carriage. The prices paid are as follows:—Indigo, Madras, 2*s*. to 3*s*.; Kurpah, 3*s*. to 4*s*.; Bengal, 4*s*. 10*d*. to 6*s*.; cochineal, 1*s*. 4*d*. to 1*s*. 6*d*. per lb.; alum, 6*s*. to 6*s*. 5*d*.; copperas, 3*s*. 6*d*. to 4*s*.; and sal-ammoniac, 36*s*. to 38*s*. per cwt.

STATISTICS.

MINERAL STATISTICS OF THE UNITED STATES IN 1887.

Copper.

Total production 184,670,524 pounds, of which 3,750,000 pounds were made from imported pyrites. The total value was 21,052,440 dollars, at an average of 11·4 cents per pound. The estimated total consumption of copper in the United States increased by about 14 per cent.

Lead.

The production of lead was 160,700 short tons, valued at 14,463,000 dollars at 90 dollars per short ton. The heavy increase of "desilverised" lead from 114,829 short tons in 1886 to 135,552 in 1887 was probably due to the importation of Mexican lead-silver ores. The large product of non-argentiferous lead, 25,148 short tons, is due chiefly to the development of the Saint Joe district in Missouri. The production of white lead and the several oxides from pig-lead increased to a total of about 75,000 short tons.

Zinc.

The producers' returns show an increase from 42,641 short tons in 1886 to 50,340 in 1887. The price increased to 4¾ cents per pound, making the total value in 1887 4,782,300 dollars. The production of zinc oxide was practically steady at 18,000 short tons, valued at 1,440,000 dollars.

Quicksilver.

Production and value increased from 29,981 flasks, valued at 1,060,000 dollars, to 33,825 flasks, valued at 1,429,000 dollars. Except 65 flasks from Oregon, the total supply came from California. The price in 1887 varied from 36·50 dollars to 48 dollars per flask in San Francisco.

Nickel.

The supply includes 183,125 pounds of metallic nickel, valued at 117,200 dollars, 10,846 pounds of metallic nickel contained in matte, and 11,595 pounds contained in nickel ammonium sulphate. Total value, 133,200 dollars.

Cobalt Oxide.

The product includes 5,769 pounds of cobalt oxide for potters' use and 12.571 pounds of oxide in matte exported to Europe. Total value 18,774 dollars.

Chromium.

Shipments from California increased to 3,000 tons on account of better freight facilities by rail to the Eastern States. The total value in San Francisco was 40,000 dollars.

Manganese.

The total production of manganese ore in the year ending 31st December 1887 was 34.524 tons, valued at 333,844 dollars. The production of manganiferous iron ore was 211,751 tons, valued at about 600,000 dollars. The production of argentiferous manganese ores was 60,000 tons, valued, chiefly for its silver, at about 600,000 dollars.

Antimony.

The production, all in California, was 75 tons, valued at 15.500 dollars. This is an increase from 35 tons in 1885, valued at 7,000 dollars.

Aluminium.

The production of aluminium bronze containing 10 per cent. aluminium increased to 144,764 pounds in 1887, valued at 57,905 dollars. Other alloys, principally of iron and aluminium, amounted to 42.617 pounds, worth 17,000 dollars.

Platinum.

Considerable search by dealers produced 448 ounces of crude platinum, valued at 1,838 dollars. Part of this came from British Columbia.

Coke.

The total production of coke in the United States for the year ending 31st December 1887 was 7,857,487 short tons, valued at 15,723,574 dollars. This is the greatest product ever reached in the United States, being 1,022,419 tons greater than in 1886.

Petroleum.

Total production, 28,249,543 barrels of 42 gallons each. The total value at an average of 60 cents was 16,949,726 dollars. The increase over 1886 was very slight, only 139,428 barrels. There was a decrease of 11¼ cents per barrel in the average price.

Natural Gas.

The production of natural gas in the United States in 1887 was equivalent to 9,055,000 short tons of coal displaced. This, at an average value of 1·50 dollars a ton, would make the value of the coal displaced by natural gas (which is the measure of the value of the gas) 13,582,500 dollars. In 1886 the corresponding quantity was 6,353,000 tons, worth 9,847,150 dollars.

Cement.

The production of cement from natural rock was 6,692,744 barrels, valued at 77½ cents per barrel, making 5,186,877 dollars as the value of the year's product.

Corundum.

Total production from North Carolina and Georgia, 600 short tons, with a spot value of 108.000 dollars.

Novaculite.

Production, 1,200,000 pounds, valued in the rough state at 16.000 dollars.

Infusorial Earth.

Maryland produced 3,000 tons, worth 15,000 dollars.

Precious Stones.

The value of American gems in the rough state amounted to 88,000 dollars, besides gold quartz for specimens and gems, valued at 75,000 dollars.

Phosphate Rock.

South Carolina phosphate rock, 480,558 long tons, valued at 1,836,818 dollars, an increase of 50,009 tons, but a decrease of 36,118 dollars in the value, due to greater competition, reducing the price to 3·75 dollars for land and 4 dollars for river rock.

Marls.

In New Jersey the production is estimated at 600,000 tons, worth about 300,000 dollars. While the New Jersey marl is yielding slowly to commercial fertilisers, the Virginia marls, as well as those in North and South Carolina, Georgia, Mississippi, and Florida, are finding increased local use.

Salt.

Production in 1887, 7,831,962 barrels (of 280 pounds); value, 4,093,846 dollars. The annual production has increased each year since 1883, but the total value has declined, being less in 1887 than in 1884, although only 6.514,937 barrels were made in that year.

Bromine.

Stocks accumulated in 1886 and reduced the output of 1887 to 199,087 pounds, valued at 61,717 dollars. The price was held at 31 cents per pound.

Borax.

Production 11,000,000 pounds, all from California and Nevada. Total value, 550,000 dollars, at 5 cents per pound for the average grade. The price was rising at the close of 1887.

Sulphur.

Production about 3,000 tons, from Utah, worth 100,000 dollars. Litigation checked the use of an increased plant. The imports of Sicilian sulphur, with small shipments from Japan, were 98.882 long tons, valued at 1,688,360 dollars.

Pyrites.

Production 52,500 long tons, valued at 210.000 dollars, at 4 dollars per ton at the mines.

Barytes.

The production increased to 15.000 long tons of crude barytes, valued at 75,000 dollars at the mines.

Gypsum.

The condition of the industry is practically unchanged. The estimated total product was 95,000 short tons of crude gypsum, valued at 425,000 dollars. In addition, 162.154 long tons of crude gypsum were imported, chiefly from Nova Scotia.

Mica.

The production increased to 70.500 pounds, valued at 142.250 dollars. The increase was chiefly in North Carolina. New Hampshire, Massachusetts, and Virginia also produced mica. No shipments were reported from the Black Hills or New Mexico. The use of mica waste is increasing; 2,000 tons, worth 15,000 dollars, were ground in 1887.

Felspar.

The amount consumed, principally by potters, was 10,200 long tons, valued at 56,100 dollars before grinding. This includes freight to the principal markets, Trenton or New York. The consumption in 1886 was about 5,000 tons less than the production returned by quarrymen.

Flint.

For pottery 19,800 tons were used. Including the use for sandpaper and in glass manufacture, the total consumption was about 32,000 tons, worth, unground, 185.000 dollars.

Potters' Clay.

The consumption of kaolin and ball clay by potters aggregated 28,000 tons, valued at 290,000 dollars. In addition, the potters used 15,000 tons of fireclay, worth 50,000 dollars.

Asbestos.

The total product hardly exceeded 150 tons, worth 4,500 dollars. In addition, several hundred tons of fibrous actinolite were used for weighting paper.

Mineral Paints.

Including ochre, metallic paints, and small quantities of umber and sienna, the production amounted to 20,000 long tons, selling for 310,000 dollars at the mines.

Graphite.

The production at Ticonderoga is reported as unchanged. Small lots, ranging from graphitic clay to pure graphite, were produced in North Carolina. Total production, 416,000 pounds, worth 34,000 dollars.

Fluorspar.

The production remained constant at 5,000 tons in Indiana. The total value was 20,000 dollars.

Mineral Waters.

The product which was sold amounted to 8,259,609 gallons, worth 1,261,473 dollars.—*Engineering and Mining Journal, New York.*

PRODUCTION OF PIG-IRON AND STEEL IN THE UNITED STATES IN 1888.

The American Iron and Steel Association has received from the manufacturers complete statistics of the production of pig-iron, Bessemer steel ingots, and Bessemer steel rails in the United States in the first six months of the present year. These statistics are not only complete but they are accurate; they are not "estimated."

TOTAL PRODUCTION OF PIG-IRON.

States.	Blast Furnaces.			
	In Blast January 1, 1888.	July 1, 1888.		
		In.	Out.	Total.
Maine	1	1	..	1
Massachusetts	2	2	2	4
Connecticut	5	4	5	9
New York	20	15	25	40
New Jersey	8	6	12	18
Pennsylvania	153	130	110	240
Maryland	3	3	12	15
Virginia	14	12	20	32
North Carolina	1	1	1	2
Georgia	2	2	2	4
Alabama	19	23	10	33
Texas	1	1	..	1
West Virginia	2	1	8	9
Kentucky	4	6	1	7
Tennessee	14	14	6	20
Ohio	49	38	38	76
Indiana	2	1	1	2
Illinois	12	7	9	16
Michigan	14	12	15	27
Wisconsin	7	6	8	14
Missouri	5	4	8	12
Minnesota	..	..	1	1
Colorado	1	1	1	2
Oregon	..	..	..	..
California	..	..	1	1
Washington Territory	..	..	1	1
Total pig-iron	339	290	297	587
Charcoal pig	74	70	94	164
Coke and bit. pig	147	125	103	228
Anthracite pig	118	95	100	195

TOTAL PRODUCTION OF PIG-IRON—*continued.*

States.	Production. Tons of 2,000 pounds. (Includes Spiegeleisen.)		
	First Half of 1887.	Second Half of 1887.	First Half of 1888.
Maine	2,350	2,047	2,550
Massachusetts	5,875	5,239	7,005
Connecticut	10,684	11,057	10,236
New York	137,807	158,765	134,900
New Jersey	106,857	65,697	59,393
Pennsylvania	1,745,796	1,938,822	1,630,845
Maryland	17,127	20,300	6,250
Virginia	81,773	93,942	92,495
North Carolina	1,400	2,240	1,100
Georgia	23,914	17,053	23,658
Alabama	141,021	150,841	169,696
Texas	1,929	2,454	2,968
West Virginia	32,560	49,751	45,601
Kentucky	24,915	16,992	21,267
Tennessee	119,687	130,657	122,847
Ohio	458,640	516,899	528,536
Indiana	8,710	4,501	7,300
Illinois	251,166	314,287	294,520
Michigan	95,466	118,077	106,578
Wisconsin	64,779	68,729	51,477
Missouri	67,104	71,539	60,789
Minnesota	..	..	..
Colorado	13,164	12,127	11,522
Oregon	..	..	..
California	..	..	..
Washington Territory	1,586	..	..
Total pig-iron	3,415,210	3,771,996	3,382,503
Charcoal pig	263,428	314,754	278,238
Coke and bit. pig	1,950,339	2,320,296	2,111,804
Anthracite pig	1,201,443	1,136,946	992,461

Note.—Much the larger part of the pig-iron classed above as anthracite pig-iron is made with a mixture of anthracite coal and coke as fuel. The quantity of iron made with anthracite alone is steadily growing smaller. In the first half of 1888 it amounted to only 107,802 net tons.

SPIEGELEISEN.

The quantity of spiegeleisen and ferromanganese made in the first half of 1887 was 25,436 net tons; in the second half, 22,162 tons; in the first half of 1888, 21,162 tons.—*Engineering and Mining Journal, New York.*

Mineral Products of the United States, 1882 to 1887.

—		1882.		1883.		1884.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Metallic.			Dollars.		Dollars.		Dollars.
Pig-iron, spot value	Long Tons	4,623,323	106,336,429	4,595,510	91,910,200	4,097,868	73,761,624
Silver, coining value	Troy Oz.	36,197,695	46,800,000	35,733,622	46,200,000	37,744,605	48,800,000
Gold, coining value	„	1,572,186	32,500,000	1,451,249	30,000,000	1,489,949	30,800,000
Copper (value, New York)	Lbs.	91,646,232	16,038,091	117,151,795	18,064,807	147,805,407	18,106,162
Lead (value, New York)	Short Tons	132,890	12,624,550	143,957	12,322,719	139,897	10,537,042
Zinc (value, New York)	„	33,765	3,646,620	36,872	3,311,106	38,544	3,422,707
Quicksilver (at San Francisco)	Flasks	52,732	1,487,042	46,725	1,253,632	31,913	936,327
Nickel (at New York)	Lbs.	281,616	309,777	58,800	52,920	64,550	48,412
Antimony (at New York)	Short Tons	60	12,000	60	12,000	60	12,000
Platinum (crude, at New York)	Troy Oz.	200	600	200	600	150	450
Aluminium (at New York)	„	..	..	1,000	875	1,800	1,350
Total metallic products		..	219,755,109	..	203,128,859	..	186,426,074
Non-metallic (Spot Values).							
Bituminous coal	Long Tons	60,861,190	76,076,487	68,531,500	82,237,800	73,730,539	77,417,066
Anthracite	„	31,358,264	70,556,094	34,336,469	77,257,055	33,175,756	66,351,512
Petroleum	Barrels	30,053,500	23,704,698	23,400,229	25,740,252	24,089,758	20,476,294
Lime	„	31,000,000	21,700,000	32,000,000	19,200,000	37,000,000	18,500,000
Building stone		..	21,000,000	..	20,000,000	..	19,000,000
Salt	Barrels	6,412,373	4,340,140	6.192,231	4,211,042	6,514,937	4,197,734
Cement	„	3,250,000	3,672,750	4,190,000	4,293,500	4,000,000	3,720,000
Limestone for iron flux	Long Tons	3,850,000	2,310,000	3,814,273	1,907,136	3.401,930	1,709,965
Phosphate rock	„	332,077	1,992,462	378,380	2,270,280	431,779	2,374,784
New Jersey marls	Short Tons	1,080,000	540,000	972,000	486,000	875,000	437,500
Borax	Lbs.	4,236,291	338,903	6,500,000	585,000	7,000,000	490,000
Mica	„	100.000	250,000	114.000	285,000	147,410	368,525
Ochre	Long Tons	7,000	105,000	7,000	84,000	7,000	84,000
Crude barytes	„	20,000	80,000	27,000	108,000	25,000	100,000
Precious stones		..	75,000	..	74,050	..	82,975
Gold quartz jewellery		..	75,000	..	115,000	..	140,000
Pyrites	Long Tons	12,000	72,000	25,000	137,500	35,000	175,000
Manganese ore	„	3,500	52,500	8,000	120,000	10,000	120,000
Chrome iron ore	„	2,500	50,000	3,000	60,000	2,000	35,000
Asbestos	Short Tons	1,200	36,000	1,000	30,000	1,000	30,000
Graphite	Lbs.	425,000	34,000	575,000	46,000	..	..
Cobalt oxide	„	11,653	32,046	1,096	2,705	2,000	5,100
Slate pigment	Long Tons	2,000	24,000	2,000	24,000	2,000	20,000
Sulphur	Short Tons	600	21,000	1,000	27,000	500	12,000
Asphaltum	„	3,000	10,500	3,000	10,500	3,000	10,500
Corundum	„	500	80,000	550	100,000	600	108,000
Felspar	Long Tons	14,000	70,000	14,100	71.112	10,900	55,112
Zinc-white	Short Tons	10,000	700,000	12,000	840,000	13,000	910,000
Bromine	Lbs.	250,000	75,000	301,100	72,264	281,100	67,464
Mineral waters	Gallons sold	..	..	7,529,423	1,119,603	10,215,328	1,459,143
Natural gas		..	215,000	..	475,000	..	1,460,000
Gypsum	Short Tons	..	..	..	..	..	..
Flint	Long Tons	25,000	100,000	25,000	100,000	30,000	120,000
Fluorspar	Short Tons	4,000	20,000	4,000	20,000	4,000	20,000
Novaculite	Lbs.	..	..	..	..	..	..
Rutile	„	500	1,800	550	2,000	600	2,000
Total non-metallic products		..	228,410,380	..	242,111,889	..	220,050,674
Total metallic products		..	219.755,109	..	203,128,859	..	186,426,071
Unspecified mineral products, estimated		..	8,000,000	..	8,000,000	..	7,000,000
Grand Total		..	456,165,489	..	453,210,718	..	413,476,748

Long tons are tons of 2,240 avoirdupois pounds, "short" tons are 2,000 pounds. "Coining value" is 1·2929 dols. per troy ounce for silver, and 20·6718 dols. per troy ounce for gold.

The flask of quicksilver is 76½ pounds, the barrel of petroleum contains 42 U. S. gallons, the barrel of lime contains 200 pounds, the barrel of salt contains 280 pounds, the barrel of common cement contains 300 pounds, the barrel of Portland cement contains 400 pounds.

No pure metallic aluminium was produced in the United States in 1887. The value given is for the aluminium in alloys.

MINERAL PRODUCTS OF THE UNITED STATES, 1882 TO 1887—*continued.*

		1885.		1886.		1887.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
METALLIC.			Dollars.		Dollars.		Dollars.
Pig iron, spot value	Long Tons	4,044,525	64,712,400	5,683,329	95,195,760	6,417,148	121,925,800
Silver, coining value	Troy Oz.	39,910,279	51,600,000	39,445,312	51,000,000	41,269,240	53,441,300
Gold, coining value	,,	1,538,376	31,801,000	1,881,250	35,000,000	1,596,500	33,100,000
Copper (value, New York)	Lbs.	170,962,607	18,292,999	161,235,381	16,527,651	184,670,524	21,052,440
Lead (value, New York)	Short Tons	129,412	10,469,431	135,629	12,667,749	160,700	14,463,000
Zinc (value, New York)	,,	40,688	3,539,856	42,641	3,752,408	50,340	4,782,300
Quicksilver (at San Francisco)	Flasks	32,073	979,189	29,981	1,060,000	33,825	1,429,000
Nickel (at New York)	Lbs.	277,904	191,753	214,992	127,157	205,556	133,200
Antimony (at New York)	Short Tons	50	10,000	35	7,000	75	15,500
Platinum (crude, at New York)	Troy Oz.	250	187	50	100	448	1,838
Aluminium (at New York)	,,	3,100	2,550	..	27,000	..	74,905
Total metallic products		..	181,599,365	..	215,364,825	..	250,419,283
NON-METALLIC (SPOT VALUES).							
Bituminous coal	Long Tons	64,840,668	82,347,648	65,810,676	78,481,056	78,426,214	97,939,656
Anthracite	,,	34,228,548	76,671,948	34,853,077	76,119,120	37,578,747	84,552,181
Petroleum	Barrels	21,842,041	19,193,694	28,110,115	20,028,457	28,249,543	16,949,726
Lime	,,	40,000,000	20,000,000	42,500,000	21,250,000	46,750,000	23,375,000
Building stone		..	19,000,000	..	19,000,000	..	25,000,000
Salt	Barrels	7,038,653	4,825,315	7,707,081	4,736,585	7,831,962	4,093,846
Cement	,,	4,150,000	3,492,500	4,500,000	3,990,000	6,692,744	5,186,877
Limestone for iron flux	Long Tons	3,356,956	1,678,478	4,717,163	2,830,297	5,377,000	3,226,200
Phosphate rock	,,	437,856	2,846,064	430,549	1,872,936	480,558	1,836,818
New Jersey marls	Short Tons	875,000	437,500	800,000	400,000	600,000	300,000
Borax	Lbs.	8,000,000	480,000	9,778,290	488,915	11,000,000	550,000
Mica	,,	92,000	161,000	40,000	70,000	70,500	142,250
Ochre	Long Tons	3,950	43,575	15,800	285,000	20,000	310,000
Crude barytes	,,	15,000	75,000	10,000	50,000	15,000	75,000
Precious stones		..	69,900	..	79,056	..	88,600
Gold quartz jewellery		..	140,000	..	40,000	..	75,000
Pyrites	Long Tons	49,000	220,500	55,000	247,500	52,500	210,000
Manganese ore	,,	23,258	190,281	30,193	277,636	34,524	333,844
Chrome iron ore	,,	2,700	40,000	2,000	30,000	3,000	40,000
Asbestos	Short Tons	300	9,000	200	6,000	150	4,500
Graphite	Lbs.	327,883	26,231	415,525	33,242	416,000	34,000
Cobalt oxide	,,	68,723	65,373	..	36,878	18,340	18,774
Slate pigment	Long Tons	1,975	24,687	3,000	30,000	2,000	20,000
Sulphur	Short Tons	715	17,875	2,500	75,000	3,000	100,000
Asphaltum	,,	3,000	10,500	3,500	14,000	4,000	16,000
Corundum	,,	600	108,000	645	116,190	600	108,000
Felspar	Long Tons	13,600	68,000	14,900	74,500	10,200	56,100
Zinc-white	Short Tons	15,000	1,050,000	18,000	1,440,000	18,000	1,440,000
Bromine	Lbs.	310,000	89,900	428,334	141,350	199,087	61,717
Mineral waters	Gallons sold	9,148,401	1,312,845	8,950,317	1,284,070	8,259,609	1,261,473
Natural gas		..	4,854,200	..	9,847,150	..	13,582,500
Gypsum	Short Tons	90,405	405,000	95,250	428,625	95,000	425,000
Flint	Long Tons	30,000	120,000	30,000	120,000	32,000	185,000
Fluorspar	Short Tons	5,000	22,500	5,000	22,500	5,000	20,000
Novaculite	Lbs.	1,000,000	15,000	1,160,000	15,000	1,200,000	16,000
Rutile	,,	600	2,000	600	2,000	1,000	3,000
Total non-metallic products		..	240,114,544	..	243,963,063	..	281,637,062
Total metallic products		..	181,599,365	..	215,364,825	..	250,419,283
Unspecified mineral products, estimated		..	7,000,000	..	6,000,000	..	6,000,000
Grand Total		..	428,713,909	..	465,327,888	..	538,056,345

"Unspecified mineral products" includes, except where an amount is specified in the table, fire-clay, kaolin, potters' clay, common brick clay, terra cotta, building sand, glass sand, limestone used as flux in lead smelting, limestone in glass making, iron ore used as flux in lead smelting, marls (other than New Jersey), gypsum, tin ore, iridosmine, mill buhrstone and stone for making grindstones, novaculite, lithographic stone, talc and soapstone, quartz, nitrate of soda, carbonate of soda, sulphate of soda, native alum, ozocerite, mineral soap, strontia, infusorial earth and tripoli, pumice-stone, sienna, umber, zinc-white, and mineral waters.—*Engineering and Mining Journal, New York.*

BOARD OF TRADE RETURNS.

Imports.

—		July 1886.	July 1887.	July 1888.
Drugs, unenumerated..	Value £	46,226	54,817	62,665
Chemical manufactures and products, unenumerated	„	125,300	139,869	100,918
Chemicals and dye-stuffs, unenumerated	„	163,410	157,294	185,526
Oils, not enumerated...	„	109,988	89,632	76,535
Alkali	Cwt.	6,484	5,363	6,243
	Value £	5,169	4,998	6,242
Brimstone	Cwt.	59,204	48,642	60,890
	Value £	15,386	11,046	13,851
Nitrate of soda	Cwt.	137,718	78,180	112,020
	Value £	60,352	32,500	49,049
„ of potash......	Cwt.	12,963	12,349	18,809
	Value £	11,794	11,136	10,217
Quicksilver	Lbs.	334,317	356,525	22,125
	Value £	30,420	30,801	2,195
Cinchona bark.........	Cwt.	12,071	10,492	14,072
	Value £	61,374	39,763	41,747
Gum Arabic	Cwt.	2,783	4,112	6,853
	Value £	10,826	19,269	21,588
Lac, seed, shell, stick, and dye	Cwt.	5,112	10,162	8,157
	Value £	14 359	20,551	19,391
Bark (for tanners' or dyers' use)..........	Cwt.	48,074	11,786	47,598
	Value £	22,040	20,032	25,444
Aniline	Value £	22,809	25,895	22,115
Alizarine	„	14,872	18,786	20,802
Other coal-tar dyes	„	..	1,103	902
Cochineal..............	Cwt.	678	398	152
	Value £	4,324	2,606	917
Cutch and gambier	Tons	1,368	1,075	1,496
	Value £	34,174	25,787	35,600
Indigo	Cwt.	2,472	2,106	1,975
	Value £	32,542	37,072	31,687
Madder, madder-root, &c.	Cwt.	951	1,845	2,101
	Value £	1,365	2,521	2,082
Cocoa-nut oil	Cwt.	4,307	730	2,713
	Value £	0.378	1,118	2,982
Olive oil	Tuns	1,511	1,631	586
	Value £	55,885	57,088	22,301
Palm oil	Cwt.	110,685	82,404	75,397
	Value £	114,507	77,979	72,778
Petroleum oil	Gals.	6,295,797	10,429,298	8,702,755
	Value £	172,583	260,681	204,188
Various seed oils.......	Tons	1,851	747	714
	Value £	40,810	18,179	17,854
Turpentine	Cwt.	64,442	65,819	71,248
	Value £	78,208	83,422	94,484

Exports.

—		July 1886.	July 1887.	July 1888.
British and Irish produce:				
Drugs and chemical preparations, and medicines.........	Value £	73,887	64,982	65,716
Sundry chemicals	„	271,122	298,561	322,275
Painters' colours and materials	„	107,465	112,114	115,712
Alkali	Cwt.	446,899	460,001	458,590
	Value £	134,176	137,070	119,578
Bleaching materials.	Cwt.	105,309	102,278	116,639
	Value £	32,837	38,776	45,366
Seed oil.............	Tons	4,223	4,546	5,353
	Value £	92,952	98,788	108,387
Pickles, vinegar, sauces, condiments, and confectionery.	Value £	93,371	93,150	105,157
Soap................	Cwt.	40,416	50,095	37,493
	Value £	40,073	46,687	35,775
Foreign and Colonial merchandise:				
Chemicals, unenumerated	Value £	18,443	17,487	14,638
Cinchona bark	Cwt.	7,541	7,290	12,958
	Value £	31,246	33,246	33,896
Cochineal...........	Cwt.	780	533	686
	Value £	5,309	3,447	3,528
Cutch and gambier .	Tons	896	901	407
	Value £	23,830	23,398	11,711
Gum Arabic	Cwt.	4,620	3,552	4,912
	Value £	15,176	14,624	19,958
Indigo..............	Cwt.	2,483	2,863	1,823
	Value £	50,890	63,070	39,062
Lac, seed, shell, stick, and dye	Cwt.	5,419	6,071	7,849
	Value £	15,136	15,335	20,277
Cocoa-nut oil	Cwt.	5,318	8,457	9,921
	Value £	7,185	12,060	11,793
Olive oil	Tuns	232	309	324
	Value £	9,938	12,142	13,210
Palm oil	Cwt.	76,180	27,703	59,836
	Value £	78,171	27,116	57,388
Petroleum oil	Gals.	28,040	25,430	35,897
	Value £	1,352	1,351	1,575
Quicksilver.........	Lbs.	327,687	618,294	243,485
	Value £	28,658	54,837	24,295

VALUE OF THE EXPORTS FROM THE UNITED KINGDOM OF CHEMICAL PRODUCTS AND PREPARATIONS OF BRITISH ORIGIN AND MANUFACTURE.

To	1883.	1884.	1885.	1886.	1887.
	£	£	£	£	£
Russia	81,874	73,478	88,073	69,267	78,206
Sweden	54,907	61,145	59,845	69,022	55,223
Norway	8,608	7,921	11,363	11,587	11,086
Germany	247,222	291,421	223,632	208,261	246,194
Holland	282,292	286,331	241,096	207,855	190,538
Belgium	147,664	109,659	75,819	94,351	94,111
France	251,537	290,270	207,113	277,655	388,407
Portugal	35,894	31,518	31,524	28,993	22,215
Madeira	699	1,073	1,317	1,316	1,279
Spain	56,012	62,214	43,319	45,932	46,171
Italy	66,033	70,362	57,857	57,978	73,350
Austria	8,088	9,800	6,595	8,248.	3,719
Bulgaria	976	976	1,119	992	873
Turkey (Europe)	7,773	8,700	8,856	6,694	7.786
Turkey (Asia)	5,796	7,048	6,419	5,165	4,802
Egypt	6,199	7.294	6,933	5,423	5.810
China (including Hong Kong and Macao)	15,611	12,280	20,901	13,328	16,145
Japan	11,860	20.288	23.069	42,217	61,516
United States	466,170	354.736	395,618	400,476	399,010
Mexico	8,235	5,894	9,786	14,377	20,750
Argentine Republic	13,066	18,294	27,298	38,524	35,284
Channel Islands	3,750	8,104	10,751	6.211	3,074
Cape of Good Hope	8,746	19,033	21,029	17,964	33,500
Natal	1,947	4,499	7,812	5,768	10,704
Mauritius	2,203	2,078	2,001	1,432	1,655
British India	81,792	84,587	84,364	81,994	106,211
South Australia	9,314	10,238	12,414	8,887	11,652
Victoria	34,536	43,916	46,169	41,967	49,301
New South Wales	26,263	34,442	39,098	36,927	39,438
New Zealand	26,603	25,279	40,563	33,878	35,012
Canada	39,507	36.807	35,512	37,799	37,803
British Guiana	2,667	3,360	3,596	2,838	3.653
Falkland Islands	3,083	1,481	2,015	2,155	1,639

VALUE OF THE EXPORTS FROM THE UNITED KINGDOM OF CHEMICAL MANUFACTURES AND PRODUCTS OF FOREIGN ORIGIN.

	£	£	£	£	£
Russia (southern ports)	1,870	1,575	3,507	9,735	7,302
Germany	35,438	15,494	39,556	11,577	33,838
France	16,360	15,896	15,828	15,376	20,853
Italy	7,030	10,697	9,072	5,199	12,098
Japan	3,140	3,937	4,898	9,117	10,724
United States	185,402	86,100	103,737	37,823	113,944
Victoria	1,931	3,972	6,398	7,567	8,083
New South Wales	7,101	9,076	9,201	4,888	7,816
New Zealand	5,229	6,702	6,212	5,681	8,459
Canada	10,467	14,458	7,836	7,925	9,655

—*Chemist and Druggist.*

MISCELLANEOUS.

THE GERMAN POTASSIUM CHLORIDE INDUSTRY.

The new potassium chloride factory in Langensheim, Harz, erected by the Kalisalzwerk, Vienenburg, will, says *Kuhlow's Trade Review*, commence operating in a few days. The Potassium Chloride Association has therefore informed the separated factories, among which are the Vereinigte Chemicalien-Fabriken at Leopoldshall and the Strassfurter Chemische Fabrik, that the Kalisalzwerk Vienenburg will in future manipulate its own carnallite. The oversea export of potassium chloride has, for the present, almost entirely ceased, for ships can hardly be found to accept freightages, except at very high rates, to North American harbours, owing to the lack of return cargoes. Stocks have in consequence grown very large, and the lately announced limitation of the raw salt output will probably prove insufficient. It is hoped, however, that this temporary stagnation in the export trade will be compensated for in August.

THE COMPRESSED CARBONIC ACID GAS INDUSTRY.

In consequence of the running out of the patent rights two years ago, is now worked in ten factories instead of in two as formerly. The Berlin Limited Company, the first of the kind (which has also works on the Rhine), has an annual sale of about 500,000 kilos.; of the compressed gas about 70,000 kilos. are used in Berlin daily. The price, with the increased competition, has fallen from 16 m. for an 8-kilo. bottle to 7 m., and finally to 5 m. A considerable quantity of the substance is used for imparting the necessary effervescent properties to draught beer, &c., and for this purpose a proportion worth (now) about one-eighth of a penny per glass is required.

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

10,237. R. C. Sayer, Bristol. Filters. July 14.

10,246. R. Schwartzkopff, London. Apparatus for indicating the levels of liquids in vessels containing liquid under pressure. July 14.

10,280. S. Hanson, London. Apparatus for supplying fuel to furnaces. July 16.

10,281. J. Willoughby, A. Gledhill, and J. W. Bannister, London. Method and apparatus for utilizing waste heat for consuming smoke in furnaces. July 16.

10,308. J. Turner, London. Smoke-consuming apparatus. July 16.

10,361. E. Bazin, London. Means and apparatus for producing cold. July 17.

10,382. L. P. Payne-Galwey, London. Distilling apparatus. July 17.

10,403. T. Slaiter, London. Multiple evaporating apparatus. July 20.

10,496. J. Battye, Batley. Heat and fuel economiser and smoke-consuming apparatus. July 20.

10,506. J. A. Radley, Lowestoft. Centrifugal pump. July 20.

10,554. F. N. Mackay and A. G. Christiansen, Liverpool. Apparatus for refrigerating and condensing. July 21.

10,655. C. D. Abel.—From Langen and Hundhausen, Germany. Method and apparatus for washing or treating with liquids granular substances, or substances in a state of magma. Complete Specification. July 23.

10,720. H. H. Lake.—From T. R. Houseman and C. B. M. Sprowles, United States. Apparatus for drying or desiccating granular and other materials. Complete Specification. July 24.

10,870. J. McLeownan McMurtrie, Glasgow. Method and means for controlling the outflow of water under pressure. July 27.

10,885. J. Newton and D. A. Quiggin, Liverpool. Apparatus for condensing steam for heating or cooling fluids, and for evaporating water. July 27.

10,935. J. Newton and D. A. Quiggin, Liverpool. Apparatus for condensing steam for heating or cooling fluids and for evaporating water. July 28.

10,993. S. Birkett and J. Robinson, London. Construction of the nozzles of filter-press taps. Complete Specification. July 30.

11,151. J. Newton and D. A. Quiggin, Liverpool. Apparatus for condensing steam, for heating or cooling fluids, and for evaporating water. August 1.

11,268. E. Theisen, London. Condensing apparatus. August 3.

11,357. M. Negro, London. Improved filter for any process of filtering. August 7.

11,359. E. C. Fasoldt and E. W. Smith, London. Air-compressing pumps. Complete Specification. August 7.

11,436. J. Fitton, Dewsbury. An improved retort or chamber for the production of acid gases or vapours. August 8.

11,485. W. R. Watson and R. A. Robertson, Glasgow. Apparatus for evaporating, concentrating, and distilling liquids. August 9.

11,727. T. Gaunt and E. H. Clapp, London. Apparatus for evaporating liquids. Complete Specification. August 14.

11,746. S. Pultney and J. Thomson, Glasgow. Tuyeres for furnaces. August 15.

• *COMPLETE SPECIFICATIONS ACCEPTED.*

1887.

13,017. P. A. Newton.—From Messrs. Theisen and Langen. Apparatus for cooling or heating liquids and air. July 28.

1888.

7168. C. D. Abel.—From E. Langen. Furnace for roasting, calcining, burning, drying, &c. August 18.

8663. J. Johnston. Apparatus for heating, drying, &c. August 11.

9533. H. Gehrke and A. Wohlfahrt. Filtering apparatus. August 4.

9756. A. Dervaux. Apparatus for the purification of water. August 11.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

10,186. A. Campbell and W. Boyd, Glasgow. Improvements in purifying or treating coal gas and other gaseous or liquid products of destructive distillation, and in part applicable in the alkali manufacture. July 13.

10,224. The Gaseous and Liquid Fuel Supply Co., Limited, London. The generation of gaseous fuel and the combustion thereof in steam generator furnaces. July 14.

10,272. G. Kendal, Huddersfield. A new or improved method for the better consumption of fuel and smoke preventing. July 16.

10,336. A. McDougall, Manchester. Improvements in the manufacture of gas from oils and other liquid hydrocarbons. July 17.

10,510. A. McDougall, Manchester. Improvements in apparatus and means for the combustion of oils and other liquid hydrocarbons for the production of heat. July 20.

10,843. F. F. Rateau, London. Improvements in the manufacture of artificial fuel, which will also serve for lighting purposes, and in apparatus for use with the said fuel. July 26.

10,938. C. Wells, London. An improved method of making candles. July 28.

11,161. G. L. Morris and W. T. Wilson, London. Improvements in apparatus for the generation of gas from hydrocarbon oils. Complete Specification. August 1.

11,443. J. Elliott, London. Improvements in gas-producing apparatus in which the carbonization of coal is continuously effected. August 8.

11,606. L. Branda, London. The rapid fire-lighter. August 11.

11,631. J. Frodsom and A. McLinden, Maryport. Combustion of gas in blast furnace heating stoves and boiler furnaces. August 13.

11,677. G. Frank, London. Improvements in the manufacture of compressed artificial fuel. August 13.

11,680. N. J. Fenner and H. W. Fenner, London. Improvements in the distillation of hydrocarbons or other bodies capable of similar treatment, and in means or apparatus employed therein. August 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

11,367. G. Thew, J. Stansfield, G. Long, and G. Rowland. Making illuminant gas and other chemical products from human excreta. August 18.

12,481. W. H. Nevill. Artificial fuel for heating and gas producing. August 4.

13,993. W. Wilkie. An improvement in effecting the combustion of fuel. August 18.

1888.

1018. C. Herzog. Apparatus for carburetting air and enriching gas. August 11.

9532. J. Rippon. Manufacture of fire-lighters. August 4.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATION.

10,186. A. Campbell and W. Boyd. *See* Class II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

10,314. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. Improvements in the manufacture of methylene blue and allied colouring matters. July 16.

10,315. J. Y. Johnson.—From The Farbenfabriken vormals F. Bayer and Co., Germany. A process for the production of mercaptols. July 16.

10,653. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Berlin. Manufacture of brown colouring matters, which dye cotton without the use of a mordant. July 23.

10,845. H. H. Lake.—From K. Oehler, Germany. Improvements in and relating to the manufacture of colouring matters. July 26.

11,501. J. C. Mewburn.—From La Société Jeannolle et Cie., France. Improvements in the production of fast black colour for dyeing or printing fibres and fabrics. Complete Specification. August 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

11,318. H. H. Lake.—From Leonhardt and Co. Manufacture of alphanaphtholdisulpho acid, and production of colouring matters therefrom. August 18.

12,667. C. S. Bedford. New colouring matters and process of manufacturing the same. August 4.

16,484. J. Y. Johnson.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of azo dyes. August 4.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

10,227. J. Williams, Willesden. *See* Class XIX.

10,633. W. Hitchcock-Spencer, London. Improved apparatus for the treatment of rhea or China grass and other vegetable fibrous matters. July 23.

10,635. J. Papleux, London. Improvements in the treatment of rhea or China grass and other vegetable fibrous materials. July 23.

10,758. C. Huelser.—From A. Brociner and B. Iscovits, Austria. A new fibre, and the process of producing the same. July 25.

11,417. S. A. Rosenthal, London. An improved composition for sizing or dressing woollen and other fabrics, and for other purposes. August 7.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

10,560. F. Law, Rochdale. Improved method of bleaching oily cotton waste. July 21.

11,186. J. S. Knott, Manchester. Improvements in the method of, and in apparatus for, bleaching and finishing textile fabrics and materials. August 2.

11,420. H. Richmond, London. Apparatus for scouring, dyeing, bleaching, and otherwise treating yarn in cops. Complete Specification. August 7.

11,452. J. C. Mewburn. From La Société Leblois, Piceni et Cie., France. Improvements in bleaching, dyeing, or otherwise operating on textile materials, and in apparatus employed therein. August 8.

11,806. E. Sutcliffe and G. E. Sutcliffe, Manchester. Improvements in dyeing aniline black. August 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,644. H. E. Newton. From the Actiengesellschaft für Papier und Druck Industrie Leykam Josefsthal, Austria. Process for bleaching jute. July 28.

1888.

9729. T. Hill and T. Mayfield. Machine for drying and ageing bleached or dyed yarns, goods in piece, or manufactured articles. August 18.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

10,186. A. Campbell and W. Boyd. *See* Class II.

10,187. A. Campbell and W. Boyd, Glasgow. Improvements in obtaining chlorine from hydrochloric acid or chlorides, and in regenerating peroxide of manganese which is used in the process. July 13.

10,193. G. H. Bolton, J. R. Wylde, and H. Auer, Liverpool. Improvements in the manufacture of permanganates and chlorates. July 13.

10,309. W. P. Thompson.—From G. Lunge and P. Naef, Switzerland. Improvements in treating impure hydrochloric acid or mixed gases containing hydrochloric acid so as to separate impurities therefrom. July 16.

10,322. J. Hargreaves, Liverpool. Improvements in the treatment of sulphuretted hydrogen to obtain sulphur, and in apparatus employed therein. July 17.

10,861. F. J. Shaw, Newcastle-on-Tyne. The manufacture of peroxide of iron and sulphate of magnesia. July 27.

11,020. C. A. Faure, London. Improvements in the method of producing aluminium chloride. July 30.

11,294. L. Mond and G. Eschellmann, London. Improvements in or relating to the obtaining of inert gases. August 4.

11,581. D. Gamble, Liverpool. Improvements in the manufacture of chlorine and hydrochloric acid, and in apparatus or plant applicable therefor. August 11.

11,599. E. W. Parnell and J. Simpson, Liverpool. Improvements in obtaining sulphur from sulphuretted hydrogen, and in apparatus therefor. August 11.

11,734. C. N. Hake, London. Improvements in the manufacture of nitrate of ammonia. August 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

10,295. C. Wigg. Obtaining muriate of ammonia and carbonate of lime from the residual chloride liquors of the ammonia alkali process. July 28.

10,900. J. B. Thompson. Manufacture of soda, and apparatus therefor. August 4.

13,004. W. P. Thompson.—From S. Wolf. Application of acid sulphate of soda in the manufacture of cellulose, and for other purposes. August 4.

13,336. J. E. Johnson-Johnson. Manufacture of acetic acid and apparatus therefor. July 28.

13,647. C. Heinzerling. Separating chlorine from gas mixtures. August 11.

13,648. C. Heinzerling. Furnaces for decomposing metallic oxychlorides and superoxidizing metallic oxides. August 4.

13,695. C. Huggenberg. Obtaining nitrites, chromates, manganates, permanganates, and arseniates. August 11.

14,003. F. Bale. Manufacture of ammonia and hydrochloric acid, and apparatus therefor. August 11.

14,906. C. Fahlberg. Apparatus for the production of phosphorus trichloride. August 18.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

10,343. J. R. Crossthwaite, Stockton-on-Tees. Improvements in the combination of materials employed in the construction of chimney-pieces, mantel-pieces, or the like structures. July 17.

10,481. H. Leak, London. Improved means of supporting pottery ware in kilns or ovens while being baked or fired. Complete Specification. July 19.

10,966. G. Woolliscroft, Longton. A new system of decorating pottery, tiles, and porcelain, by gold and other metals. July 30.

11,016. H. J. Haddan.—From The Josephine Glass Works, Germany. Improvements in the manufacture of red glass. July 30.

11,198. E. Brooke, Halifax. Improvements in the burning of white or coloured glazed bricks and pottery ware. August 2.

11,230. J. Bevington, London. Combining and constructing a potter's oven and hardening on kiln in one erection, and for utilizing the waste heat of the potter's oven for hardening on and enamelling purposes. August 3.

11,651. J. Armstrong, London. A method of making bottles or other hollow-ware, and appliances therefor. August 13.

11,794. J. Armstrong, London. A method of making rolled glass, and appliances therefor. August 16.

11,821. W. Adamson, London. Improvements in placques. August 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,852. J. Spencer. *See* Class X.

1888.

8333. F. L. Jeyes and F. Short. Mode of ornamenting glass-ware. August 1.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

10,312. G. J. Snelus, T. Gibb, J. C. Swan, H. Smith, and W. Whamond, London. Improvements in and connected with the manufacture of cement. Complete Specification. July 16.

10,473. J. Schlesinger.—From W. Siller, Germany. Improvements in the manufacture of cement. July 19.

10,525. A. J. Boult.—From A. F. W. Döhring, Germany. Improvements in or relating to water and fireproof floors, ceilings, roofs, wall-plasterings, and the like. Complete Specification. July 20.

10,586. A. McLean, London. Improvements in blocks or slabs for paving and other purposes. July 21.

10,669. G. A. Herdman, London. Improvements in the preparation of asphalt for pavements, roadways, buildings, bridges, and other applications. July 24.

11,053. F. W. Wetherell. *See* Class X.

11,610. H. Johnson, London. Improvements in bricks for pavements and floors. August 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

12,500. E. Winser, F. Winser, and J. Winser. Treating clay or gypsum, and apparatus therefor. August 18.

13,534. T. C. Hutchinson. *See* Class X.

13,902. R. Punshon. Paving, flooring, and roofing material. August 18.

1888.

10,312. G. J. Snelus, T. Gibb, J. C. Swan, H. Smith, and W. Whamond. Manufacture of cements. August 18.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

10,181. J. Cameron and A. M. Grant, Glasgow. Improvements in furnaces for smelting ores of silver, copper, nickel, or cobalt. July 13.

10,182. S. Alley and J. A. MacLellan, Glasgow. Improvements in and connected with apparatus for making moulds for casting. July 13.

10,223. J. S. MacArthur, R. W. Forrest, and W. Forrest, London. Improvements in extracting gold and silver from ores or other compounds. July 14.

10,254. G. C. Fricker, London. Improvements in preparing metallic sheets for receiving a metallic coating. July 14.

10,262. M. Gledhill, London. Improvements relating to the forging of metal cylinders, armour plates, projectiles, and other objects, and to apparatus therefor. July 14.

10,266. J. A. Stephan and R. Southerton, Birmingham. Improvements in the manufacture of aluminium and its alloys. July 16.

10,334. J. Nicholas, Ilford. Improvements in the extraction of gold, silver, and platinum from their ores. July 17.

10,347. C. C. Townsend, Madras. The manufacture of malleable iron castings without annealing. July 17.

10,415. C. Gassner, jun., London. Improvements in the production of hydrated peroxide of iron from galvanic dry elements. Complete Specification. July 18.

10,657. J. Perins, London. New process for extracting zinc from pyrites containing blende, the waste of the same, and from any other ores containing sulphide of zinc. Complete Specification. July 23.

10,698. B. Hill and J. W. Rees, Liverpool. Improvements in ovens or furnaces applicable for drying or heating galvanized or other metallic sheets, and in appliances to be used in connexion therewith. July 24.

10,707. J. Sheldon, London. Improvements in converters used in the manufacture of iron and steel, and in the method of heating the said converters. July 24.

10,785. W. G. Foster, London. Improvements in the manufacture of sodium and potassium, and in apparatus therefor. July 25.

10,849. M. A. Howell, jun., London. An improvement in the manufacture of soft back steel. July 26.

10,850. M. A. Howell, jun. Improvements in the manufacture of steel. July 26.

10,947. R. C. Thompson and J. H. Bowman, Liverpool. Improvements in treating certain coated refuse metals for the recovery of the coating material therefrom, and apparatus employed therein. July 28.

10,973. C. Armstrong and J. A. Robinson, Spenney Moor. Safety hydrostatic blasting tube for blasting coal, stone, &c. July 30.

11,022. W. R. Lake.—From Frankenthaler Kesselschmide Velthingsen and Co., Germany. An improved method or process of covering articles of iron with lead. July 30.

11,053. F. W. Wetherell, Stockton-on-Tees. Utilizing blast furnace slag in the manufacture of bricks for refractory or ordinary building purposes. July 31.

11,144. A. Gray, London. Roasting ores and other minerals. August 1.

11,565. A. T. Wedelin, J. J. Robinson, and J. Gordon, London. Improvements in the method and apparatus for extracting metals. August 10.

11,620. M. F. H. Lintz, London. Improvements relating to the manufacture of tin and terne plates, and to apparatus therefor. August 11.

11,638. R. Main, Glasgow. Improvements in preparing pulverulent ores of iron and manganese for use in the manufacture of iron and steel. Complete Specification. August 13.

11,653. J. Bruker, London. Process for decorating objects or surfaces of cast-iron. August 13.

11,691. T. Andrews, Manchester. Apparatus for consolidating small iron or steel-scrap. August 14.

11,270. J. B. Spence, London. Improvements in the manufacture of aluminium. August 3.

11,308. J. Cameron and A. M. Grant, Glasgow. Improvements in converters of furnaces for treating silver, copper, nickel, and cobalt, or their compounds. August 4.

11,347. J. Williams and G. L. Morris, Landore. Finishing metal plates that have been coated with tin, terne, or any other alloy. August 7.

11,399. C. T. J. Vautin, London. An improved method of extracting gold from the various auriferous ores. August 7.

11,445. R. Rickard, London. An improved process for obtaining the precious metals from speiss, mattes, or regulus. August 8.

11,512. P. M. Parsons, London. Improvements in metallic alloys. August 9.

11,736. G. Baron de Overbeck, London. Improvements in the production of the metals of the alkaline earths. August 11.

11,854. J. G. Thomas and G. H. White, London. Improvements in means or apparatus to be employed in coating metal sheets with tin, terne, and other metals or alloys. August 16.

11,855. F. Siemens, London. Improvements in open hearth furnaces. Complete Specification. August 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

10,043. W. P. Thompson.—From G. A. Faurie. Manufacture of aluminium, magnesium, calcium, and similar metals and their alloys. July 28.

11,412. B. H. Thwaite. Calcining and heating argillaceous, calcareous, and metalliferous substances, or mixtures thereof, and apparatus therefor. August 18.

11,571. R. E. Shill and A. Martin. Hardening or chilling the face of armour or other plates and projectiles. August 18.

12,272. G. Siddell. Process of hardening iron and steel. July 28.

12,856. C. A. Burghardt and W. J. Twining. Production of aluminium and aluminium bronze. July 28.

13,212. G. Hatton. Improvements in the open hearth method of manufacturing iron and steel, and in furnaces employed therein. August 4.

13,531. T. C. Hutchinson. Treating blast-furnace slag for the manufacture therefrom of hydraulic or similar cement. August 11.

13,852. J. Spencer. Reverberatory furnaces for heating, metallurgical, glass making, and similar operations. August 11.

14,174. J. S. MacArthur, R. W. Forrest, and W. Forrest. Obtaining gold and silver from ores and compounds. August 11.

14,793. J. E. Bott and C. H. Cousins. Manufacture of cast steel shells, projectiles, and other steel castings. August 11.

1888.

8862. G. W. Gesner. Treating metallic articles to render them non-corrodible. July 28.

9197. G. W. Gesner. Apparatus for oxidizing the surface of metals. July 28.

9253. E. Walsh, jun. Blast furnaces. July 28.

9652. H. H. Lake.—From O. B. Peck. Process and apparatus for generating steam from heated or molten slag, &c. August 4.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

10,604. I. A. Timmis, London. Improvements in the elements for secondary batteries. July 21.

10,637. G. Havenith, London. Improvements in plates for accumulators. July 23.

10,952. L. S. M. Pyke and H. T. Barnett, London. Improvements in dynamo-electric machines. July 28.

10,954. E. H. Geist, London. Improvements in or connected with dynamo-electric machines. Complete Specification. July 28.

11,479. T. Parker and A. E. Robinson. *See* Class XX.

11,569. H. Pieper, London. Improvements in secondary and other electric batteries. August 10.

11,582. F. H. Varley, Westminster. Improvements in apparatus for the electro-deposition of metals and for the separation of chemical compounds or bases therefrom. August 11.

11,681. E. Liebert and S. A. Rosenthal, London. Improvements relating to electric batteries and to exciting liquids or compounds therefor. Complete Specification. August 13.

11,718. J. Gozo, London. An induction apparatus—a substitute for dynamo-electric machinery—for the generation of electricity, without converting the energy of mechanical motion into the energy of electric currents, *i.e.*, without moving coils of wire past magnets or magnets past coils of wire. August 14.

11,817. J. C. Hobbs, Cleveland, U.S.A. Improvements in electric furnaces. Complete Specification. August 16.

11,858. O. C. D. Ross, London. Improvements in electric batteries. August 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

10,200. H. C. Bull & Co., Limited, and H. C. Bull. Dynamo-electric generators and motors. July 28.

10,611. R. P. Milburn. Electrical batteries. August 11.

12,203. T. L. Hemming. Dynamo-electric machines. August 11.

1888.

713. T. Coad. Voltaic or galvanic batteries. August 18.

7619. G. J. Weir. Primary electric battery. August 18.

9206. C. Lütcke and P. George. Galvanic elements or batteries. August 4.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

10,296. M. V. Brisset, London. Improvements in the treatment or purification of fatty acids and in apparatus employed therein. July 16.

10,370. B. Willcox.—From M. Ten Broeck Davidson and E. Warne, United States. An anti-friction composition. Complete Specification. July 17.

11,486. J. C. Stitt, Liverpool. Improvements in the manufacture of soap and in apparatus employed therein. August 9.

11,505. C. Weigelt. *See* Class XV.

11,545. C. H. Currie, Liverpool. Improvements in and relating to illuminating and lubricating oils. Complete Specification. August 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

8947. G. Tall. Manufacture or purification of cotton seed oil. July 28.

13,017. J. W. Paton, Liverpool. Cleansing powder or compound. July 28.

1888.

9768. S. C. Fenton, J. Fitton, jun., and J. Fenton. Manufacture of soaps and soap compounds. August 11.

9794. W. Walker. Production of grease for lubricating purposes. August 11.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

10,179. W. M. Power, London. The manufacture of a non-blooming picture varnish. July 13.

10,192. J. H. Eastman, Liverpool. Improved coating or preservative material for iron, steel, and other structures, or for coating the bottoms of iron and steel ships or other vessels, and process of manufacturing the same. July 13.

10,301. E. Oates, London. An improved varnish-removing compound. July 16.

10,305. E. Oates, London. An improved paint-removing compound. July 17.

10,379. J. H. Jackson, London. An improved liquid enamelling composition. July 17.

10,426. R. W. E. McIvor, London. Improvement in the production of white lead or carbonate of lead, and the apparatus therefor. Complete Specification. July 18.

10,601. R. Turnbull, London. Improvements in anti-corrosive compositions and materials for ships and other structures, and in the method of applying the same. July 21.

10,757. F. Wendling, London. A new paint for stones, plaster, and the like. July 25.

11,209. A. J. Davison, London. Non-corrosive and anti-fouling compositions. Complete Specification. August 2.

11,398. P. Brentini, London. An improved compound for removing paint from painted surfaces. August 7.

11,554. W. O. Wotton, London. An improved anti-fouling composition. August 10.

11,579. S. B. Beswick, Birkenhead. An improved varnish for cleaning and preserving harness. August 11.

11,777. P. V. Vandersteenstraaten, Upton Park. An improved manufacture and treatment of compounds as substitutes for ivory, whalebone, india-rubber, varnish, and other substances. August 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,885. A. G. Wass. Combination of substances for the manufacture of varnish, paint, enamel, &c. August 18.

1888.

2070. J. Hauff. Producing soluble polybasic aluminium chlorides and nitrates, and employing same in dyeing and printing. July 28.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

10,362. P. Puech, London. A new or improved process for unhairing skins and pieces of skins. July 17.

10,482. J. Rivage and J. B. Matrod, London. An improvement in tanning. July 19.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,151. M. Korn and R. Bach. Apparatus for treating seal and other furs to remove the stiffer hairs. July 28.

1888.

9902. J. Myers. Preparing hides and skins for tanning. August 11.

10,138. J. Myers. Preparing hides or skins for aluming or dyeing. August 18.

XV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

10,360. B. Foster and W. Foster, London. Improvements in the means or apparatus for drying, roasting, or calcining animal matter for manurial and other purposes, also for recovering the grease and ammonia given off in the operation. July 17.

11,595. C. Weigelt, London. Improvements relating to the preparation of artificial manures from fish and other substances, and to the extraction of oil therefrom. August 9.

11,731. C. N. Hake, London. Improvements in the manufacture of nitrate of ammonia. August 14.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATION.

11,598. P. Trentler and P. Schwarz, Berlin. A method of manufacturing glutin. August 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,164. G. Fletcher. Evaporation and concentration of sugar cane juice and other liquids, and apparatus therefor. August 18.

1888.

9775. C. Steffen and C. J. Langen. Process and apparatus for refining sugar. August 18.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

10,216. H. Gugenheim, London. Improvements in the manufacture of saccharine liquors for brewing and other similar purposes, and in the mode of their manufacture. Complete Specification. July 13.

10,852. H. S. Bethell and A. Tack, London. Improved mode of treating alcohol to render it undrinkable. July 26.

10,968. J. Death, Bandon. To lessen the consumption of fuel in the manufacture of pot-still whisky, to prevent over-firing, and to increase the output of spirit. July 30.

11,180. J. Mitchell, Glasgow. An improved method for preserving the sediment from distilleries for use as a sheep and cattle food. August 2.

11,664. J. Coleman and J. Henson, London. Improvements in malting, and in apparatus for turning and separating grain during the process of malting. August 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,034. A. de Gaulne. Apparatus for filtering alcoholic beverages. July 28.

13,840. A. H. Huntley. Manufacture of yeast. August 11.

1888.

9305. J. W. Bailey and J. A. R. Greaves. Manufacture of a new or improved saccharum for brewers, distillers, and vinegar makers. July 28.

9401. V. d'Ostachiewicz and L. de Gerlicz. Improvements in the process of alcoholic fermentation. July 28.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

10,171. J. Greenwood, London. Improved method of preserving milk and also destroying all bacteria or disease germs existing therein, by means of electricity. July 13.

10,488. A. W. MacIlwaine, London. An improved manufacture of cattle and other food. July 19.

11,113. C. T. Vachell, Bristol. Improvements in cooling and preserving food, and in vessels employed therefor. August 1.

11,180. J. Mitchell. *See* Class XVII.

11,225. A. B. Lennox, T. Field, and W. Brown, London. Improvements in bread fermentation. August 3.

11,447. A. C. Drenckhan, London. An improved process for rendering milk consistent without any chemical alteration of the same. Complete Specification. August 8.

11,500. W. Robertson, London. An improved article of food or solidified jelly. August 9.

B.—SANITARY CHEMISTRY.

10,879. G. Francis, London. Improvements in the construction of furnaces for destroying refuse. July 27.

11,663. T. Donnithorne, London. Improvements in the treatment of sewage. August 13.

11,841. A. N. Bertram, Glasgow. Improved method of destroying the noxious fumes or gases arising from chemical manufactures or processes. August 16.

C.—DISINFECTANTS.

11,069. H. Oppenheim, jun., and R. H. E. Hewer, London. The manufacture of a valuable disinfectant in the form of an antiseptic and deodorising tablet. July 31.

COMPLETE SPECIFICATION ACCEPTED.

A.—CHEMISTRY OF FOODS.

1887.

13,840. A. H. Huntley. *See* Class XVII.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

10,227. J. Williams, Willesden. Improvements in rendering paper and textile fabrics waterproof. July 14.

10,598. K. M. Tata, London. Improvements in writing paper. July 21.

10,915. W. D. Grozier, Glasgow. Improvements in connection with the pulp strainers of paper-making machines, the same being applicable to pulp strainers generally. July 28.

11,061. J. B. Ryder, London. Improvements in apparatus for straining pulp. July 31.

11,124. J. H. Robinson and A. Robinson, Manchester. Improved material to be used as, or as a substitute for, paper, and in the manufacture thereof. August 1.

11,150. C. F. Dahl, London. A new and improved blowing-out and washing process in making paper pulp from esparto, straw, and other similar vegetable substances. August 1.

11,152. F. Darkin, London. Machine or apparatus for separating vegetable fibres from the pulpy matters. Complete Specification. August 1.

11,458. H. Bache-Wüg, C. Barche-Wüg, and V. B. Drewsen, London. An improved method of producing pure cellulose. August 8.

11,848. H. H. Lake.—From A. Selkirk, United States. Improvements in the treatment of vegetable substances for the manufacture of paper stock, pulp, or fibre. Complete Specification. August 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

12,903. A. Wright. Manufacture of paper pulp. July 28.

1888.

9339. T. Goodall and T. Webster. Apparatus for straining pulp. July 28.

8059. H. H. Lake.—From J. A. Manning, W. M. Peckham, and A. Chambers. Apparatus for treating vegetable substances for production of paper stock. August 18.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATION.

11,479. T. Parker and A. E. Robinson, Manchester. Improvements in the manufacture of iodine and iodoform by electrolysis. August 9.

COMPLETE SPECIFICATION ACCEPTED.

1887.

13,366. W. L. Wise. From the Actiengesellschaft für Chemische Industrie. Manufacturing retene from resin oil. August 4.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATION.

10,176. J. Lewis, Birmingham. Improvements in the production of photographs in colours. July 13.

COMPLETE SPECIFICATION ACCEPTED.

1887.

13,725. J. W. T. Cadett. Means for settling or cooling photographic emulsions on glass or other suitable material. August 11.

XXII.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

6498A. C. A. Jensen.—From J. W. Graydon, United States. Improvements in the method of preparing high explosives for use, and in the charge or cartridges made of such explosives. Originally included in No. 6498, and thus ante-dated May 1.

10,284. J. Nicholas, Ilford. Improvements in explosives. July 16.

10,722. A. V. Newton.—From A. Nobel, France. Improvements in explosive compounds. July 21.

10,724. J. Y. Johnson.—From F. C. Glaser, Germany. Improvements in cartridges. July 24.

10,887. S. A. Day, London. Improvements in electric cartridges and primers. July 27.

11,224. L. E. L. E. Maissin, France. Improvements in the manufacture of safety fuses. August 2.

11,422. A. Campbell, jun., and W. R. Lawson, London. A railway fog signal. August 8.

11,750. C. Lamm, London. An improved process for moulding cartridges and apparatus therefor. August 15.

11,751. C. Lamm, London. Improvements in protecting and preserving explosives. August 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,029. T. Nordenfelt. Fuses for projectiles. August 4.

1888.

9398. F. Hargrave. Rockets for signalling at sea. July 28.

◆ ◆ ◆

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THE JOURNAL

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NOTICES.

Foreign and Colonial members are hereby advised that the subscription of 25*s*. for 1889 falls due on January 1st next. The Council having resolved to enforce Bye-law 29, only such members as have paid their subscriptions will be entitled to receive the Journal next year.

Notice is hereby given that the numbers for January, 1882, 1883, and 1886, and February, 1886, are exhausted, and no orders for those copies can be executed.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

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Deaths.

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J. Peter Griess, Ph.D., F.R.S., Burton-on-Trent.

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SESSION 1888-89.

The first Meeting of the Section will take place on Monday, November 5th, 1888.

Papers to be read by—
Mr. J. Heron. "On a new form of Polarimeter."
Mr. Thos. T. P. Bruce Warren. "The Adulterations of Oils and Methods of Detection."

Communication.

A NOTE AND A CORRECTION.

On page 482 of this Journal, the July issue, in the notice of the "Scottish Shale Oil and Paraffin Industry," we say, in reference to a letter exhibited in the Glasgow Exhibition in the show case of Young's Paraffin Light Co. (Limited), that Dr. Lyon Playfair called Mr. Young's attention to the great value of the bituminous Scottish coal and shale. As will be seen from the letter which is now published for the first time by the kind consent of T. Graham Young, Esq., Dr. Playfair called Mr. Young's attention to the petroleum at Alfreton, and not to the Scottish coals and shale.

"26, Castelman Villas,
"Barnes,
"Surrey,
"3rd December 1847.

"My dear Young,

"You know that mineral naphtha is a very rare natural product, and that there is no spring of it in this country, all of it being imported from the Continent or Persia. Lately a large spring of this valuable petroleum has been discovered in my brother-in-law's estate in Derbyshire, near Alfreton. It yields about 300 gallons daily. It is about the consistence of thin treacle and with one distillation gives a clear colourless naphtha of brilliant illuminating power and would dissolve caoutchouc easily. They intend to set up stills for it immediately, but as they are ironmasters and this would be a separate manufacture, I have advised them, if possible, to sell it in the crude state to chemical manufacturers, and thus not introduce a new system. Now, does this come within the possible province of your works? if so, I will get you a gallon bottle sent for examination, and perhaps you could make a capital thing of it and enable my friends to do the same. Now, as a member of Council of the Chemical Society, let me remind you of your promise of a paper on gases for us, do not forget that.

"Ever yours,
"Lyon Playfair.

"P.S.—You know naphtha is now extensively used for adding to the illuminating power of gas, and you know the bitumen, the residue of the distillation, is a valuable product."

Obituary.

J. PETER GRIESS, Ph.D., F.R.S.

A VICE-PRESIDENT OF THE SOCIETY OF CHEMICAL INDUSTRY.

It is with great regret that we have to announce the sudden death, by an attack of apoplexy, of Dr. J. Peter Griess, F.R.S., on Wednesday night or Thursday morning of August 29th or 30th. He had left Burton-on-Trent just a fortnight before his death for a holiday rest at Bournemouth, and had taken with him his four children. He was then believed to be in good health, and appeared to remain so up to the time he retired to his room on Wednesday night (August 29th). On Thursday morning he was found dead in bed by the side of one of his sons, who was suffering from congestion of the lungs.

Dr. Griess was sixty-four years of age, and had been with the firm of Messrs. Allsopp and Sons about twenty-seven years. His wife, formerly a Miss Mason, daughter of the late Mr. W. Mason, surgeon, and sister of Mr. P. B. Mason, J.P., died a few years ago. The remains of the distinguished chemist were interred on Monday, September 3rd, in the tomb of his late father-in-law, Dr. Mason.

Dr. Griess was a native of Hesse-Cassel, and eventually became a student under Kolbe at Marburg along with Professor Schmitt of Dresden, who was also a friend of his early boyhood, as well as a schoolfellow. About the year 1856 Griess came to London as private assistant to Dr. A. W. Hofmann, of the Royal College of Chemistry, and here he laid the foundation of his future great work on the diazo- and azo-compounds. As the translated extract from his letter to the writer, printed in this Journal 1887, 626, shows, the reaction discovered by Gerland in Kolbe's laboratory, by which, at Kolbe's suggestion, nitrous acid was caused to act upon amidobenzoic acid, and to produce the hydroxybenzoic acid, suggested to Griess the idea of converting picramic acid into the dihydroxydinitrophenylic acid in a similar manner, but Griess worked in a cold solution, whilst Gerland employed higher temperatures. The result was that Griess obtained a compound of a new order; and his own words should here be quoted, as they are of great interest.

"In gleicher Weise versuchte ich nun die Picraminsäure (Amidodinitrophenylsäure) in Oxydinitrophenylsäure $C_6H_2(NO_2)_2(OH)_2$ überzuführen, wobei ich jedoch eine Verbindung mit so auffallenden und eigenthümlichen Eigenschaften erhielt, dass ich sofort vermuthete dass dieselbe einer ganz neuen Körperklasse angehören müsse." (See this Journal *loc. cit.*).

The discovery of the first diazo-compound was made in the year 1858, as Griess himself says in his letter to the writer already referred to, but so far as we know his first research was published in Liebig's Annalen in 1856. Since that time his published papers have been very numerous, as the Proceedings and Transactions of the Royal Society, the Chemical Societies of London and Berlin, and the Philosophical Transactions (Edinburgh) bear testimony, and his work on the azo- and diazo-compounds forms specially classic ground.

In 1859 Griess came to Burton to act as chemist to Messrs. Allsopp and Son, and he filled the post of scientific adviser to this firm up to the time of his death.

In 1869 the greatest honour this country can confer upon high scientific merit was awarded to him in his election as a Fellow of the Royal Society. He was connected at an early date with the Chemical Society, and has filled the office of Vice-President of that body. He was also a Vice-President of the Berlin Chemical Society and of the Society of Chemical Industry, and he was an original Fellow of the Institute of Chemistry. The University of Munich conferred upon him the degree of Doctor of Philosophy *pro honoris causâ*, and he had more than one call to a professorial chair in the Universities of Germany. These offers were, however, declined, as he felt that his usefulness would not be increased by such a change, and that to take any active part in professorial duties would interfere too much with the work he had set himself to do. The subject of this brief notice was an ideal student; one who quietly and unostentatiously pursued truth for its own sake, and possessed in an eminent degree the true scientific instinct. Endowed with a rare combination of mental gifts, a mind clear and logical, and well stored with the most varied knowledge, and an untiring tenacity of purpose, he was well fitted to wrest from Nature some of her inmost secrets, which he has opened, and left to the world as an inheritance. Those who had the privilege of his friendship found in Dr. Griess a generous, warm-hearted, and true friend, and one who was ever ready to encourage and help younger men along the path of scientific research which he himself had traversed so successfully.

They will not soon forget that open, genial countenance which truly expressed the breadth of mind and sympathy combined with simple directness of purpose so characteristic of the man.—W. S.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

A Self-registering Thermometer. C. Lintner, sen. Allgem. Brauerei-und Hopfen-zeit. 28, 1039.

One of the most important operations in the preparation of malt is the drying of the malt, and it is of great importance to have a permanent record of the prevailing temperature of the drying kiln. Sendtner has constructed a thermometer for this purpose, which has proved in many breweries both very suitable and trustworthy. It consists of two glass rods, between which a metal rod is fixed. The metal of the bar consists of an alloy, which has a high coefficient of expansion, and the molecular structure of which is not altered at the temperature prevailing in the drying kiln. The rod is connected by levers with an autographic apparatus.—S. H.

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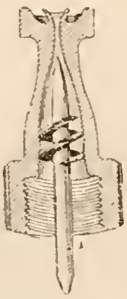
* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*.	½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*.......	1*d*.
„ 1*s*. 6*d*., „ „ 2*s*. 4*d*.......	1½*d*.
„ 2*s*. 4*d*., „ „ 3*s*. 4*d*.......	2*d*.

Application of Watersprays to Chemical Industry. Zeits. f. angew. Chem. 1888, 404.

The waterspray (Fig. 1) made by Körting, of Hanover, contains in the contracted part a spiral of metal, which is kept in its place by the pressure of the fluid.

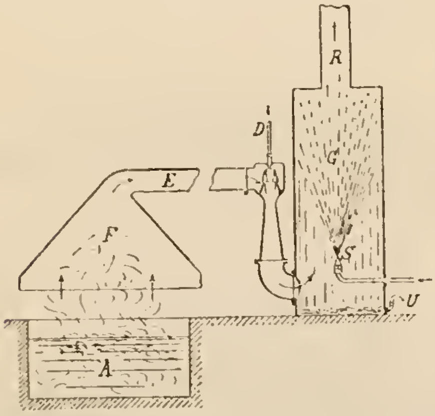
Fig. 1.



The liquid in passing through it receives a circular motion from the spiral, and issues from the jet in a conical shower of small drops. This spray is used to moisten the air of spinning works, chicory manufactories, and malt kilns, to lay dust, and for similar purposes.

Small sprays, made of platinum, are also in use, whilst in two superphosphate works it is used to condense the fumes (HF, &c.) evolved on treating the phosphatic mineral with sulphuric acid.

Fig. 2.



The arrangement is shown in Fig. 2. A hood F is fixed over the vessel A in which the mineral is treated with sulphuric acid. A steam pump D aspirates the acid fumes through E, and drives them into the vessel G. This space is completely filled with finely divided water from the spray diffuser S. The purified gases escape at R, and the acid liquid is drawn off at U.

The spray might be used perhaps with advantage in Glover and Guy-Lussac towers.—H. T. P.

PATENTS.

Improvements in and connected with Apparatus for distilling Ammoniacal Liquors. R. Wyllie, Warrington. Eng. Pat. 11,799, August 31, 1887. 8*d*.

This invention relates more especially to the distillation of ammoniacal liquors produced or used in the ammonia-soda process. The ammoniacal liquor, in finely-divided streams, is subjected to heat. The streams of the liquor are obtained by bringing the liquor on to a succession of trays arranged in a vertical apparatus. The edges of these trays are serrated, and the liquor in flowing over the edges is broken up. The overflow is caught by lower or catch trays which constitute diaphragms. A central hole, with a serrated rim, is provided in each catch tray. The liquor overflowing from the lip of the uppermost tray falls on to the catch tray below it, and then flows over the lip of this tray on to the next, and so on throughout the series of trays. Steam passes in the opposite direction to the liquor, heats the finely-divided streams of the liquor, and carries forward to the outlet of the apparatus the free ammonia liberated. Previously to the above described process, the steam is passed repeatedly through the same liquor in another series of trays which form diaphragms. To the liquor in these trays milk of lime is added. Each of these trays is provided with a man-hole and lid and several pipes of an inverted U form, through which the steam and ammonia ascend in their flow upwards. The exits of these pipes deliver the steam and vapour in a horizontal direction to the bottom of the trays and the liquor contained in them, thus causing a very active circular motion of the liquor. The liquor descends from one tray to another by overflow pipes, the mouths of which are placed at such a distance from the bottom of the trays as will maintain the required depth of liquor within them, and their lower ends dip into the liquor of the tray next below. Thus each pipe is sealed, and the spaces between the trays constitute close compartments. The inverted U pipes and the dip pipes are provided with non-return check valves. When the liquors reach the bottom compartment all the ammonia has been liberated, and they are discharged through a suitable pipe.—S. H.

An Improvement in Refrigerating Apparatus. I. Imray, London. From La Compagnie Industrielle des Procédés Raoul Pictet, Paris, France. Eng. Pat. 12,631, September 17, 1887. 8*d*.

From two horizontal cylindrical vessels, connected together by pipes at their ends, a number of U tubes extend down into the brine (or other liquid to be cooled), each U tube communicating by its upper limbs with the two vessels. All the U tubes are tied together by copper strips extending the whole length of their straight sides, each strip soldered along its edges to two contiguous U tubes. The vessels and tubes are charged with volatile liquid in sufficient quantity to fill the U tubes and nearly half the cylindrical vessels above, leaving in these spaces for vapour. On exhausting, evaporation takes place, the U tubes withdrawing heat from the liquid to be cooled. In this apparatus a large amount of surface is exposed.
—O. H.

Improvements in and relating to Apparatus for evaporating Brine and other Solutions, and for similar purposes. A. Knoop, Minden, Germany. Eng. Pat. 17,290, December 15, 1887. 8*d*.

The apparatus consists of a cylindrical vessel into which the brine, alcohol, or other liquid to be evaporated or distilled is fed through a rotary distributing pipe which projects the liquid against the sides of the vessel, which are heated from without. The apparatus cannot be described in detail without the drawings which accompany the specifications. –E. E. B.

Improvements relating to the Purification of Water in Steam Boilers and to Apparatus therefor and for similar purposes. H. T. Yaryan, Toledo, U.S.A. Eng. Pat. 6352, April 28, 1888. 8*d*.

In the working of steam boilers the water becomes contaminated with oil, gathered in the process of condensation, and it is the custom to remedy this defect by surface blow-offs, whereby a portion of the oil is removed. To avoid the waste of water that results, this invention provides an apparatus for the collection of the impure blow-off water and the separation of its impurities by evaporation, the pure condensed water being returned to the boiler. The apparatus is also arranged for the distillation of sea-water to compensate for loss in the working of the boiler.—W. E. K.

II.—FUEL, GAS, AND LIGHT.

Combustion of Coal. Scheurer Kestner. Rev. Scient. February 18, 1888.

This paper, read before the Société Chimique of Paris, gives a resumé of some researches upon the combustion of coal carried on since 1868.

In 1858 the Société Industrielle of Mulhouse organised a competition for the purpose of ascertaining what was the most advantageous form of steam boiler. Several systems were tried on the large scale and under the same conditions, and the results were reported upon by M.M. Burnat and Dubied. These gentlemen availed themselves of all the resources that physical science could place at their disposal, but the chemical aspect of the question received little attention. Their conclusions as regards the air supply were based mainly upon the readings of the anemometer, and they had not the assistance that would have been afforded by an analysis of the gaseous products of combustion. Consequently they were ignorant as to the amount of heat lost by combustible gases passing away unconsumed, and as to the conditions required for minimising this loss. It should also be remembered that the data furnished by the anemometer, incomplete under any circumstances, are further vitiated by the large inrush of air that takes place whenever the fire-hole door is opened.

This was not the only defect in their report. They had attempted to compare the number of calories generated with the number for which they could actually account, and found themselves confronted by the enormous discrepancy of a deficit of 20 per cent. Now, at the time of these experiments no one had accurately determined the heat of combustion of any coal, and M.M. Burnat and Dubied, in order to ascertain the amount of heat generated, were obliged to avail themselves of the exceedingly defective law of Dulong, and calculate the heat of combustion of the coal from its elementary composition, attaching to the carbon and hydrogen of the coal the respective coefficients 8,080 and 34,600, and deducting from the number so obtained that corresponding to the oxygen, which is considered as forming water.

Such was the position of affairs when the author took up the matter in 1868, with a view to combating this discrepancy of 20 per cent. Realising that it might proceed either from heat having in some way escaped unnoticed, or from an over-estimation of the heat of combustion of the coal, he made a threefold division of the problem, and set himself—firstly, to ascertain the quantity and composition of the products of combustion; secondly, to determine accurately the heat of combustion of coal; thirdly, to repeat the experiments of M.M. Burnat and Dubied, following their method, but with such modifications as might be suggested by the study of the composition of the gaseous products of combustion.

The composition of the gases arising from the combustion of coal had been studied before 1868 by men whose names —that of Ebelmen, for example—are sufficient guarantee for the accuracy of their figures as applied to their analyses; but unfortunately the manner in which their samples were drawn precludes our attaching any importance to their results. Peclet, the first in this field, contented himself by reversing a flask filled with water in the gaseous current. Ebelmen's experiments were as imperfectly conducted, though this remark does not apply to his researches upon blast furnace gases, which are much more uniform in composition. No more reliable are the experiments of Sauvage, whose samples were taken over some minutes from the grate of a locomotive in motion; nor those of M. Comines de Marsilly, whose sampling did not extend beyond seconds; nor those of M. Debette, quoted by M. Combes, in his report on the means of consuming or preventing smoke. It will be seen at once to be of vital importance that the sample operated upon should be thoroughly representative of the gases under investigation, and to this end the fire should be in operation at least a day before the conditions may be considered normal. It is also necessary that a large number of samples should be taken, or else (which is preferable) that the drawing should be a continuous one.

A point in the flue leading to the chimney was chosen for the taking of the samples, in order that the gases might be as well mixed as possible. Another reason for this was that, as Cailletet has shown, the gases too near the fire exist in a state of dissociation. For the actual drawing the plan adopted was to take first a very large sample, and then a further sample from that. A column of ten metres of water, three centimetres in diameter, was employed to aspirate a considerable quantity of gas from the flue, and from this current on its way from the flue to the aspirator, a second sample was drawn into a glass gasholder containing several litres of mercury. The drawing of samples extended over the whole length of the operation.

The earlier investigators have, in the author's opinion, established one fact only, viz., that in the products of combustion, in spite of the presence of an excess of oxygen, there are always to be found combustible gases—carbonic oxide, hydrocarbons, and free hydrogen. Reason would indicate—and this is borne out by the author's researches—that the higher the excess of oxygen the lower would be the proportion of combustible gases, but the worthlessness of some of the old analyses on this subject is evidenced by the fact that they show at one time excess of oxygen and excess of combustible gas, and at another time a deficiency of both. The samples giving such results have evidently been non-representative.

An exhaustive series of experiments was made with a view to determine the most advantageous proportions in which air should be admitted. When Ronchamp coal was supplied with 8—9 c.m. of air per kilo. the combustible gases escaping unconsumed amounted to from 6 to 18 per cent. upon the carbon in the coal. With 10—12 c.m. the loss fell to 4—6 per cent., and with 15 c.m. it was only 1—1½ per cent. The net result of these experiments led to the conclusion that an excess of air should be employed, amounting to about 50 per cent. of the quantity theoretically required.

To ascertain the loss occasioned by smoke a measured quantity of the gas was aspirated through a glass tube lightly packed with asbestos for a length of 25—30 c.m. This filtering apparatus was placed side by side with the tube, through which passed the sample for analysis. The black discolouration, which did not penetrate more than 5—6 c.m. into the asbestos, consisted not only of carbon but also of hydrocarbons, which imparted to it a tarry consistency. The quantity was determined by combustion, and subsequent weighing of the carbonic acid formed. Strange to say, even when a very thick black smoke was purposely produced by limiting the air supply, the loss to be accounted for in this way was only 1½ per cent. An increase of the air supply reduced it to one-half per cent. These figures are confirmed by the general experience with smoke-consumers. Many eminent engineers, and not a few quacks, have occupied themselves with apparatus for this purpose, but its use has always involved a loss instead of effecting an economy. The author knows of only two effectual methods of smoke-consuming. The one is to avoid the formation of smoke by a gradual system of mechanical firing; the other is to burn the smoke formed at the moment of charging by promoting an intimate mixture of the very hot gases, a jet of steam being introduced for this purpose close to the bridge. In both cases the cost of working exceeds the saving effected by the suppression of the smoke, and practice is still behind theory in this respect at least. Smoke is formed in two ways. Berthelot has shown that certain hydrocarbons when heated to suitable temperatures are decomposed with formation of a new hydrocarbon and deposit of solid carbon. This takes place on the grate where combustion is going on. The second way is by the dissociation of the gases. The author has proved this by the following experiment—a repetition of one of Deville's, to whom the discovery of dissociation is owing. A curved copper tube was introduced into the gaseous current just behind the fire-bridge, both ends of the tube projecting outwards. When this tube remained empty it soon attained the temperature of the gases at this point, and when withdrawn was coated with a mixture of cupric and cuprous oxides, according as the current at that place was more or less oxidising or reducing. When, however, water was allowed to circulate through this tube so quickly as not to be sensibly warmed, there was deposited a thick coating of smoke-black proceeding from the dissociation of the gases. The sudden cooling necessary to produce this effect is provided by the boiler surface, dissociation occurring when the hot gases come into contact with its comparatively cool shell.

The volume of air passing through the grate was calculated from the composition of the products of combustion, the following formula being employed—

$$V = \left[\frac{C}{0{\cdot}000536\, V'} \left(V' + \frac{V''}{2} + V''' \right) + \frac{8\left(H - \frac{O - S}{8}\right)}{0{\cdot}001437} \right] 4{\cdot}761.$$

Where V represents the volume of air employed per kilo. of coal burnt; C, O, H, S, respectively, the carbon, oxygen, hydrogen, and sulphur in grammes per kilo. of coal burnt; 0·000536, V', V'', V''' respectively, the carbon, carbonic acid, carbonic oxide, and oxygen contained per litre of the products of combustion; 8, the equivalent of oxygen; 0·001437, the weight of a cubic centimetre of oxygen; 4·761. the proportion by volume existing between air and the amount of oxygen it contains. It must of course be understood that only the pure coal actually burnt was taken into consideration, the necessary deductions being made for ashes, &c. passing through the grate-bars.

It was thought necessary to supplement the study of Ronchamp coal (a bituminous one) by similar researches with other coals, in order to establish some relation between the nature of the coal and the gaseous products of combustion. From this point the co-operation of M. Meunier Dollfus was obtained. Samples from the Sarrebrück coalfield were employed as offering a choice of coals both bituminous and otherwise. The products of combustion of the various kinds differed little from one another or from those of the Ronchamp coal. On the whole they required rather more air and yielded rather more smoke—the percentage of the latter rising to 2 under the conditions most favourable for its production.

In the direction of the second part of the author's plan of research there had also been no serious experiments made previously. Dulong, indeed, had fixed the average heat of combustion of coal at 7,600, but his results were obtained with imperfect apparatus, nor did he define what he considered an average coal; and it will be readily seen that the heat of combustion may vary according as the coal is more or less bituminous and contains a higher or lower percentage of ash. The author and his colleague determined therefore to disregard Dulong's figures, and make accurate determinations of their own. The samples operated upon were obtained by repeated subdivisions of the bulks of coal actually used at the boiler fire, and, as finally obtained, consisted each of some 10 grms. in the state of fine powder. Their representative nature was established by the close agreement between the percentages of ash yielded by them and the weights actually obtained from the boiler ash-holes. The fineness of the samples was at first a source of some difficulty, as the combustion of a powder was incomplete in the calorimeter employed—that of Favre and Silbermann. It swelled up and caused the formation of smoke, which would of course have impaired the accuracy of the results, but this drawback was obviated by substituting a platinum capsule hung by three wires for the platinum cartridge case used by Favre and Silbermann, and by not operating on more than 5 or 6 decigrammes of substance. The combustion was effected by a current of oxygen (diluted in some instances with air), which was brought by a fine jet to the centre of the capsule. But the employment of so small a quantity of substance involved a new difficulty. Favre and Silbermann had so conducted their experiments as to secure an elevation of some 10° in the calorimeter bath, but in this case the temperature did not rise more than 2°, and an ordinary thermometer was of no use. A special thermometer was therefore made by M. Baudin for this purpose. It contained 63 grms. of mercury; each degree occupied a length of 36 millimetres on the scale, and was divided into 50 parts, but could be read to a five-hundredth. This instrument, which has since become well known, was also on Walferdin's metastatic principle, serving for all ranges of temperature, though its stem only comprised 10° Centigrade. It may be worth mentioning that, as stated by Mulder, soda-lime was found to be very much superior to potash as an absorbent for the gases produced by the combustion.

From these experiments it was seen that the heats of combustion of different coals varied considerably, sometimes exceeding the values found by calculation, and sometimes (but more rarely) falling short of them. Generally speaking, however, bituminous coals gave higher results and a larger volume of gaseous products of combustion than non-bituminous. The bituminous coal of Creusot gave 9,620 calories; the non-bituminous from Louisenthal in the Sarrebrück district gave only 8,215. With the exception of a Russian coal which fell even below that of Louisenthal, these were the two extremes, the yield in most cases lying between 8,500 and 8,700 calories. Instances were found of coals showing identical elementary composition, but differing considerably in calorific power. A partial light is thrown on this phenomenon by a knowledge of the fixed and volatile constituents of the coal, as will be seen directly, but so far the investigators have found themselves unable to determine the calorific power of any coal with certainty save by actual experiment. It almost always exceeds that obtained by following Dulong's law, and often exceeds the addition of the calorific powers of the total carbon and hydrogen present.

M. Cornu, the engineer of the Société des Appareils à Vapeur, of Lille, has put forward a theory that the fixed carbon in a coal may have a different calorific power from that which is volatile. To the former he assigns the established value for wood charcoal 8,080, and to the latter 11,214 as the heat of combustion of carbon in the state of vapour. This hypothesis applied to the author's results appears to indicate a means of arriving at the calorific power by calculation much more approximately than is possible by the use of Dulong's law. If the heats of combustion of the two kinds of carbon and of the hydrogen be added together, and the oxygen disregarded, the error rarely exceeds 5 per cent. In proof of this may be cited the fact that the heats of combustion of 20 coals from the North of France were determined by actual experiment and compared with the figures obtained by using M. Cornu's formula. In four cases the agreement was perfect, in seven there was a discrepancy of 1—2 per cent., and in six a discrepancy of 3—6 per cent., while in three the difference rose to 8—11 per cent.

The task now remaining was to repeat the experiments of M.M. Burnat and Dubied on the large scale, following their methods but drawing conclusions as to volume from the composition of the escaping gases instead of from the readings of the anemometer. It has already been shown that the deficit of 20 per cent. observed at Mulhouse in 1858 could in no wise be attributed to an over-estimation of the heat of combustion of the coal employed.

The boiler used in the author's experiments was of the kind common in Alsace, three-tubed, externally fired, and provided with a feed-water heater. Although every conceivable precaution was taken to prevent the escape of any calories unnoticed, and although the smoke and the composition of the gases were taken into account, the observations of 1868 showed a deficit ranging from 21 to 27 per cent. The calories in the case of Ronchamp coal were distributed as follows:—

	Per Cent.
As steam	63·6
In chimney gases	5·1
As combustible gases escaping	4·9
As smoke	0·
As water vapour in the smoke	3·
Not traced	23·
	100·0

Since that time the feed-water heater has been changed for another of improved construction. The old one consisted of six cylinders placed two by two in a brickwork setting, and the feed water traversing these acquired a temperature corresponding to 8 per cent. of the total calories generated. With the new heater, which was on the tubular system, the efficiency rose to 12 per cent.

An experiment made three years ago on a coal from the Ruhr gave the following results :—

	Per Cent.
Calories converted into steam................	67·3
„ traced in products of combustion ...	11·6
	78·9

and in a recent trial of an English coal of exceptional quality, almost smokeless and giving only traces of combustible gases, steam was raised equal to 74·5 per cent. of the total calories generated, and the deficit was reduced to 17 per cent. To get some idea of the direction of this loss it was suggested by an English engineer, Mr. Donkin, that the boiler should be got under pressure, and that account should be taken of the quantity of fuel required to keep it *in statu quo* for a given length of time, all outlets being closed. This experiment was carried out over several days and nights, and led to the conclusion that the loss by radiation from the boiler alone was about 4·6 per cent. Of the remaining 12 per cent. the author's opinion is that almost the whole may be accounted for by external radiation. The return of steam was found to vary by from 8 to 10 per cent., according as the experiment was carried out in summer or winter. This fact was established by repeated experiments with different kinds of coal. Now, if the difference of temperature between summer and winter can cause this variation (equal to about 7 per cent. of the total calories), it may fairly be inferred that, if we could estimate the loss resulting from the constant contact of the brickwork with the surrounding air, we should not fall far short of the total number of calories to be accounted for. This opinion is confirmed by more recent experiments not yet made public.

On account of the hostile criticism to which the work of the author and his colleague has been exposed, it was thought advisable to repeat in 1885, after an interval of 17 years, the old experiments of 1868. The results were the same; and the heat of combustion of Ronchamp coal was determined anew within a few calories of the value found in 1868. Further, M.M. Schwackhoefer, in Austria, and Alexejeff, in Russia, have recently published researches upon the calorific power of the coals of their respective countries, and for certain qualities have obtained results as high as the author's. In fact the hostile criticism, of which M.M. Fischer and Bunte were the chief exponents, may now be considered as silenced. The name of M. Bunte recalls mention of a Society that was founded in Munich for the purpose of determining at one and the same time the heat of combustion and the practical calorific power of the principal coals of Bavaria. Over 100,000 francs were spent for this purpose, but unfortunately the apparatus employed was neither a calorimeter nor a boiler, and the results could neither be compared with those yielded by calorimetric research nor with the efficiency observed in actual industrial practice. Imperfect, however, as the apparatus was, it appears that certain coals gave results exceeding the values obtained by calculation : one, a sample from the Ruhr, exceeding the calorific intensity found by the author in his own investigations, and yielding 300 more calories than were obtained by adding the heats of combustion of its carbon and hydrogen. This fact, however, had quite escaped the notice of M. Bunte, because in his calculations he had neglected to take into consideration the ash of the coal, and the effect of this omission will be seen at once from the fact that the sample analysed contained only 6 per cent. of ash, whereas that actually used at the furnace gave 11—almost double.—A. R. D.

PATENTS.

Improvements in the Desulphurisation of Gaseous Products. J. J. Hood and A. G. Salamon, London. Eng. Pat. 10,127, July 19, 1887. 6*d.*

The desulphurising agent employed is an artifically prepared hydrated dioxide of manganese, such as "Weldon mud." The gas may be passed through water holding this in suspension, or the mud may be dried and so packed in a convenient apparatus that the gas may pass over and through it. If an excess of acid be present, a salt of manganese is formed, and free sulphur deposited, but if the mud be used in its original alkaline state, as is preferable, sulphide of manganese and free sulphur are formed. In this latter case the sulphide of manganese will retain any carbon bisulphide that may be present. After use the mud may be revivified by atmospheric oxidation until highly charged with sulphur. It is then treated with dilute acid, whereby the manganese is dissolved out—to be reconverted into hydrated dioxide for use over again. Or, alternatively, the sulphur may be burned from the spent material, and the residual oxides of manganese used in the manufacture of chlorine.
—A. R. D.

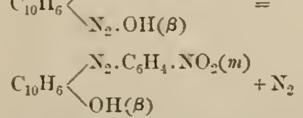
Improvements in Incandescence Bodies for Illuminating purposes and in the Treatment of Mantles produced therefrom. O. Imray, London. From C. A. von Welsbach, Vienna, Austria. Eng. Pat. 11,195, August 16, 1887. 6*d.*

Incandescence bodies prepared from the earths of the rarer metals, as described in Eng. Pats. 15,286 of 1885 (this Journal, 1886, 522), and 3592 of 1886 (this Journal, 1887, 212), are strengthened by an impregnation with a solution of one or more of the following salts, the strengthening being produced by the vitrification that takes place on the application of heat. The salts recommended are the niobates, tantalates, titanates, silicates, and phosphates of the rarer metals and magnesium. To facilitate the combustion of the fibrous material used in the preparation of these incandescence bodies, an impregnation with nitrate of ammonium is prescribed.—A. R. D.

IV.—COLOURING MATTERS AND DYES.

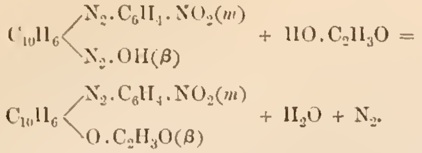
Researches on the Constitution of Azo- and Diazo-Derivatives. III. Compounds of the Naphthalene-β-Series. R. Meldola and F. J. East. J. Chem. Soc. Trans. 1888, 460.

The chief object which the authors have in view in this branch of their work is the determination of the constitution of the azo-derivatives of β-naphthol and β-naphthylamine. In the present paper, which is the first instalment of the series, the action of nitrous acid has been studied under various conditions upon the azo-derivatives obtained by the action of the diazotised nitranilines on β-naphthylamine. If metanitrobenzene-azo-β-naphthylamine is dissolved in 140—150 parts of glacial acetic acid and the theoretical quantity of sodium nitrite (one molecule) added to the cold solution, a diazo-compound is formed, and this on heating the solution to the boiling point, becomes decomposed with the formation of the corresponding β-naphthol-azo-derivative in accordance with the equation—



$$C_{10}H_6\left\langle\begin{matrix}N_2.C_6H_4.NO_2(m)\\N_2.OH(\beta)\end{matrix}\right. = C_{10}H_6\left\langle\begin{matrix}N_2.C_6H_4.NO_2(m)\\OH(\beta)\end{matrix}\right. + N_2$$

By using less acetic acid (70 parts) and keeping the temperature at 70° during the whole course of the reaction, the acetic acid itself takes part in the process with the formation of metanitrobenzene-azo-β-naphthyl acetate—



$$C_{10}H_6 \begin{cases} N_2.C_6H_4.NO_2(m) \\ N_2.OH(\beta) \end{cases} + HO.C_2H_3O =$$

$$C_{10}H_6 \begin{cases} N_2.C_6H_4.NO_2(m) \\ O.C_2H_3O(\beta) \end{cases} + H_2O + N_2.$$

The latter compound, when crystallised from alcohol, forms red filamentous needles melting at 161°—162° C., and easily decomposed by alcoholic potash with the formation of metanitrobenzene-azo-β-naphthol (m.p. 194°). By a similar process paranitrobenzene-azo-β-naphthyl acetate, which forms flat orange needles melting at 192°—193° C., was obtained from paranitrobenzene-azo-β-naphthol (m.p. 249°). Both these azo-β-naphthyl acetates can also be prepared by the direct acetylation of the corresponding azo-β-naphthol compounds by boiling the latter with acetic anhydride and anhydrous sodium acetate. In a similar way benzene-azo-β-naphthyl acetate, $C_6H_5.N_2.C_{10}H_6.OC_2H_3O(\beta)$ has been prepared by the action of sodium acetate and acetic anhydride on benzene-azo-β-naphthol. It forms orange-coloured scales melting at 117°. The authors point out in conclusion that the reactions of the β-naphthylamine azo-derivatives described in the present paper, taken in conjunction with the work of Zincke and others, appear to negative the idea formerly entertained that these compounds no longer contain amidogen. If this conclusion should be confirmed by the study of the products of reduction of the alkyl or acetyl derivatives, which is now being undertaken in the Finsbury Technical College, it will follow that the azo-naphthol compounds also contain hydroxyl. The authors reserve expressing any opinion on the constitution of these β-naphthalene derivatives till more experimental evidence has been acquired.—R. M.

Researches on the Constitution of Azo- and Diazo-Derivatives. IV. Diazo-amido Compounds (continued). R. Meldola and F. W. Streatfeild. J. Chem. Soc. Trans. 1888, 664.

The authors commence by pointing out that as a result of their former investigations the alkyl-derivatives of diazo-amido compounds containing two dissimilar aromatic radicles of the general formula $X.N_3R'.Y$ are capable of existing in three isomeric modifications:—(1) Produced by the action of diazotised $X.NH_2$ on $Y.NHR'$. (2) Produced by the action of diazotised $Y.NH_2$ on $X.NHR'$. (3) Produced by the direct alkylation of the mixed compound $X.N_3H.Y$ formed by the action of diazotised $X.NH_2$ on $Y.NH_2$, or of diazotised $Y.NH_2$ on $X.NH_2$. In the first part of the present paper a description is given of the methyl-derivative prepared by the methylation of the compound $(m)NO_2.C_6H_4.N_3H.C_6H_4.NO_2(p)$ prepared by the action of diazotised paranitraniline on metanitraniline or of diazotised metanitraniline or paranitraniline (m.p. 211°). It forms bright yellow needles melting at 148°, and decomposed by cold hydrochloric acid into a mixture of meta- and paranitrobenzene-diazo-chlorides and the corresponding methylnitranilines. A pair of isomeric methyl-derivatives isomeric with the preceding has also been prepared, (1) by the action of diazotised paranitraniline on methylmetanitraniline, and (2) by the action of diazotised metanitraniline on methylparanitraniline. Both of these compounds crystallise in the form of small yellow needles, the first melting at 168° and the second at 176°—177°. The compounds $(p)NO_2.C_6H_4.N_3(CH_3).C_6H_4.NO_2(p)$ and $(m)NO_2.C_6H_4.N_3(CH_3).C_6H_4.NO_2(m)$ have been prepared by the methylation of the corresponding symmetrical diazo-amido compounds. The first melts at 219° and the second at 127°—128°. Dinitrodibromo-diazo-amidobenzene, $NO_2.BrC_6H_3.N_3H.C_6H_3Br.NO_2$, obtained by the action of nitrous acid on the nitrobromaniline $C_6H_3.NO_2.Br.NH_2 =$ 1:3:4 (m.p. 104°), forms hair-like orange needles melting at 202°. Paradichlordiazo-amidobenzene, $(p)Cl.C_6H_4.N_3H.C_6H_4.Cl(p)$ and its ethyl-derivative have been prepared, the latter by direct ethylation. The substance is formed by the usual method from parachloraniline, and crystallises in ochreous needles melting at 130°. The ethyl-derivative forms flat, straw-coloured needles, fusing at 85·5°. The mixed compound from aniline and paratoluidine, $C_6H_5.N_3H.C_6H_4.CH_3(p)$, gives an oily benzyl derivative, and the benzyl derivative obtained by the action of diazotised paratoluidine on benzylaniline is also oily. The benzyl derivative of diazo-amidotoluene, $(p)CH_3.C_6H_1.N_3(C_7H_7).C_6H_4.CH_3(p)$, obtained by direct benzylation, forms ochreous needles melting at 114°. The nitranilines (para and meta) do not appear to be capable of forming mixed diazo-amido compounds with parachloraniline; in all the experiments a *mixture* of the two symmetrical compounds was obtained, except in one preparation, when diazotised paranitraniline was made to act upon parachloraniline in hydrochloric acid solution. A very small quantity of a substance crystallising in brilliant octohedra of m.p. 181° was isolated from the mixture in this case, and appeared to consist of the desired mixed compound, $(p)NO_2.C_6H_4.N_3H.C_6H_4.Cl(p)$, but the yield was too small to enable the examination of the substance to be continued. Another pair of mixed isomerides has been prepared (1) by the action of diazotised metanitraniline on ethylparachloraniline, and (2) by the action of diazotised parachloraniline on ethylmetanitraniline. The first of these crystallises in long flat lustrous plates of an ochreous colour melting at 106°; the other modification consists of flat pale yellow needles melting at 129·5°. In the concluding section of the paper the authors give details of a method for determining quantitatively the amount of diazo-chloride formed by the decomposition of the diazo-amido compounds by means of hydrochloric acid in the cold. The method consists essentially in allowing the acid to act upon the finely-powdered diazo-amido compound till decomposition is nearly complete, filtering into an alkaline solution of β-naphthol, and then collecting, washing, drying, and weighing the pure azo-β-naphthol compound on a tared filter. The results show that the resolution is in all cases practically quantitative.—R. M.

On the Naphthylene Diamines, and a New Method for their Formation. M. Lange. Chem. Zeit. **12**, 856—857.

The first commercial use made of these bodies was in the production of an azo colouring matter, from the 1 : 4′ diamine (Germ. Pat. 39,954, Chem. Zeit. **11**, 875), capable of dyeing cotton without a mordaunt.

Liebermann and Dittler also prepared a tetrazo dye from the 1:4 derivative, while the other known naphthylene diamines behave as ortho-compounds.

If a dihydroxynaphthalene be heated with ammonia and ammonium chloride for several hours under pressure to 200°—250° C., the corresponding diamine results, in the form of a sparingly soluble precipitate; *e.g.*, from the dihydroxynaphthalene corresponding to the so-called α-naphthalene di-sulphonic acid of Ebert and Merz (Ber. **9**, 609), a 2:2′ naphthylene diamine is obtained.

This substance is easily soluble in alcohol, ether, benzene, &c., also fairly soluble in hot water, and crystallises therefrom in small white plates, which become reddish when exposed to air, and melt at 161° C. It does not give a colouration with ferric chloride. Most of its salts are easily soluble in water; the hydrochloride is not precipitated by concentrated hydrochloric acid. Nitrous acid converts it into a tetrazo-compound, which forms double compounds with amines and phenols, and yields diazo dyes.

The dihydroxynaphthalene prepared by Emmert (Annalen, **241**, 368) from the β-naphthalene disulphonic acid of Ebert and Merz, when treated by the same method, yields the 2:3′ derivative, melting at 216°—218° C., and giving a green colouration with ferric chloride. Its salts are less soluble than those of the diamine described above, the sulphate being nearly insoluble in cold water; the hydrochloride is precipitated by concentrated hydrochloric acid.

Nitrous acid behaves with this as with the previous substance.

The 1:4′ naphthylene diamine obtained from the dihydroxynaphthalene (Germ. Pat. 41,934. Chem. Zeit. **12**,

220) corresponding to Armstrong's 1:4′ naphthalene disulphonic acid, is identical with that formed by Zinin (Annalen, **52**, 361) from α-dinitronaphthalene.

It melts at 189° C.; its sulphate is difficultly soluble in water, and gives a blue colouration with ferric chloride. It behaves with nitrous acid like the two other diamines described above.

The colours of the diazo colouring matters derived from these naphthylene diamines, in the case when the other substance used to form the double compound is a naphthylamine sulphonic acid, are as follows: yellow-red for the 2:2′ derivative, somewhat bluer for the 1:4′ derivative, and violet-red for the 2:3 derivative. Similar gradations of tint are observed when other amines or phenols are substituted for the naphthylamine sulphonic acid. All these bodies dye cotton without a mordant.—B. B.

PATENTS.

New or Improved Colouring-Matters, and Process of Manufacturing the same. C. S. Bedford, Leeds. Eng. Pat. 12,667, September 19, 1887. 6*d*.

These are yellow, orange, or brown colouring-matters obtained by combining the diazo-salts derived from aniline and its homologues or the naphthylamines, or the sulphonic acids of these bases, with the active principles of fustic and mahogany. As an illustration of the method of working the process, the author describes the preparation of the colouring-matter from Jamaica fustic. The wood is chipped or rasped and exhausted by repeated boiling with water, to which it is preferred to add, for the two first boilings, a three per cent. solution of sodium carbonate. 500 lbs. of wood should give altogether about 860 gallons of liquor. When cold, a solution of 25 lbs. of aniline, made into diazo-sulphate in the usual way, is run into the fustic extract, the solution being kept alkaline by sodium carbonate. The colour is precipitated at once, or may require to be thrown out by sulphuric acid. The brown colouring-matter from naphthylamine is prepared in the same way. The colouring-matters may be produced in the fibre by alternate immersion in the fustic liquor and diazo-solution, and also in the wood itself by rasping the latter and allowing it to remain in the diazo-solution till saturated, when the combination is completed by the addition of sodium carbonate.—R. M.

Improvements in the Manufacture of Azo Dyes. J. Y. Johnson, London. From the "Farbenfabriken vorm. F. Bayer and Co," Elberfeld, Germany. Eng. Pat. 16,484, November 30, 1887. 8*d*.

The colouring-matters claimed are various shades of blue-black capable of dyeing cotton without the use of a mordant, and produced by combining the tetrazo-salts of para-diamines, or their sulphonic or carboxylic acids, with α-naphthylamine, then diazotising the amido-azo compounds thus produced, and combining again with amines, phenols, or their sulphonic and carboxylic acids. The following examples illustrate the method of carrying out the various modifications of the process:—(1.) Benzidine is diazotised in the usual way, and combined with one molecule of α-naphthylamine. The brown amido-azo compound is then again diazotised, and the solution mixed with an alkaline solution of α-naphtholmonosulphonic acid, when the blue-black colouring-matter is precipitated. (2.) Diazotised benzidine is combined with one molecule of α-naphthylamine, as in the last example, the intermediate product again diazotised, and the tetrazo-salt thus obtained combined with one molecule of naphthionic acid and one molecule of α-naphtholmonosulphonic acid. (3.) Benzidine is diazotised as before, and combined with two (instead of one) molecules of α-naphthylamine. The amido-azo compound is then again converted into a tetrazo-salt, and combined with two molecules of α-naphtholmonosulphonic acid. The product is described as a beautiful blue-black colouring-matter. (4.) The insoluble amido-azo compound from tetrazodiphenyl and two molecules of α-naphthylamine is made soluble by sulphonation, then diazotised and combined with two molecules of α-naphtholmonosulphonic acid. The next examples relate to the compounds from paraphenylenediamine and diamido-azobenzene:—(5.) Acetylparaphenylene diamine is diazotised and combined with one molecule of α-naphthylamine; the product is collected and washed with acidulated water, to completely remove any excess of naphthylamine, then again diazotised and combined with α-naphtholmonosulphonic acid in alkaline solution. The acetyl-group is removed by boiling the product with soda lye, the blue dyestuff, now containing an amido-group, is again diazotised and combined with α-naphtholmonosulphonic acid, when a fine indigo colouring-matter is precipitated. (6.) Acetylparaphenylene diamine is diazotised and combined with aniline. After standing for 24 hours the excess of aniline is removed by heating, and hydrochloric acid added. The insoluble product is filtered off, washed with acidulated water, diazotised, and combined with α-naphthylamine, the product again diazotised, and combined with the α-naphtholsulphonic acid. The acetyl-group is eliminated as before, the product diazotised, and then combined with a second molecule of the α-naphtholsulphonic acid. (7.) Paraphenylene diamine is diazotised in strong hydrochloric acid, and the solution mixed with excess of aniline. The diazo-amido compound formed is converted into the amido-azo compound by keeping the mixture at 40° C., with the addition of aniline and hydrochloric acid. The product is filtered, and the uncharged aniline removed by washing with dilute hydrochloric acid. The amido-azo compound is diazotised and combined with α-naphthylamine, the product is filtered, washed with dilute acid, again diazotised, and combined with α-naphtholmonosulphonic acid in the usual way. The colouring-matter is grey-black. The next examples relate to the dyestuffs from naphthylene diamine. (8.) The acetyl-derivative of this last base is diazotised and combined with aniline, the product is collected, washed with dilute acid, again diazotised, and combined with α-naphtholmonosulphonic acid. The acetyl-group is removed from the colouring-matter in the usual way, the product is once more diazotised, and again combined with α-naphtholmonosulphonic acid. (9.) Naphthylene diamine is converted into its tetrazo compound, and the latter combined with aniline and then converted into the amido-azo compound in the usual way. The latter is collected and washed with acidulated water, diazotised, and combined with α-naphtholmonosulphonic acid in alkaline solution, when the colouring-matter at once separates. Any other para-diamine may be used in place of those mentioned in the examples, *e.g.*, benzidine and homologues, benzidine-sulphone, diamidodiphenol ethers, diamidostilbene or fluorene, diamido-azobenzene and homologues, or the sulphonic or carboxylic derivatives of these bases.—R. M.

Improvements in the Manufacture of Azo Dyes. J. Y. Johnson, London. From the "Farbenfabriken vorm. F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 16,493, November 30, 1887. 6*d*.

This specification relates to the production of yellow or brown-red colouring-matters capable of dyeing cotton directly from an alkaline bath without the use of a mordant. The dyestuffs are produced by the combination of tetrazo-salts of diamines with the chrysoïdines or with triamido-azobenzene (Bismarck brown). Mixed azo-dyes can be obtained by combining the tetrazo-salt first with one molecule of chrysoïdine or Bismarck brown and then with a second molecule of an amine, phenol, &c., or the order of combination may be reversed. The intermediate products obtained by the combination of one molecule of the tetrazo-salt with one molecule of triamidoazo-benzene are not in themselves dyestuffs, but can be converted into such by displacing the free diazo-group by hydroxyl by boiling with water. The following examples illustrate the working of the process:—(1.) Benzidine is diazotised and combined with two molecules of chrysoïdine. The product is collected, washed, dried, and made soluble by treatment with fuming sulphuric acid. (2.) Benzidinedisulphonic acid is used instead of the benzidine of the last example, and at once gives a soluble colouring-matter. (3.) Naphthionic acid is diazotised and combined with one molecule of triamido-azobenzene. (4.) The monosulphonic acid of benzidine is diazotised and the tetrazo-salt combined with two molecules of triamido-azobenzene. The product is sparingly soluble in water and dyes cotton of a brownish red.—R. M.

Improvements in the Manufacture of Dyestuffs. J. Y. Johnson, London. From the "Farbenfabriken vorm. F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 6319, April 28, 1888 6*d*.

The inventors have discovered that the sodium salts of the sulphonic acids of certain bases derived from thio-derivatives of paratoluidine are capable of dyeing cotton in an alkaline bath, and also possess the property of being diazotised in the fibre and then of combining with phenols, amines, &c. to form a series of dyes varying from orange to red or violet. The thio-derivatives referred to may be obtained by known methods from two atoms of sulphur and two molecules of toluidine, or from four or more atoms of sulphur and two molecules of the base. The sulphonic acids of these sulphurised bases dye cotton of a greenish-yellow shade. The preparation of dithioparatoluidine is conducted by fusing 10 parts of the base with 6—7 parts of sulphur at 200°—220° C., and finally at 250° C. till sulphuretted hydrogen is no longer evolved. The melt is cooled, powdered, extracted with hot hydrochloric acid, and the dithio-base precipitated by ammonia. The sulphonic acids are prepared as follows:—(1.) Thioparatoluidine is gradually mixed with five times its weight of fuming sulphuric acid containing about 20 per cent. of anhydride, the temperature being kept below 30° C. The operation is complete when a sample dissolves in dilute alkali with a yellow colour. The melt is poured on to ice, and the sulphonic acid, which is insoluble in water, collected and washed and converted into a sodium salt. (2.) The sulphonic acid of dithioparatoluidine is prepared with 30 parts of moderately-heated monohydrated sulphuric acid; the melt is cooled and fuming acid containing 40 per cent. of anhydride added till a sample is soluble in dilute alkali. The product is poured on to ice, collected, washed, dissolved in alkali, filtered and precipitated by hydrochloric acid. The sulphonic acid, after being thus purified, is converted into its sodium salt.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Ligneous Fibre and some Modifications of Cellulose. W. Hoffmeister. Landw. Jahrb. **17**, 239.

The author finds that it is possible to produce a nearly pure cellulose by a suitable treatment of the fibre with potassium chlorate and hydrochloric acid in the cold and a subsequent washing with ammoniacal water. In cases, where the chlorine mixture might destroy the cellulose fibre, the impure cellulose is first extracted with sodium hydrate and then precipitated from this solution. By the action of sodium hydrate solutions of different strengths, cellulose is changed into different modifications. The solubility of cellulose of different origin varies to some extent, but the solution gives the reactions of the common cellulose, although sometimes with some difficulty. The skeleton of mushrooms consists of cellulose, which is completely soluble in hydrochloric acid and sodium hydrate, from which solutions it can be precipitated without change. This cellulose does not give the reactions characteristic to common cellulose. Those forms of cellulose which are soluble in dilute sodium hydrate solutions are more easily converted into sugar than those which are only soluble in concentrated solutions. The substances which incrustate cellulose often prevent the appearance of the cellulose reaction. They can be removed either by hydrochloric acid or ammonia, according to their nature. It is also these bodies which prevent the solubility of cellulose by sodium hydrate and ammoniacal cupric oxide. They are destroyed or dissolved by the chlorine mixture, whereas the cellulose itself undergoes no change. Ammonia extracts a substance which is the cause of the lignin reaction, for if finely-rasped wood be thoroughly extracted with ammoniacal cupric oxide, no lignin reaction can be obtained.—S. H.

PATENTS.

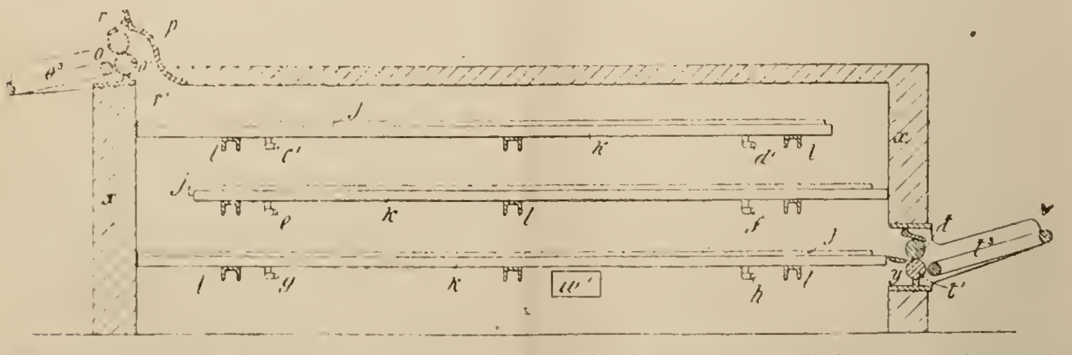
An Improved Method of and Apparatus for Determining the Percentage of Clean Wool contained in a given Quantity of Raw Wool. E. Jaegermayer, Voeslau, Austria. Eng. Pat. 8045, June 3, 1887. 11*d*.

The object of this invention is to enable any person to determine by a rapid and simple operation the yield of any particular quality of raw wool, that is to say, the percentage of clean wool that will be obtained after washing the raw material.

For this purpose a given weight of the raw wool is compressed in a cylinder under a given pressure. An apparatus in connexion with the cylinder indicates the reduced volume of the wool resulting from the given pressure. From this indicated volume is calculated the specific gravity of the raw material, and thus the percentage of clean wool ascertained. The specification is accompanied by a series of 10 drawings.—E. J. B.

An Improved Method of and Apparatus for Carbonising or Destroying Vegetable-matter contained in or Mixed with Woollen, Silk, or other Animal Fibre or Fabric. J. Fitton, J. Fitton, jun., and E. Fitton, Dewsbury. Eng. Pat. 12,506, September 15, 1887. 11*d*.

The apparatus is shown in sectional elevation in the figure. The chamber *x* is made of brick or other suitable material. The iron bars *k* form a series of three floors.



Every alternate bar is connected to a crank motion outside the chamber, which gives to them an up-and-down and to-and-fro motion. In this way the material to be treated, which is fed into the chamber along the endless apron o^3 and through the rollers *r* and r^1, is carried along the floors and is finally discharged by the rollers *t* and t^1. During its passage through the chamber the material is exposed to the action of hot hydrochloric acid gas. The specification contains other drawings illustrating completely the method of working.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Communications from the Chemistry and Dyeing Department of the Bradford Technical College. E. Knecht, Journ. Soc. Dyers and Colourists, 1888, 104—107.

On the Absorption of Certain Acids, Bases, and Salts, by Wool, Cotton and Silk. (O. Fürstenhagen and S. R. Appleyard.)—It is well known that the textile fibres, notably those of animal origin, possess the remarkable property of absorbing certain acids, bases, or salts from dilute aqueous solution, but the actual extent to which such absorption takes place has not hitherto been fully investigated.

The first quantitative determinations appear to have been undertaken by Chevreul, and an account of them is published in the "Dictionnaire Technologique," vol. xxi. p. 365 (about the year 1833). Chevreul finds that when wool or silk is steeped in a dilute solution of acid of known strength, the solution becomes weaker; in the case of cotton, the solution will become stronger. He states, further, that the acid can be removed from the fibre by continued washing.

Bolley, in his "Kritische und Experimentelle Beiträge zur Theorie der Färberei (Zürich, 1859), confirms Chevreul's experiments as regards wool and silk, but finds that cotton is without any action on weak acids.

The most recent investigation on the subject is that of Mills and Takamine, published in the "Journal of the Chemical Society" (March 1883), and entitled: "On the Absorption of Weak Reagents by Cotton, Silk, and Wool." The latter authors divide the results of their investigations into: (1) The rate and amount of absorption of individual reagents; and (2) the ratio of absorption of mixed reagents. The authors have determined, with a great degree of accuracy (the temperatures are even measured to a tenth of a degree), the actual and relative amounts of sulphuric acid, hydrochloric acid, and caustic soda absorbed in certain fixed units of time by cotton, silk, and wool. The chief results arrived at are, that when wool is treated with dilute hydrochloric acid and dilute caustic soda (the solutions containing equal molecules of each reagent), the absorption takes place in the proportion of 2 HCl : 3 NaOH. The corresponding results for silk and cotton are 3 HCl : 10 NaOH. The relative amounts absorbed by cotton and silk are:—

	Cotton.	Silk.
Sulphuric acid.............	1	2·6
Hydrochloric acid.........	1	2·2
Caustic soda...............	1	2·3

In conclusion, the authors express the hope that their investigation, "while bearing, on the one hand, on questions of great technical importance, may not be without its value in the profounder study of cotton, silk, and wool—three bodies of definite chemical composition, but whose intimate constitution still remains obscure."

To this latter passage Knecht takes exception. The assertion that wool and silk are definite chemical compounds requires, in his opinion, stronger confirmation. The various kinds of wool, for instance, which have been analysed, possess, it is true, a *similar* percentage composition, but it is scarcely admissible to represent the chemical composition of this fibre by the formula $C_{54}H_{157}N_5SO_{15}$, especially when the variation amounts to as much as two per cent. in the different analyses. Moreover, the temperatures at which the degrees of absorption were determined 4° C. and 8·2° C. are such as no wool-dyer would think of employing.

It was chiefly with a view of throwing some additional light on the subject of the composition of wool, that a somewhat lengthy and tedious series of experiments was undertaken.

The *wool* used in these experiments was a scoured unbleached flannel, containing 15 per cent. of moisture. The ash contained—

0·094 per cent. calcium, as CaO.
0·224 „ potash, as K_2O.

When boiled for a length of time (about one hour) in distilled water, it left the solution neutral.

The *cotton* used was a boiled and bleached cotton yarn. The *silk* was ungummed spun silk.

Absorption of Acids, Alkalis, and Salts by Wool.—Since the results of these experiments were intended to throw some light on what takes place in the treatment of "all-wool" and "mixed goods," the temperature employed was in each case 100°, which is slightly above that actually used in dyeing on the large scale, but sufficiently near to be able to draw analogies.

The results are of interest as showing the readiness with which wool will absorb a small percentage of acid, and that the absorption is not proportional to the concentration of the solution. Thus, using 2½ per cent. of acid, the proportion absorbed is to that employed as 1 : 1·13, whereas when 40 per cent. are used the proportion is as 1 : 8·3. In the ordinary process of acid dyeing it may be taken, therefore, that from 2·3 per cent. of sulphuric acid is absorbed by the wool. The greater part of this actually remains in the wool if soft water is used for washing off. The tenacity with which the acid is retained by the fibre is readily seen from the results of the following two experiments:—

A quantity of wool was first boiled for one hour in 5 per cent. sulphuric acid. It was then removed, washed lightly with distilled water (back into the original solution), and boiled, for the purpose of removing the absorbed acid, for one hour in distilled water. This was repeated a second and third time, with the following results:—

	Per Cent.
Amount of acid left in solution	1·40
1st boiling out	0·84
2nd „	0·34
3rd „	0·08
Total free acid boiled out	1·26

If this latter figure is added to the amount of free acid left in solution, we get 2·66, which, when subtracted from the amount originally employed, leaves 2·34 as representing the percentage of acid permanently absorbed or neutralised. The amount of free acid retained, even after having boiled for an hour in distilled water, is noteworthy, and shows the great tenacity with which the wool retains the acid. The tendering of cotton warps in mixed goods is no doubt frequently due to this property.

Absorption of Hydrochloric Acid by Wool.—The same conditions were adhered to as in the experiments with sulphuric acid.

Acid employed.	Acid left in Solution.	Acid absorbed.	Indicator.
Per cent.	Per Cent.	Per Cent.	
7·94	4·84	3·10	Phenolphthalein.
15·88	6·75	9·13	„
23·81	11·97	11·85	„

A fresh quantity of wool was now mordanted with 7·94 per cent. hydrochloric acid, and then extracted by successive boilings in distilled water.

——	By KOH and Phenolphthalein.	By $AgNO_3$.
	Per Cent.	Per Cent.
Amount of free acid left in solution	4·83	5·00
1st boiling out	1·29	1·36
2nd „	0·55	0·67
3rd „	0·37	0·38
4th „	0·12	0·18
5th „	0·06	0·17
6th „	Neutral	0·02
Total acid boiled out...	2·39	7·78
Original amount of acid employed	7·94	7·94
Left in solution and boiled out	7·22	7·78
Permanently absorbed or neutralised	0·72	0·16

Absorption of Caustic Potash by Wool.—

Alkali employed.	Alkali left in Solution.	Alkali combined.	Indicator.
Per Cent.	Per Cent.	Per Cent.	
1	0·58	0·42	Mothyl-orange.
2½	1·34	1·16	„
5	2·05	2·95	„

A fresh quantity of wool was now boiled with 2½ per cent. KOH, washed lightly, and extracted with boiling water.

The results show that the affinity of wool for alkalis is not nearly so great as for acids. The amount of alkali permanently absorbed or neutralised is practically nil.

The absorption of certain neutral salts was next studied :—

—	Amount taken.	Left in Solution.	Absorbed.
Sodium chloride	4·85	3·56	0·29
	9·70	9·47	0·23
	19·40	18·63	0·77
Calcium chloride............	9·00	8·99	0·01

A curious result was obtained on boiling wool with 10 per cent. of its weight of magnesium sulphate. The solution after boiling was *alkaline*, in fact its alkalinity was equivalent to 0·52 per cent. MgO. What reactions have actually taken place here it would be difficult to conjecture, but the result is of interest if only as an additional proof of the great affinity which wool exhibits towards sulphuric acid.

Wool boiled in a solution of 10 per cent. of tartar (chemically pure) left 5·6 per cent in solution, and absorbed 4·4. Of this only 0·12 per cent. could be removed by boiling out once with distilled water. The estimation of the tartar was made with caustic potash and phenolphthaleïn as indicator.

Behaviour of Wool towards a Solution of Alum.—The experiments with alum prove more exactly what has long been known—viz., that when wool is boiled in a solution of alum, a basic salt becomes fixed on the fibre, while free acid remains in solution. The acidity of the solution is, however, not nearly so great as is usually supposed to be the case.

Experiments with Cotton.

Sulphuric Acid.—Cotton boiled under conditions similar to those observed with wool in 5 per cent. of its weight of sulphuric acid, absorbed 1·9 per cent., leaving 3·1 per cent. in solution. On boiling out in fresh distilled water the cotton lost further only 0·2 per cent.

In a second experiment, cotton was boiled in 10 per cent. sulphuric acid, then boiled out three times in succession.

	Per Cent.
Amount left in solution	6·57
1st boiling out	0·25
2nd „	0·10
3rd „	0·05
Total boiled out...........	0·40
Total H_2SO_4 originally taken	10·00
Left in solution and boiled out......	6·97
H_2SO_4 absorbed or neutralised.......	3·03

Whether the sulphuric acid is here merely mechanically absorbed or chemically combined cannot at present be decided. Nevertheless the comparatively large amount of sulphuric acid absorbed by cotton and not removable by boiling with water, is noteworthy.

Caustic Potash.—For caustic alkalis cotton does not appear to have any affinity. A quantity of cotton boiled in 2·5 per cent. caustic potash left 2·49 per cent. in solution, and consequently only absorbed 0·1 per cent.

Calcium Chloride.—For neutral salts like this there appears to be absolutely no attraction on the part of the cotton. Cotton boiled with 9 per cent. calcium chloride did not absorb any at all.

Experiments with Silk.

The experiments with silk were confined to the absorption of hydrochloric and tartaric acids.

Hydrochloric Acid used.	HCl in Solution.	HCl absorbed.	Indicator.
Per Cent.			
3·97	2·25	1·72	Methyl-orange.
7·94	5·85	2·09	„
15·88	12·22	3·66	„

Tartaric Acid.—Silk treated for an hour in 25 per cent. tartaric acid at about 50° C. left 22·5 per cent. in solution ; 2·5 per cent. was consequently absorbed.

Sulphuric Acid.—Silk boiled for one hour in 20 per cent. sulphuric acid gave :—

	Per Cent.
In solution	18·5
Absorbed	1·5

Conclusions.—To sum up briefly, the following conclusions may be drawn from the results of this investigation :—

1. Wool, silk, and cotton all possess the property of absorbing acids from dilute solution. At a boiling temperature the affinity of sulphuric acid seems to be greatest for wool, after which follows cotton, and lastly silk. By boiling with water the free acid is partially extracted from the fibres.

2. In the case of wool, at least, the absorption seems to be due to a chemical combination. This is partly proved by the presence of combined ammonia in the solution in which the material has been boiled, but more definitely by the results obtained with hydrochloric acid. Practically no acid is *permanently* absorbed ; it can all be removed by continued boiling. That which was considered at first to be permanently absorbed is simply neutralised by some basic constituent or constituents of the fibre. The absorption of chromic acid by wool in mordanting with bichromate of potash or soda is analogous, and is probably also due to chemical combination.

3. Wool absorbs considerably more caustic potash than cotton, but it can all be removed by boiling with water.

4. When boiled with 15 per cent. of alum, wool effects a partial decomposition of the salt, leaving free acid in solution. The amount of the latter is, however, very small. The alumina and sulphuric acid appear to be absorbed in about equivalent proportions.

On the Behaviour of Animal Fibres towards the Acid Colouring-Matters.—From the results of the experiments on the absorption of acids by wool and chiefly by the rapid decrease in the ratio of acid absorbed to acid employed, the author was led to suppose that there must be some compound in the substance of the wool which possesses strongly basic properties, and which not only combines with the colourless acids mentioned, but also with the colour acids or acid coal-tar colours.

He believes now he has isolated this lake-producing compound by the following simple method :—100 grms. of wool were boiled for about two hours with 200 grms. of strong sulphuric acid and 300 grms. of water. After about 30 minutes the wool began to dissolve, and was at the end of two hours all dissolved with the exception of a slight residue. The light-brown solution was filtered and examined. With most of the acid coal-tar colours it produced richly-coloured precipitates, which are insoluble, or sparingly soluble, in water, easily soluble in alkalis, and are reprecipitated by acids from the alkaline solution. Tannic acid produced a voluminous dirty-white precipitate, and bichromate of potash a yellow crystalline precipitate. Alum and copper sulphate were without action, even in presence of an excess of copper sulphate. The only two lakes examined more closely were those obtained with *Crystal scarlet* 6 *R* and *Soluble blue.*

The *Crystal scarlet lake* weighed about 10 per cent. of the weight of the wool dissolved. It formed shining scales which are so intensely coloured as to appear almost black in reflected light, but the red colour is easily seen in transmitted light.

By dissolving wool in caustic soda, acidulating the solution with sulphuric acid, and filtering from the somewhat copious precipitate thus formed, a clear, almost colourless, solution was obtained, which showed similar properties to the one just described. It yielded a copious cheesy-white precipitate of similar consistency with bichromate of potash. *Soluble blue* is completely precipitated.

It is insoluble in dilute sulphuric acid, slightly soluble in boiling water, from which it separates out again on cooling in the form of microscopical warts which are of an intense scarlet colour. In dilute ammonia it dissolves easily, but is reprecipitated unchanged by the addition of hydrochloric acid. In strong sulphuric acid it dissolved with a blue-violet colour, which, on dilution with water, was rendered turbid and red again. In ether, bisulphide of carbon, and cotton-seed oil it is insoluble, but sparingly soluble in alcohol.

The *Soluble blue lake* forms scales with a coppery reflex which show similar properties to those of the scarlet lake.

Indigo extract also produced a precipitate which was, however, entirely soluble in hot water, but separated out again on cooling.

A solution of *cochineal and stannous chloride* produced an insoluble scarlet precipitate.

The first question now was, What is this lake-producing substance? By carefully neutralising the sulphuric acid with caustic soda, I obtained a cheesy precipitate, which, when filtered, washed, and dried, was obtained in the form of a hard, brown, amorphous mass, difficultly soluble in acids, but easily soluble in caustic alkalis. It gave similar reactions to the original sulphuric acid solution, and was no doubt either wholly or in part the lake-producing substance. At first it was thought that it must be either leucin or tyrosin, two well-known decomposition products of wool, but I found this not to be the case, since neither of these substances gives in solution the slightest indication of a precipitate with either *Crystal scarlet* or *Soluble blue.* The same or a similar compound seems to be produced from silk, since the solution of this fibre in equal proportions of sulphuric acid and water gives a similar precipitate with Crystal scarlet. A freshly-prepared solution of gelatin is not affected by Crystal scarlet, but after having been boiled for two or three hours with dilute sulphuric acid it yields a copious precipitate with the scarlet solution.

By dissolving wool which had been dyed with about 50 per cent. Crystal scarlet in the same proportions of sulphuric acid and water as those used before, a violet-coloured solution was obtained, from which, on diluting with water, apparently the same scarlet lake was precipitated as the one just referred to.

Although the author does not claim to have proved conclusively that the lake-giving substance which he has isolated actually exists as such in the wool, it nevertheless appears highly probable that this is the case after the wool has undergone a treatment with acid. It is well known that wool boiled (mordanted) in sulphuric acid can be dyed with the acid scarlets, yellows, blues, &c., but this will at once be attributed to the free acid retained by the wool. However, this is not the case, as is shown by the following experiment. A small piece of wool is boiled with 10 per cent. of its weight of sulphuric acid for one hour, washed and boiled in 100 times its weight of distilled water, and the washing repeated until after the ninth boiling of an hour's duration with fresh distilled water, the water is left absolutely neutral to methyl-orange. The wool now contains no free acid. On dyeing in 2 per cent. Crystal scarlet *without* any addition of acid, the wool showed a considerably fuller and more even shade than another pattern dyed with 2 per cent. of the same dyed along with 2½ per cent. of sulphuric acid. In the former case the bath was not exhausted. The chemical changes which take place here are probably the reverse, but analogous to those which the author has shown to take place when animal fibres are dyed with basic coal-tar colours.

An estimation of the sodium in the *Crystal scarlet* 4 *R* used in these experiments showed it when dried to be as nearly as possible a chemically pure product, corresponding to the formula $C_{20}H_{12}N_2S_2O_7Na_2$.

Every practical dyer knows that when wool is boiled in a neutral solution of these acid dyes it merely becomes tinted. Crystal scarlet forms no exception to this rule. Even when the dye-bath is made up with sufficient sulphuric acid to neutralise the sodium contained in the dye (0·2 per cent. acid for 2 per cent. dye), the result is scarcely appreciably better. Nor is double this amount sufficient to produce a full shade, and practical experience has shown that the minimum amount necessary to produce the fullest shade is from 2·3 per cent., or from 20 to 30 times as much acid as would theoretically be necessary to liberate the free colour acid. No attempt has hitherto been made to explain *why* such a large proportion of sulphuric acid should be necessary to ensure good results. It seems evident, however, from the preceding results, that the main *rôle* of the sulphuric acid in dyeing is to chemically change a portion of the wool and render it capable of combining with the dye. What the nature of this chemical change is the author hopes to determine shortly.—W. S.

An Antimony Mordant from Whey. M. Kretschmar. Chem. Zeit. 12, 943.

The whey is freed from albumen by precipitation, and the precipitate filtered off. The clear filtrate is allowed to ferment, and the strongly acid liquor thus obtained readily dissolves, in the presence of alkali, large quantities of antimony oxide. It is digested with antimony oxide in excess, warmed and filtered after some time, when it is found to contain in one litre as much antimony as is equivalent to 66 or 70 grms. of tartar-emetic. The solution keeps clear for any length of time, and can be neutralised and diluted with water without depositing basic antimony compounds. For dyeing purposes it is most suitable to dilute 1 litre of the solution with 13 litres of water.—S. H.

Antimony Mordant from Whey. M. Kretzschmar. Chem. Zeit. 12, 1020.

In reply to numerous correspondents upon this subject the author states that albumen can be precipitated sufficiently well for commercial purposes in many cases by boiling with a small quantity of sulphuric acid, removing the excess of acid subsequently by means of calcium carbonate. Solutions which contain chiefly albumen and but little of the other albuminoids may be treated with magnesium sulphate, the excess of which is precipitated by boiling with calcium carbonate. Another excellent precipitant is ferric sulphate. It is most important in all these cases to have the solutions fresh and as little peptonised as possible, since the peptones are not precipitated. The solution may be tested by boiling it, filtering if necessary, and adding a little moist cupric hydrate. After warming the solution and shaking, only a slight blue colouration should be produced.—E. E. B.

PATENTS.

The Preparation of Cotton Fibres for Dyeing. W. J. S. Grawitz, St. Maur-les-Fossés, France. Eng. Pat. 11,355, August 19, 1887. 6*d*.

To obviate the difficulties from breakage in handling, attendant on dyeing cotton before it is spun, the slivers of cotton from the carding and combing machines are formed into hanks and placed in bags made of open fabric, or clamped between frames, or otherwise, to prevent movement in the liquors with which they are to be treated. The hanks thus prepared are first boiled in pure or alkaline water, and they may then be safely subjected to the various operations of dyeing.—W. E. K.

Improvements in Dyeing Cotton and other Vegetable Fibres and Yarns, and Fabrics composed thereof. J. H. Gartside, Manchester, and J. Barnes, Stalybridge. Eng. Pat. 11,394, August 20, 1887. 6*d.*

For the purpose of obtaining fast shades of drab, fawn, or similar colours known as "Khakee," the material is treated successively with (1) a solution of sumac or other tannin material; (2) a mixture of nitrate of iron and chromium acetate; (3) a boiling solution of bichromate of potash or soda; and (4) a boiling solution of carbonate of soda. The material is washed after each operation, with the exception of the first, and at the close of the process is subjected to the action of steam.—W. E. K.

Production of Compounds of Antimonic Fluoride with Alkaline Fluorides, and the Application thereof, and of known Combinations of these Substances, to Dyeing and Printing. C. D. Abel, London. From C. Wachendorff, Oestrich-on-the-Rhine, Germany. Eng. Pat. 11,879, September 1, 1887. 6*d.*

As substitutes for the tartar-emetic used in the printing of cotton fabrics the following compounds of antimony fluoride with alkaline fluorides may be used with equal efficacy, viz., (*a*) tri-potassium antimony fluoride, $3\,KFl.SbFl_3$; (*b*) sodium antimony fluorides, $NaFl.SbFl_3$ and $2\,NaFl.SbFl_3$: (*c*) ammonium antimony fluorides, $NH_4Fl.SbFl_3$ and $3\,NH_4Fl.SbFl_3$. These compounds are prepared by dissolving oxide of antimony in hydrofluoric acid and adding the requisite quantity of carbonate of potash, carbonate of soda, or aqueous ammonia as the case may be. They are of a stable character and have therefore no detrimental effect upon the usual means of packing; they crystallise and dissolve readily in water; they do not injure animal or vegetable fibre, and form with tannic acid and dyestuffs just as pure and fine colours as tartar-emetic. Generally speaking they are applied in printing and dyeing in the same way as tartar-emetic itself, the quantity used depending on the proportion of antimony oxide contained in them. No antimony oxide separates on dissolving the salts in water, whilst the antimony oxide is taken up very rapidly and perfectly by the fibre, so that the bath can always be renewed without loss of the antimony mordant. Both the preparation of the compounds above named and their use in dyeing and printing are claimed by the patentee. In addition thereto the use of the subjoined similar compounds, described by F. A. Fluckinger in 1852 (Pogg. Ann. **87**, 245) is also claimed: $KFl.SbFl_3$, "$3\,KFl.SbFl_3$," $3\,NaFl.SbFl_3$, and $2\,NH_4Fl.SbFl_3$, these being inferior only as regards their physical properties, aud in particular their power of crystallisation.—W. E. K.

Improvements in Apparatus for Dyeing Wool, Cotton, Silk, or other similar Fibrous Material. C. T. Clegg, Manchester, H. A. Clegg, Heaton Norris, and F. Lee, Didsbury. Eng. Pat. 12,602, September 17, 1887. 8*d.*

This invention relates to machinery designed chiefly for dyeing wool in balls or bundles known as "tops," but is applicable also to other raw or manufactured textile material, and may likewise be applied for bleaching, scouring, washing, &c. It consists of an apparatus wherein the fibrous material to be operated upon is carried or forced to and fro through the dye-liquor in such a way that the liquor is caused to pass through the material as it moves along. The dye-vessel is cylindrical in shape, and the carrier for the goods to be dyed takes the form of a hollow piston packed closely to the sides of the chamber, so that when the piston is in motion the liquor is forced to pass through the goods contained in its interior. Any suitable means for driving the piston may be adopted, and the dye-vessel may be heated by a steam pipe, or be surrounded by a steam jacket. The hollow piston may be provided with movable trays or buckets for the convenience of handling the goods. The cylinder is closed by a plate fixed by screws, and removable for the purposes of introducing and taking out the goods.—W. E. K.

An Improved Process for Bleaching Jute. H. E. Newton, London. From the Actiengesellschaft für Papier und Druck Industrie Leykam Josefsthal, Vienna, Austria. Eng. Pat. 14,644, October 27, 1887. 6*d.*

This process is applicable to jute in any form, whether in the raw state, as rags, paper, half stuff, yarn, or fabric. The jute is first boiled with caustic lime, and then submitted to the action of chlorine gas or "chloric hydrate" until it takes an orange tint. After washing, it is treated with a weak alkaline solution, which converts the greater portion of the colouring-matter (already altered in its character by means of the chlorine) into a form easily soluble in water. The colour is readily removed by washing, and the jute can then be bleached as easily as any other vegetable fibre in the ordinary way with chloride of lime, &c.—W. E. K.

Producing Soluble Polybasic Aluminium Chlorides and Nitrates, and employment of the same in Dyeing and Printing. J. Hauff, Stuttgart, Germany. Eng. Pat. 2070, February 10, 1888. 4*d.*

Basic aluminium chlorides and nitrates up to the compounds $Al_6Cl_2(OH)_{16}$ and $Al_6(NO_3)_2(OH)_{16}$ are obtained (*a*) by dissolving aluminium hydrate in aluminium chloride or nitrate respectively; (*b*) by dissolving the hydrate in hydrochloric or nitric acid; (*c*) by first preparing basic aluminium sulphate by dissolving aluminium hydrate in sulphuric acid or in sulphate of aluminium, and then precipitating with barium chloride or barium nitrate; and (*d*) by treating neutral aluminium chloride or nitrate with alkali. For the preparation of highly basic salts it is necessary that the aluminium hydrate used should be as free from sulphuric acid as possible. The solutions of the basic compounds thus formed may be evaporated and the dry salts prepared. These basic mordants have the peculiarity of not combining with dyestuffs in the cold, whilst when steamed they form colours of a purity and strength which have hitherto only been obtained by the application of neutral aluminium sulphocyanide, and they serve therefore as substitutes for the sulphocyanide and acetate of alumina in printing. For dyeing, the mordants have the advantage of fixing themselves evenly on unfinished threads without any special means, and much less aluminium is lost in the operation of mordanting than when other aluminium salts are used.
—W. E. K.

Improvements in Bleaching. Brin's Oxygen Company, Limited, London. From L. Q. Brin, Paris. Eng. Pat. 5453, April 12, 1888. 8*d.*

This invention consists in the combined use for bleaching purposes of oxygen or air and bleaching-powder or other chlorinated bleaching salt or chlorine. The oxygen or air is passed under the requisite pressure into the mixture of bleaching solution and material to be bleached, the whole being preferably kept agitated in a potcher churn or other suitable vessel, or the oxygen or air may be passed into the bleaching bath in which the material to be bleached is immersed, or through which it is passed. The vessel may be open or closed, and in the latter case the excess of oxygen may be led off for use in further operations. In case of the use of chlorine gas, the oxygen or air may be passed direct under the requisite pressure into the chamber, churn, or other vessel in which the material to be bleached is being subjected to the action of the gas, or preferably the oxygen or air may be passed into the still in which the chlorine is being generated. Oxygen may be used in this way either where gas bleaching is being employed or where the chlorine is passed into a mixture of water and the material to be bleached.—W. E.K.

An Improved Method of and Apparatus for Dyeing, Washing, and Drying Fibrous or Textile Materials. C. Bohringer, Waldkirch, Germany. Eng. Pat. 7796, May 28, 1888. 8*d.*

The material to be treated is placed in the perforated basket of a centrifugal machine, in which receptacle it is dyed, washed, and dried in continuous succession. The interior of the casing of the machine and its perforated basket are connected by means of one and the same conduit, with a suitable source of colour, of water, and of air. By means of three-way cocks suitably adjusted, first the dye-liquor is passed in and caused to circulate through the basket; next, water is forced through, the basket being slowly revolved during this washing operation; and, lastly, the rapidity of rotation is increased and air forced through the apparatus to dry the goods.—W. E. K.

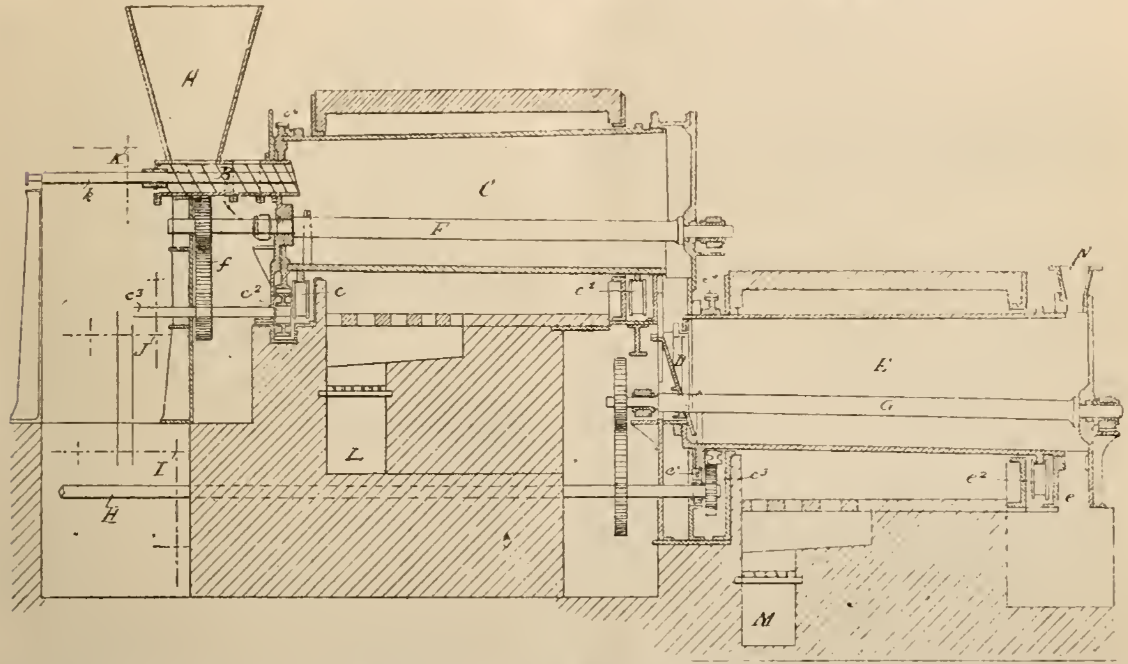
VII.—ACIDS, ALKALIS, AND SALTS.

PATENTS.

Improvements in the Manufacture of Sulphates of Soda and Potash, and in the Apparatus employed therefor. A. Walker, Irvine, N.B. Eng. Pat. 9760, July 12, 1887. 8*d.*

The apparatus consists of two parts, each containing a revolving cylinder of iron lined with fireclay, heated by being enclosed in a chamber above a furnace.

The arrangement is such that one cylinder is mounted above the level of the other. The material to be operated upon is fed by a hopper A and feeding-screw B into the cylinder C. Revolving scrapers gradually pass the material to the opposite end of the first cylinder; the mass then falls down through a shoot D into the lower cylinder E, and is carried along therein by similar scrapers until it is delivered at *e* in a finished state into a collecting cart. The volatile gases which are given off during the passage of the mass through the cylinders are carried away by a pipe to a condenser. The cylinders are mounted on two sets of rollers *c* c^1 and e^1 and e^2, and the rotation is effected by spur-gearing c^2 and c^3.—S. H.



Process or Processes and Apparatus for obtaining Pure Alumina Compounds from Bauxite and similar Materials containing Alumina. C. J. Bayer, St. Petersburg, Russia. Eng. Pat. 10,093, July 19, 1887. 8*d.*

Instead of precipitating the alumina of the aluminate by carbon dioxide in boiling solution, the inventor adds to the aluminates, prepared by fusion of the bauxite with caustic soda and sodium carbonate, and lixiviation of the melt with water, hydrate of alumina, while constantly agitating the liquid, and this decomposition or precipitation continues until the ratio between the molecules of alumina and soda are (Al_2O_3:Na_2O) 1 to 6, when it stops. After the precipitate is separated from the alkaline mother-liquor, the latter is concentrated, mixed with bauxite, boiled down and calcined. The precipitation takes place in a series of iron cylinders, each provided with a number of helical blades for agitation, the top of the first cylinder being connected by a pipe with the bottom of the next, and so on. In starting, hydrate of alumina is placed in the first cylinder, and the aluminate solution passed through the apparatus in a constant stream. A great saving in fuel is effected, since the reaction must take place in the cold, and it also offers the advantage that any silicic acid, phosphoric acid, or similar impurities are not precipitated along with the alumina, as is the case in the older method.—O. H.

Improvements in or Relating to the Manufacture of Copperas and of Ferric Sulphate or Sesqui-persulphate of Iron, commonly called Nitrate of Iron. S. Hallsworth and R. Bailes, Armley. Eng. Pat. 10,144, July 20, 1887. 6*d.*

The liquor that runs from beds of iron pyrites in copperas works is concentrated and then allowed to crystallise for a certain time. The mother-liquor, which still contains free sulphuric acid, sulphate of iron, and sulphate of alumina, is run off from the crystals of sulphate of iron, diluted with a little water, and heated to about the boiling point. One-half of the free sulphuric acid present in the liquor is neutralised by gradually adding, in a fine dry powder, "iron borings' waste or refuse," or hydrated sesqui-oxide of iron. After thus neutralising, the liquor is run into a mixing cistern and, while still hot, manganese peroxide is gradually stirred in as a very fine dry powder until the oxidation is complete and the alumina precipitated.—O. H.

Improvements in or relating to the Manufacture of Ferric Sulphate or Sesqui-Sulphate of Iron, commonly called Nitrate of Iron. S. Hallsworth and R. Bailes, Armley. Eng. Pat. 10,222, July 21, 1887. 6d.

Instead of using the liquor described in the preceding abstract (Eng. Pat. 10,144), the patentees gradually add the finely divided iron borings or waste or similar material to dilute sulphuric acid (20°—25° T.) contained in a lead-lined evaporating tank, and kept near the boiling point. When three-fourths of the acid are neutralised, the solution is cautiously oxidised by manganese peroxide, *loc. cit.*
—O. H.

Improvements in obtaining Muriate of Ammonia and Carbonate of Lime from the residual Chloride Liquors of the Ammonia Alkali Process. C. Wigg, Liverpool. Eng. Pat. 10,295, July 23, 1887. 4*d.*

In the treatment of chloride liquors left after the extraction of sodium bicarbonate in the ammonia-alkali process for the purpose of obtaining in the form of ammonium chloride all the ammonia and the carbonic acid as calcium carbonate, it is customary to neutralise the free alkali with hydrochloric acid. This operation is troublesome and has many disadvantages, and the inventor attains the same end by carefully adding calcium chloride, which forms ammonium chloride and calcium carbonate, which latter is removed by filtration. From the filtrate solid ammonium chloride may be obtained in any suitable manner.—S. H.

Improvements in the Manufacture of Carbonic Acid Gas. H. W. Deacon, Widnes. From C. Arnois, New York, U.S.A. Eng. Pat. 10,759, August 5, 1887. 8*d.*

Water-gas, or a hydrocarbon in the gaseous state, is passed through heated oxide of manganese, oxide of iron, or any other metallic oxide which will yield and absorb its oxygen readily. The gas will be burnt by the oxygen of the oxide to carbonic acid and steam, and, passing through a condenser, the steam is retained and the carbonic acid is conducted to a gasholder. After some time the water-gas is turned off, the apparatus blown out by steam (to avoid explosions and the mixing of gases), and air is driven through, which will oxidise the metallic oxide, and being so regenerated, the latter is ready to convert a new quantity of water-gas.—S. H.

The Utilisation of Alkali Waste for the Manufacture of Sulphuric Acid. J. Hanson, Wakefield. Eng. Pat. 10,818, August 6, 1887. 4*d.*

Alkali waste is exposed for some time to the atmosphere in order to convert the calcium sulphide into sulphite or hyposulphite. This oxidised black-ash waste is treated with hydrochloric acid, and the sulphur dioxide evolved led into the ordinary vitriol chamber.—O. H.

Improvements in the Manufacture of Soda and in Apparatus for the Purpose. J. B. Thompson, London. Eng. Pat. 10,900, August 9, 1887. 8*d.*

Sodium sulphate is reduced to sulphide by being mixed with half its weight of powdered carbon, and placed in a reverberatory furnace, which has been previously heated to about 1,000° C. The mass is exposed to the action of this temperature until carbonic oxide ceases to burn on its surface. It is then removed from the furnace and allowed to cool. When cold it is dissolved in water, and the clear solution subjected to the action of carbonic acid in a special kind of apparatus termed a carbonator. This vessel is in the form of a long tank with a semi-circular air-tight cover, in which revolves a shaft with a series of discs, forming a continuous screw. The discs revolving half in the liquor will always have a film of the solution upon the half which is above the solution, and the carbonic acid will thus be readily absorbed. Sulphuretted hydrogen is given off and conducted away for use in a sulphuric acid chamber or a kiln for the recovery of sulphur. It is most convenient to work several carbonators in one series, the one last charged always receiving the gas from the other vessels, in which the salt is partly carbonated. When the solution of sodium sulphide is so far carbonated that it begins to deposit bicarbonate the operation is stopped, and the liquor drawn off and boiled until any sodium sulphide that it may still contain is decomposed and carbonated by the carbonic acid contained in the bicarbonate. The following equations express the different stages of the process :—

1. $Na_2SO_4 + C_4 + O_4 = Na_2S + 4\ CO_2$
2. $Na_2S + H_2O + CO_2 = Na_2CO_3 + H_2S$
3. $Na_2S + 2\ (HNaCO_3) = 2\ Na_2CO_3 + H_2S.$

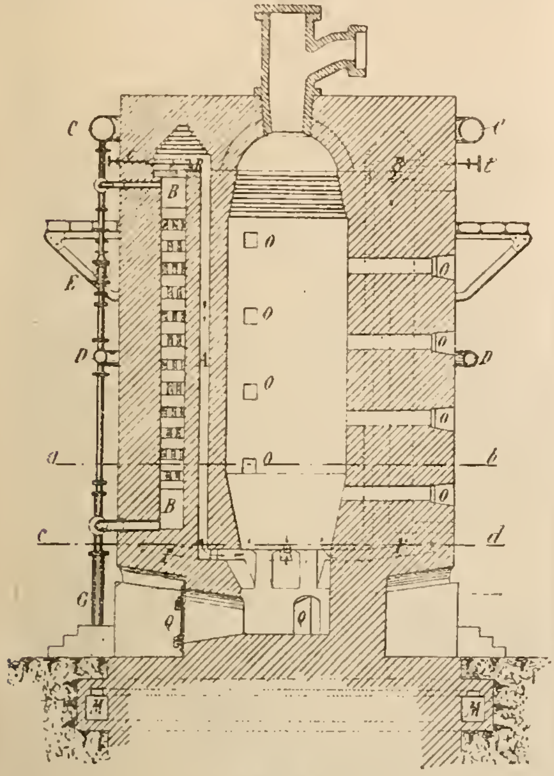
The carbonic acid required is taken from the gases given off in the first stage of the process.—S. H.

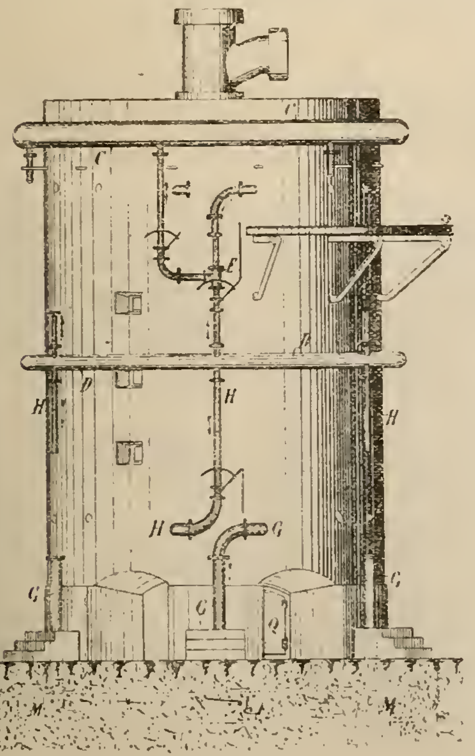
Improvements in obtaining Ammonia, Chlorine, and Hydrochloric Acid from Ammonium Chloride. L. Mond, Northwich. Eng. Pat. 10,955, August 10, 1887. 6*d.*

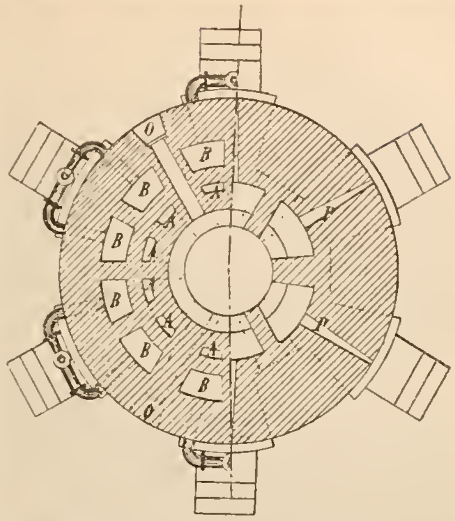
This invention is a development of previous patents, described in Eng. Pats. 65 and 66, 1048 and 1049, and 3238 of 1886. (This Journal 1887, 140, 216, 217, and 289.) The main feature of the process consists in bringing vapour of ammonium chloride into contact with certain oxides or salts at an elevated temperature, whereby they are converted into chlorides or oxychlorides, while ammonia and steam are set free, and in subsequently treating the chlorine compounds by steam or air, so as to obtain hydrochloric acid or chlorine. In practice it is found that the volatilisation of ammonium chloride is a tedious operation, and it is now proposed to introduce ammonium chloride into a vessel which contains zinc chloride in a fused state. The ammonium chloride thus takes up heat quickly and is converted into vapour far more readily. Or the volatilisation may be expedited by being carried on in a partial or complete vacuum or in a current of gas, which does not interfere with the reaction. In the next stage of the process it is found that certain oxides and salts, more particularly those of magnesia, do not allow the whole of the steam formed by the action of ammonium chloride to escape with the ammonia, and on subsequent treatment with air this gives rise to the formation of hydrochloric acid. It is therefore proposed to bring the gases resulting from the treatment with air into contact with certain oxides kept at an elevated temperature. These oxides absorb all the hydrochloric acid from the gases without acting upon the chlorine, and are converted into chlorides. From these latter the chlorine can be obtained by treating them with air. If the silicates and alumino-silicates of calcium are used for the decomposition of ammonium chloride, the temperature required to obtain chlorine gas in the last operation is much higher than the temperature required for the treatment of the substance with ammonium chloride. It is, therefore, more convenient to carry out the two stages in two separate apparatus (one superposed over the other, so that the material can be readily transferred from one to the other), and to treat the substance with ammonium chloride in the upper apparatus and take it from there to the lower one, to be treated with air or steam.—S. H.

Extraction of Chlorine from Solutions of Chloride of Magnesium. T. Schloesing, Paris, France. Eng. Pat. 11,821, August 31, 1887. 8*d.*

The solution of magnesium chloride is first concentrated in pans, until it attains the temperature of about 170° C. It then becomes pasty and foams a great deal. It is now transferred to the sole of a reverberatory furnace, where it is heated and frequently stirred. Finally a product is obtained in the form of porous grains, solid and dry in appearance, but containing still about 30 per cent. of water. This "chloride in grains" is permeable to gases, and does not melt or soften when exposed to greater heat. It is now introduced into gas retorts, and gradually heated to a red heat. The inventor has found that if a hydrochloric acid gas atmosphere is kept around the chloride, magnesium chloride can be anhydrated without much decomposition. Steam and hydrochloric acid are given off in the retort, the former at the beginning of the operation, the latter more abundantly towards the end. The hydrochloric acid gas then no longer finds water with which it can condense, and retains the gaseous state. It is withdrawn from one end of the retort and sent back again into the retort at the other end, and by thus establishing a true circulation of hydrochloric acid, the "hydrochloric tension" within the retort is so effectually increased that the resulting chloride contains from 50 to 80 per cent. of anhydrous chloride. The last phase of the process is to extract the chlorine from the chloride by heating the latter to a red heat in a current of air in a suitable kiln. The anhydrous magnesium chloride is first mixed with about a fourth of its weight of magnesia and the mixture pressed into briquettes. These are introduced into the kiln at the top and withdrawn at the bottom after treatment. The construction and heating of the kiln is as follows: the kiln is somewhat analogous to those in use for burning lime. The masonry is formed above the exit doors to the top of three concentric shells. The interior shell constitutes the kiln proper, the second surrounds the first, having between the two a space which is divided by vertical partitions into a number of equal compartments A. The third shell surrounds the second, also leaving between the two a space divided into as many compartments B as there are compartments A, and corresponding to them. These compartments B contain bricks and serve as accumulators of heat. They receive the flames of a furnace and then pass out by means of flues crossing the third shell to the chimney. When the heat accumulated in a compartment B is sufficient, the heating is stopped and air is introduced into B, which becomes heated as it rises and then enters the compartments A, down which it descends and then goes into the kiln itself. The air rises amongst the briquettes, communicates its heat to them, and decomposing the magnesium chloride, escapes along with the chlorine liberated into an apparatus, where the latter is cooled, washed, and collected. The compartments A and B are of equal and even number, so that half of the compartments B receive and accumulate heat, whilst the other half give it off to the air. The air is forced into the compartments by a fan, and the working of the kiln is continuous. From time to time briquettes are withdrawn at the bottom and a fresh charge is introduced at the top. The mixture of chlorine gas and air obtained contains about 30 per cent. by volume of chlorine.—S. H.







An Improved Method of Manufacturing Alkalis. G. E. Davis, Manchester. Eng. Pat. 11,846, September 1, 1887. 6*d.*

An alkaline chloride in a convenient form is placed in a series of cylinders and treated by a current of air, sulphurous acid, and steam. Under the influence of heat the sulphate of the alkali is formed, and hydrochloric acid passes off with the residual gases. When this operation is completed, and while the sulphate is still hot, a current of water-gas is passed through the cylinders. The carbonic oxide passes through unchanged, whereas the hydrogen reduces the sulphate to sulphide, thus :—

$$Na_2SO_4 + H_8 = Na_2S + 4\ H_2O.$$

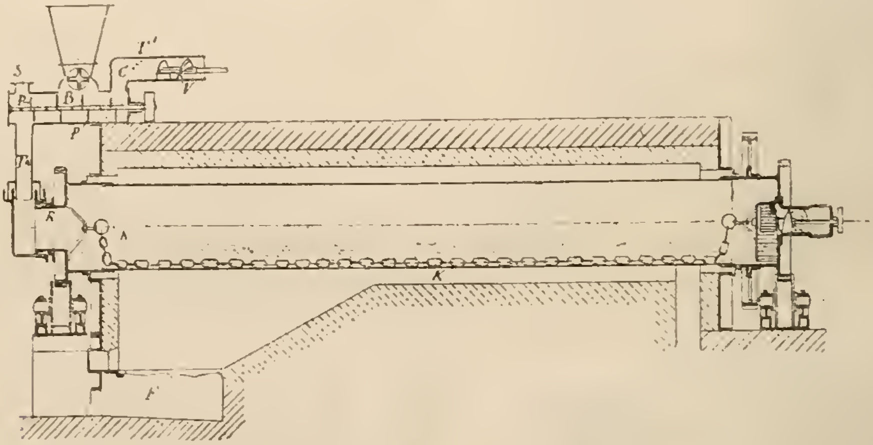
The steam, carbonic oxide, and excess of hydrogen pass on, and the two latter are collected in a gasholder for further use. The sulphide is then treated by a current of carbonic acid and steam, whereby the sulphide is converted into the carbonate, whilst sulphuretted hydrogen is liberated, which, when burned with air to sulphurous acid, may be used again in the first operation. The carbonic acid required is procured by bringing the mixture of carbonic oxide and steam, as it escapes from the apparatus in the second operation, in contact with heated surfaces, which results in a mixture of carbonic acid and hydrogen.—S. H.

Method of producing Anhydrous Sulphuric Acid and its Monohydrate, and of utilising for this Purpose the Acid Residues of Petroleum Production and other, as also Sulphates of all Metals. S. Pitt, Sutton. From V. Ragosine and P. Dvorkovitch, Moscow, Russia. Eng. Pat. 12,700, September 19, 1887. 6*d*.

Anhydrous or monohydrated sulphuric acid is made from commercial acid or the acid residues obtained as a by-product in refining petroleum by converting the acid into a sulphate, preferably of iron. Ferric sulphate is formed by dissolving iron ochre in the commercial acid or acid residues, and is then heated in a current of air to 300°—350° C. One part of the sulphuric anhydride is driven off and condensed, whilst the other two parts remain combined with the iron as ferrous sulphate. This is treated with more acid to form ferric sulphate again, and the process repeated. The current of air may be produced by means of blast machines or by a draught chimney.—E. E. B.

A New or Improved Revolving Furnace for the Decomposition of Bicarbonate of Soda. E. Solvay, Brussels, Belgium. Eng. Pat. 13,323, October 1, 1887. 8*d*.

The furnace consists of a horizontal cylinder of sheet or cast-iron of small diameter in proportion to its length. It rests upon rollers and receives rotatory motion by suitable gearing. It is also surrounded by brickwork and heated externally by the furnace F. In a previous patent (Eng. Pat. 1881, 2017) the necessity was pointed out of mixing sodium bicarbonate with soda already calcined in order to obtain a suitable working mixture. The mixing is effected by the use of a new inlet appliance, which consists of a hopper forming part of a cast-iron box B. A shaft provided with projecting arms revolves in the lower part of the hopper and causes a gradual descent of the sodium bicarbonate with which the hopper is filled, and which closes it hermetically. On the other hand, an endless screw V, constantly forces into a tube T^1, dry and hot sodium carbonate, but as the screw is terminated a little in front of C, there is also formed at this point a hermetical plug of sodium carbonate. The two products therefore arrive simultaneously and in the required proportions in the hopper box B, where they are intimately mixed together by the actions of arms P in the hopper box. They then enter the revolving cylinder by falling through the tube T^{11} in a connecting box R, which unites the cylinder by a suitable joint. The material advances through the cylinder in a very regular manner notwithstanding its horizontal position. In order to keep the sides free from hard and non-conducting crusts a chain K, formed of heavy and massive links, is hung inside the cylinder. The steam and carbonic acid given off by the bicarbonate escape through the tube S.—S. H.



Improvements in the Manufacture of Acetic Acid, and in Apparatus therefor. J. E. Johnson-Johnson, Stratford. Eng. Pat. 13,336, October 1, 1887. 6*d*.

Crude acetic acid, obtained by acidifying calcium acetate, is purified by oxidation with chromic acid or with a chromate and sulphuric acid. Pure acetic acid is made by repeating this treatment, then distilling, rejecting the first and last portions of the distillate, and finally redistilling with a small proportion of sodium carbonate. To produce glacial acetic acid the strong acid is repeatedly distilled with concentrated sulphuric acid. The vats and other vessels employed in the process are lined with thin firebricks, fixed to the sides with a cement composed of a solution of silicate of soda and silica oxide, the surface of the bricks being also coated with the cement and then dried.—E. E. B.

Improvements in Furnaces for Decomposing Metallic Oxychlorides and Superoxidising Metallic Oxides. C. Heinzerling, Zürich, Switzerland. Eng. Pat. 13,648, October 8, 1887. 8*d*.

The object of the decomposition of metallic chlorides and oxychlorides is to prepare concentrated hydrochloric acid or hydrochloric acid and chlorine therefrom. The furnace used consists of a chamber containing a number of plates, arranged in layers, and so that between every other pair of plates openings are formed at the opposite ends and sides to allow of the gases passing up and space for the oxychloride to pass down. At the side of the furnace are openings to every layer of double plates, provided with doors, to allow the oxychloride to be raked from one row of plates to the next. The plates are heated by a fire from below, the gases from which circulate between the plates. On the top of the furnace are placed hoppers with crushing rollers, which feed the oxychloride on to the top plate of the furnace. Here it is heated and then raked to the second plate to be further heated, and so on till it reaches the bottom. If steam be introduced at the bottom, it comes into intimate contact with the oxychloride and forms an oxide and hydrochloric acid. The steam always finds a large excess of oxychloride present, chiefly on the top plates, and the hydrochloric acid thus reaches the top in a concentrated state and undiluted by steam. If air be the operating agent an oxide and free chlorine is formed. The same furnace may also be used for the superoxidation of metallic oxides, for instance, chromium or barium oxide, by a current of steam or air being passed over them in a highly heated state.—S. H.

Improvements in the Manufacture of Ammonia and Chlorine and in the Apparatus employed therein. F. Bale, Droitwich. Eng. Pat. 14,001, October 15, 1887. 6*d.*

Ammonium chloride is intimately mixed with "trimanganic tetroxide" (Mn_3O_4), and the mixture heated in an ordinary Stourbridge retort at a low temperature at first. Ammonia begins to be evolved at about 130° C., and when the temperature gradually reaches 325° C. the evolution of ammonia is completed. When all the ammonia is given off, the residue is heated for some time below 350° C., at the same time passing a dry indifferent gas over the residue, which should be stirred in order to expel all the moisture, formed by the decomposition of ammonium chloride, and any residual ammonia still remaining in the retort. The absence of moisture is essential in the next stage, to prevent the formation of hydrochloric acid. Dry and hot air is then passed over the residue, the temperature is gradually raised to 400° C., and immediately chlorine is evolved, mixed with nitrogen and oxygen. If the air be carefully passed, the gases formed contain from 9 to 12 per cent. of chlorine. The evolution of chlorine continues until the chloride or oxychloride is decomposed and a residue is left, which can again be used for mixing with ammonium chloride and the liberation of ammonia, and so forth. From time to time the residue in the retort should be washed free from common salt, when the latter is present with the ammonium chloride.—S. H.

New or Improved Process and Apparatus for the Manufacture of Sulphite and Bisulphite of Ammonia. W. H. Beek, London. Eng. Pat. 17,050, December 10, 1887. 11*d.*

Ammoniacal liquor is freed from sulphur by treatment with oxide of iron, the liquor being either filtered through the oxide or mixed with it and afterwards decanted. This spent oxide or pyrites is burnt in a furnace, and the sulphur dioxide blown into a vat or washer containing water. The purified ammoniacal liquor is also distilled (without the addition of lime, which is said to be unnecessary) at the same time, and the ammonia blown simultaneously into the same vat or washer, sulphite or bisulphite of ammonia being formed according to the relative volumes of the gases blown in.

"The important feature in this new process is that the gases are introduced at the same time into a saturated liquid, which allows of the immediate crystallisation of the salt formed, without the necessity of having recourse to evaporation." The delivery of the gases are so regulated that the liquid in the vat is always neutral or slightly alkaline, in order to avoid loss of gas.

This sulphite or bisulphite, it is claimed, gives better results as a manure than sulphate. To produce the sulphate, the salt is deprived of one molecule of water by dessication, and then exposed in thin layers to the air, the oxidation being accompanied with evolution of heat ; or the oxidation may be effected in closed vessels.—O. H.

Improvements in the Treatment of Sulphide of Ammonium Solutions with Carbonic Acid Gas for the purpose of obtaining Carbonate of Ammonia and strong Sulphuretted Hydrogen. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 17,970, December 31, 1887. 6*d.*

Ammonium sulphide is converted into ammonium carbonate with evolution of sulphuretted hydrogen gas by passing carbonic acid gas through the solution. In order to keep the sulphuretted hydrogen as concentrated as possible, and at the same time use for the conversion dilute carbonic acid gas, such as is obtained from limekilns, the treatment is divided into two operations. During the first stage most of the carbonic acid is absorbed, and as scarcely any sulphuretted hydrogen is given off, the gases are passed into the atmosphere either direct or through a scrubber or purifier. As soon as an appreciable amount of sulphuretted hydrogen begins to be evolved the outlet pipe is connected with a gasholder or other receptacle for the sulphuretted hydrogen, and a further stream of carbonic acid gas, as strong as possible, passed through the solution until the carbonation is complete.—E. E. B.

Improvements relating to the Purification of Water, Factory Slop, and Sewage. H. E. Newton, London. From A. R. Leeds, Hoboken, U.S.A. Eng. Pat. 7533, May 22, 1888. 8*d.*

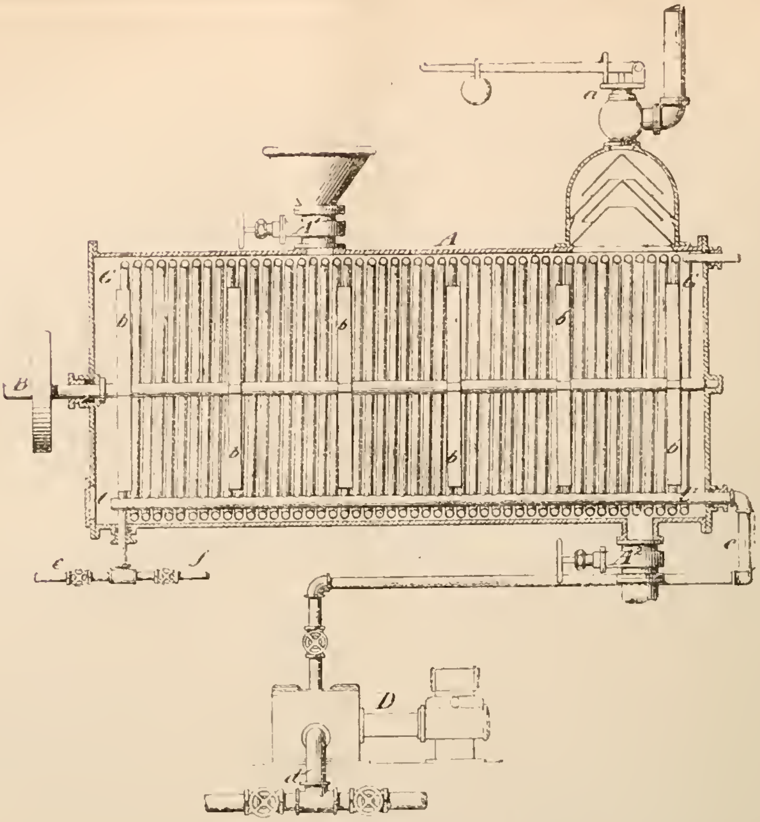
The organic impurities in water are removed by treating the water with the gases resulting from the electrolytic decomposition of water containing an acid or salt in solution, preferably hydrochloric acid. The process may be carried on continuously by passing the gases into a chamber through which the impure water is being forced. The water may be advantageously filtered both before and after the treatment with the gases.—E. E. B.

Improvements in the production of Soda Crystals and of Chlorides and Oxides of various Metals. F. Trickett and J. Noad, London. Eng. Pat. 7754, May 26, 1888. 4*d.*

A saturated solution of sodium chloride is decomposed by an electric current, the chlorine forming a chloride with the metal of the positive electrode which is precipitated. To the clear solution, which is run off, is added "carbonate of calcium or other suitable material which will give off carbonic acid, and will also precipitate in the solution any remaining traces of metal or contained foreign matter which may be decomposed during the operation." The solution is then concentrated, and the sodium carbonate allowed to crystallise. The oxides are produced by roasting the chlorides. Modifications are described.—O. H.

Improvements in the Purification of Bicarbonate of Soda obtained by the Ammonia-Soda Process. M. R. Wood, Brooklyn, U.S.A. Eng. Pat. 8958, June 19, 1888. 6*d.*

Crude sodium bicarbonate is mixed with water, and heated under pressure produced by forcing air into and through it to a temperature of from 180° to 210° F. The apparatus employed consists of a horizontal cylinder A, fitted with a loaded safety-valve *a*, and an agitator B *b*. It is also provided with a coil G, and a perforated pipe C, which is in connexion with a compressor D. After charging the cylinder with the crude bicarbonate and sufficient water to give the mass a semi-fluid consistency, the agitator is started and steam introduced into the coil G, until the temperature has risen to about 200° F. Air is then forced in through C, and a pressure of from 35 to 50 pounds per square inch is maintained in the apparatus by properly adjusting the load of the safety-valve *a*. This forced circulation of air and heating of the mixture is continued, until all the oxidisable matters are oxidised and any volatile impurities are driven off. Cold water is then made to circulate through the coil G, and the air shut off from the compressor, while carbonic acid is forced through



C for the purpose of replacing any carbonic acid driven off from the bicarbonate during the purification. The bicarbonate is then freed from the water and dried, and prepared for use.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Experiments on the Manufacture of "Crackle" Porcelain. C. Lauth and G. Dutailly. Bull. Soc. Chim., Paris, **49**, 948—956.

The term "crackle" is applied to porcelain, the glaze of which is cracked all over regularly in such a manner as to produce upon the surface a sort of network. The crackle is due to the difference between the coefficient of expansion of the glaze and of the paste, so that after the paste has been glazed at a high temperature, as the two substances do not contract equally, upon cooling, the surface of the article will be covered with a number of minute fissures or cracks. This takes place either because the baking of the paste and glaze has not been properly performed, or because the paste and the glaze are not in harmony.

With regard to the heating, if, when some pieces of ordinary porcelain are being baked, a sample be taken out as soon as the maximum temperature of the furnace has been reached, the paste will at first appear clear and the glaze well vitrified, but the sample, on cooling, will very soon be covered with cracks. If more samples be taken out from time to time it will be found that eventually the coefficient of expansion of the glaze will become modified so as to be exactly that of the paste, and then no cracks will be found when the sample is cooled. The cracking is produced, not only by insufficient firing, but also by an excess of it, due doubtless to the formation of new silicates; but "crackle" porcelain cannot be produced by underbaking or over-baking ordinary porcelain, as if the paste be not baked exactly the right amount the articles are so brittle as to be useless.

It is necessary therefore to make very careful experiments as to the amount of baking required by any particular paste to make perfect porcelain from it, and then try different modifications to produce the crackle.

For various practical reasons it is advisable to modify the composition of the glaze rather than that of the paste, and the paste chosen by the authors for their experiments is that actually in use at Sèvres for making biscuit; it is felspathic and clayey, containing but little free silica.

It contains—

	Per Cent.
Silica	66
Alumina	27
Alkalis	7

This paste bakes at a temperature of about 1,350°, whereas the baking point of ordinary hard porcelain is about 1,520°.

To produce the crackle the authors prefer to use a glaze containing more silica, and consequently with a higher melting point than that of the normal glaze for the above paste.

The glaze is made of the following materials:—

	Per Cent.
Pegmatite	51·5
Sand	38·0
Kaolin	6·0
Chalk	5·0

Compared with the normal glaze it contains:—

—	Glaze for Crackle.	Normal Glaze.
	Per Cent.	Per Cent.
Silica	79·42	66·18
Alumina	11·80	14·55
Alkalis	5·51	3·55
Lime	2·88	15·90

A glaze which also produces crackling, although not so suitable as the above, may be made containing a larger proportion of alumina consisting of—

	Per Cent.
Felspar	85·70
Sand	14·18
Kaolin	1·42

and containing—

	Per Cent.
Silica	69·92
Alumina	18·13
Alkalis	11·95

In comparing the composition of the normal glaze with those necessary to produce crackling, it will be noticed that the latter differ in the proportion of alumina they contain; when the proportion is increased, other bases have to be added to obtain the right degree of fusibility, and when the proportion is diminished the bases are likewise diminished and the silica increased.

A fine delicate crackle will be produced by making the glaze from one of the above formulæ; if a wide pattern be required, the "crackle" glaze must be mixed with ordinary glaze, and the larger the proportion of the latter the larger will be the meshes of the crackle.—E. E. B.

PATENT.

Improvements in the Utilisation of Slate, Slate Waste, Black Grit, or other similar or like Waste Materials, and in the Manufacture of Glass and other Articles therefrom. W. J. Parry, Bangor, and J. T. Welch, Bethesda, Carnarvon. Eng. Pat. 8129, June 4, 1888. *4d.*

The materials are pulverised, mixed with "cullet," and fired.—E. G. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Manufacture of Refractory Crucibles, Pots, Bricks, and Lumps for Furnaces. J. Imray, London. From A. Moszczensky, St. Petersburg, Russia. Eng. Pat. 10,166, July 20, 1887. *4d.*

About 30 parts by weight of fragments of highly refractory fireclay, 20 parts of pulverised blast-furnace slag, 20 parts of broken bottle glass, also pulverised, and five parts of crude sulphur are mixed together and heated until the mass is in a pasty condition. About 25 parts of shredded asbestos are then added, and the mixture is run into moulds of the desired form. The material is baked in the moulds until the moulded articles become firm and solid.—E. G. C.

An Improved Preparation or Manufacture of Cements. G. J. Snelus, Workington, W. Whamond, and T. Gibb, Jarrow. Eng. Pat. 12,524, September 15, 1887. *4d.*

The inventors add to hydraulic cements or cement-making materials, an oxide of iron poorer in oxygen than the peroxide, such as "blue billy," "mill scale," "forge scale," or "smithy scale," or they add in the same way silicate of protoxide of iron, such as "mill cinder," "tap cinder," &c.—E. G. C.

Manufacture of a Plastic Compound, and Treatment thereof for the Production of Moulded and Decorated Tiles, Slabs, and other Articles. M. W. Samuel, London. Eng. Pat. 12,765, September 20, 1887. *4d.*

The compound consists of a mixture of sulphur, steatite (for which may be substituted lime, gypsum, cement, chalk, or other earths), and sawdust, in place of which latter, powder of paper pulp, or of cotton, or of asbestos, or slag, may be used.—E. G. C.

An Improved Manufacture of Cements. G. J. Snelus, Workington, W. Whamond, and T. Gibb, Jarrow. Eng. Pat. 14,394, October 22, 1887. *4d.*

A mixture of blast-furnace slag and quicklime is employed. The slag is granulated by being brought into contact, while in a molten state, with water. The excess of water is removed from the slag by mechanical means.
—E. G. C.

Improvements in the Manufacture of Cement. G. J. Snelus, Workington, J. C. Swan, and H. Smith, Newcastle. Eng. Pat. 2366, February 16, 1888. *4d.*

Blast-furnace slag and lime are incorporated and burnt to form a frit or clinker, which is ground or reduced to the required degree of fineness.—E. G. C.

Improvements in the Utilisation of a Waste Product, and in the Manufacture of Cement and Porcelain. Owain Hughes, Bangor. Eng. Pat. 2619, February 22, 1888. *6d.*

According to this invention, cement is manufactured from ground slate in conjunction with lime; and slate waste, ground or otherwise, may be used as a substitute for trass, pazzolanos, clay, or any matter in which silica, alumina, alkalis, iron, manganese, magnesia, or any other ingredients found in slate, are present, for the manufacture of cement in combination with lime.—E. G. C.

An Improved Oil Cement. W. Alber, Berlin, Germany. Eng. Pat. 7020, May 11, 1888. *4d.*

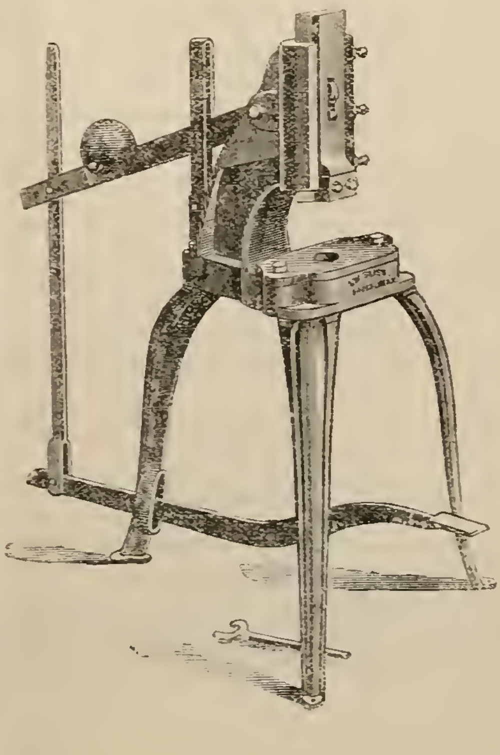
The inventor claims a cement composed of oxide of lead saturated with linseed oil, and mixed with Venice turpentine, litharge, and manganese borate.—E. G. C.

X.—METALLURGY, MINING, Etc.

Manufacture of Cupels. F. C. Blake. *Journ. Anal. Chem., Vol. II., Part 3. July* 1888.

The apparatus described is now in use for the making of all sizes of bone-ash cupels used in assaying at the works of the Pennsylvania Lead Company.

Fig. 1.



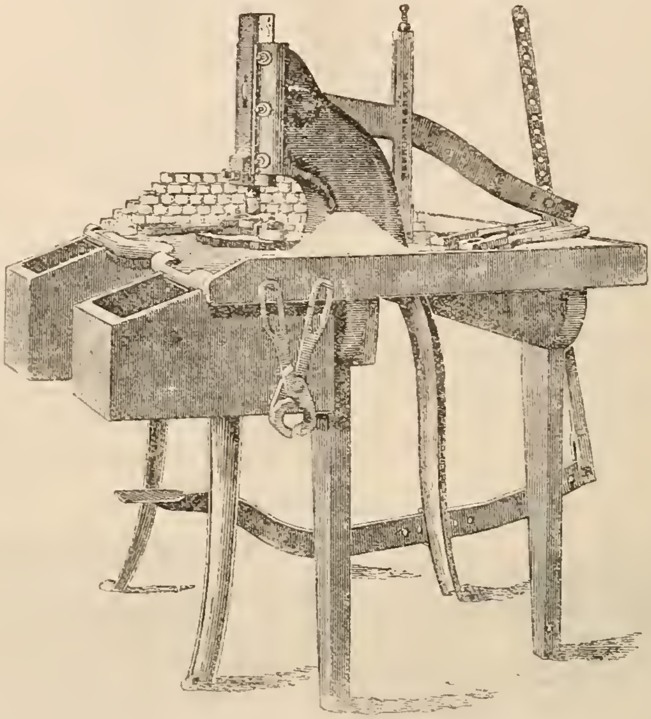
It works rapidly and easily, and turns out cupels that are very uniformly compressed, and that give under similar conditions exceedingly regular silver absorptions which are as low as those of the best hand-made cupels, or of cupels that we have tested, made by other machines.

The cupel-pressing machine is a No. 7 upright lever press of the regular style, made by the E. W. Bliss Co., of Brooklyn, N.Y. Lever presses that could be easily adapted to the work are made by several other manufacturers. The press is shown by Fig. 1. The opening at the centre of the bed-plate is filled by a removable plug made flush with the plate. Planks are fitted around the bed-plate and the back part of the press, forming a table, 38 × 48 inches, with the press in the centre. This arrangement is shown by Fig. 2, which is taken from a photograph.

On each side in front are boxes for holding bone-ash and the tools not in use. A guard extends around the table, except over the boxes, to prevent the wasting of bone-ash.

The male dies, one for each size of cupels made, are of hard brass turned to shape and polished, the style known as the western pattern being used. They are easily secured in the press slide. The moulds in which the cupels are formed are shown on the press table in Fig. 2. They are made of hard brass, and open like scissors. The bone-ash was found to adhere somewhat to iron, which was at first tried for both dies and moulds. The pressed cupel drops out at once upon opening the moulds. Three stops, having adjustment screws in each, are screwed into the bed-plate of the press—one at each side of the centre and one at the back—so that the scissors mould is held shut by the side stops and comes into place directly under the die when the end of the mould touches the back stop.

Fig. 2.



The operation of making the cupels is as follows:—The mould is held shut in one hand, filled with bone-ash by the other hand of the operator, and then shoved into place under the press slide, and by a single movement of the foot lever the cupel is pressed. The mould is then withdrawn, opened, and the cupel is placed on the drying tray.

The machine has not been tested for speed, but from three to four hundred cupels per hour can easily be made with it.

The use of a foot lever press and opening moulds are decided improvements upon hand-screw presses and solid moulds.

The power or leverage of the press can be changed in several ways, as is shown in Fig. 1, but ordinarily we use the press with the lever pin, as shown in Fig. 2. If very large cupels are to be made the pin is moved to one of the front holes.

We find that it is desirable to purchase bone-ash in large lots, and to thoroughly mix the whole lot before using, in order that the working of the cupels shall be as uniform as possible. We often can obtain better cupels by mixing together different lots of bone-ash. For example, we are now using, with the best results, a mixture of bone-ash, part of which was purchased in Denver and a part of it in New York. The results are better with the mixture than with either brand alone, though both are stipulated to be the best obtainable by the dealers in assay materials.

Of the two, the Denver bone-ash is the cheaper and a trifle the better. From a sample of the Denver bone-ash 5 per cent. would not pass through a No. 80 sieve, and 12 per cent. remained on a No. 100 sieve; of the bone-ash from New York all but 0·75 per cent. passed through the No. 80, and only 7·5 per cent. remained on the No. 100 sieve. In respect to uniform grinding, the latter bone-ash is the better, but it is on the whole a little too fine.

The best bone-ash should, I think, all pass through a No. 80 sieve, but there should be a considerable proportion of it that will not pass through a No. 100, perhaps one-fourth or one-fifth.

The Denver bone-ash contained less of the carbonate or oxide of calcium, which have a tendency to increase the silver absorption of the cupel, and also render it more liable to crack at the centre and at the edges, especially when hard lead bullion is being cupelled.

Some cupels made of ground apatite gave especially good results in cupelling lead containing considerable copper and antimony, the first antimonial litharge being much better absorbed than by the bone-ash cupels and the edges of the cupels were not cracked in the least. The silver absorption was about the same as with the bone-ash.

Magnesia added to the bone-ash has a less injurious effect than lime. We shall make some further tests with apatite cupels to see if mineral less pure than the small sample we had for trial will give good results. If such is the case it will make a useful material for cupels used for assaying very impure lead bullion. The bone-ash, free from absorbed litharge, recovered from cupels that have been used, we find by careful tests to be as good as the fresh material if it is properly sifted.

We find, as is generally known, that cupels improve by being made some time before they are used, and we carry 7,000 to 8,000 in stock, sufficient for over two months' work.—W. S.

PATENTS.

Improvements in the Manufacture of Aluminium, Magnesium, Calcium, and similar Metals and their Alloys. W. P. Thompson, Liverpool. From G. A. Faurie, St. Denis, France. Eng. Pat. 10,043, July 18, 1887. 6*d.*

The oxide of the metal (*e.g.*, alumina), which must be scarcely if at all volatile, is mixed most intimately with sulphur and carbon, preferably by working to a paste 1,500 grms. of alumina and half a litre of petroleum or other hydrocarbon, kneading well and stirring into it 500 grms. of commercial sulphuric acid. This mixture is then thrown into a red-hot crucible and then allowed to cool. It is now mixed with half its weight of filings of zinc, copper, iron, or lead, and heated to whiteness in a crucible for two or three hours. On cooling, the crucible is found to contain a dark powder and grains of alloy, which are sorted approximately according to their degree of richness; the powder being used with, or instead of, the metallic filings in a subsequent charge. By making bricks of the alumina mixture and alloy-metal, and using similar bricks of lixiviated ashes (from sodium carbonate manufacture) mixed with tar as flux, the reduction may be effected in a cupola, the alloy being tapped into moulds.—W. G. M.

Improvements in the Method of recovering Tin from Tin Scrap and similar substances. J. A. B. Bennett, King's Heath, Worcester. Eng. Pat. 10,135, July 20, 1887. 4*d.*

The scrap is subjected to the action of a bath of fused caustic soda and sodic nitrate or chlorate, whereby the tin is oxidised and dissolved with the formation of stannate. By the action of fused nitrate alone the tin is converted into oxide and can be removed from the bottom of the bath and smelted for metal.—A. W.

Improvements relating to the Production of Aluminium Alloys. H. C. Bull and Co. and H. C. Bull, London. Eng. Pat. 10,199A, July 21, 1887. 8*d.*

The metal to be alloyed with the aluminium is deposited by electrolysis from the sulphate solution on a cathode made of aluminium, the anode also being aluminium or any other insoluble substance. When sufficient metal has been deposited the cathode is removed and melted in a crucible, or on an open hearth out of contact with fuel, thus producing the alloy of aluminium with the metal deposited. The advantage of this method is the purity of the resulting alloy. The liberated acid in the depositing bath is neutralised by introducing the oxide of the metal being deposited at one end of the tank and conveying it by means of a worm along the bottom to the other; or the solution, by a continuous process, is removed and mixed with the oxide in a mixer, and passed through filters back again into the bath.—A. W.

Improvements in preparing Ferruginous Materials for Smelting or for use in open-hearth or other processes. A. M. Crossley, Shettleston, Lanark. Eng. Pat. 11,797, August 31, 1887. 4*d.*

Purple ore, ironstone dust, and other pulverulent ferruginous materials, incapable of being satisfactorily smelted, are made into blocks or lumps with 5 per cent. of a suitable calcareous cement, dried and smelted either alone or with ordinary iron ore, or may be used in open-hearth, Siemens', or other furnaces. A non-disintegrating cement is necessary, and Portland or Roman, or a hydraulic lime, or a suitable mixture of these is employed.—A. W.

Improvements in the production of Aluminium and Alloys of Aluminium. A. Feldmann, Linden, Hanover. Eng. Pat. 12,575, September 16, 1887. 6*d.*

A double fluoride of aluminium and an alkaline earth metal mixed with an excess of a chloride of the latter group, preferably strontium, is electrolysed or treated with sodium. The equations expressing the resulting reactions are respectively as follows :—

1. $(Al_2F_6 + 2\ SrF_2) + 6\ SrCl_2 = 2Al + 5\ SrF_2 + 3\ SrCl_2 + 6\ Cl.$

2. $(Al_2F_6 + 2\ SrF_2) + 6\ SrCl_2 + 6\ Na = 2\ Al + 5\ SrF_2 + 3\ SrCl_2 + 6\ NaCl.$

The three equivalents of strontium chloride here shown in excess represent the amount found in practice to be most suitable. Potassium chloride may be added to increase the fluidity, but in this case the strontium chloride must be in still greater excess. The residue may be treated with aqueous aluminium chloride solution to reproduce the double fluoride as in equation 3 ; but if alkali metal chlorides have been added, they should be washed out before this treatment, and added again in the right proportion subsequently.

3. $5\ SrF_2 + 8\ SrCl_2 + Al_2Cl_6 = (Al_2F_6 + 2\ SrF_2) + 6\ SrCl_2.$

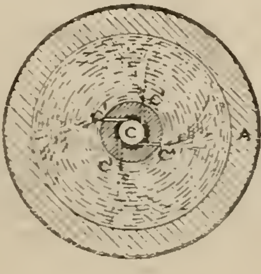
Alloys are made by using the alloying metal as cathode when the electrolytic reduction is employed, or by introducing with the alkali metal when sodium reduction is used.
—W. G. M.

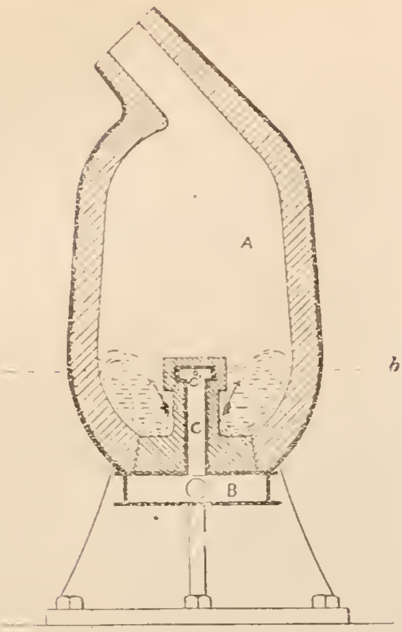
Improved Process of and Apparatus for producing a Preservative Coating on Iron and Steel Surfaces. W. P. Thompson, Liverpool. From W. T. Wells, Hackensack, New Jersey, U.S.A. Eng. Pat. 6872, May 8, 1888. 8*d.*

The coating is obtained by subjecting the metal to the combined action of steam and carbon monoxide at a red heat. The material is gradually heated in a muffle or other heating chamber, preferably by gas, till a uniform dull red heat is obtained. It is then subjected to the action of steam alone for about thirty minutes, and afterwards to the action of carbon monoxide for an hour or more, which two operations clean the metal and prepare its surface for the next and essential part of the process, which consists of maintaining the heated metal in a mixed atmosphere of steam and carbon monoxide for about five hours, by which a rustless and protective coating of oxide of iron is produced. —A. W.

Improvements in Apparatus for converting Crude Iron into Malleable Iron or Steel. J. W. Bookwalter, Ohio, U.S.A. Eng. Pat. 6952, May 9, 1888. 6*d.*

This is an arrangement of the Bessemer converter, wherein the tuyeres are so placed as to give a combined vertical and horizontal rotatory motion to the metal, by which it is asserted that agitation is avoided and the resulting scoria is not drawn into and mixed with the molten metal. A vertical shaft C closed at the top is placed in the centre of the converter, with four lateral openings near its upper end, so





arranged as to be a little beneath the surface of the metal. These are horizontal, or can be inclined slightly either way, and give the vertical rotatory motion. They are also placed tangentially, and not radially, to the central vertical axis, with a result that the blast gives a horizontal rotatory motion to the bath. These motions combined produce that movement of the molten metal by which the scoria and other impurities are thrown towards the outer circumference of the mass of metal, and accumulate near, or in contact with the sides of the converter on the surface of the metal, and remain thus separated from the mass of metal.—A. W.

An Improved Method of converting Iron into Steel. H. H. Lake, London. From E. Hardmeyer, H. W. Hatch, and J. C. Jackson, Chicago, U.S.A. Eng. Pat. 7995, May 31, 1888. *4d.*

Cast or wrought iron, in any desired shape, is placed together with a dry, finely pulverised, and well intermixed mixture of carbon, sodium chloride, and animal hoofs or their chemical equivalents, in an iron receptacle, hermetically closed and coated with fireclay, and subjected to a high temperature for twelve hours. By this treatment it is claimed that cast iron is "freed from impurities" and "carbonised" to a degree of elasticity, &c.; also that the structure of wrought iron is changed from "fibrous" to "homogeneous."—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in Secondary Batteries or Electrical Accumulators. H. Mower, London. Eng. Pat. 11,252, August 17, 1887. *8d.*

The plates consist of a lead framework, of which the two sides, or the top and bottom are connected by parallel strips of narrow lead which have been twisted into a helical form. The interspaces are filled with active material, gaps being left occasionally if required by the size of the plate. By bow-shaped springy bars of wood, the plates are kept in the centre of the cell notwithstanding expansion and contraction.—E. T.

Improvements in the production of Aluminium and Aluminium Bronze. C. A. Burghardt and W. J. Twining, Manchester. Eng. Pat. 12,856, September 22, 1887. *6d.*

In carrying out the patentees' specifications, 2602 of 1887 (this Journ. 1887, 674) and 9389 of the same year (this Journ. 1888, 441), it is found that hydrocyanic acid solution (or gas) may be wholly or in part substituted for potassium cyanide in the production of a bright deposit. —W. G. M.

Improved Method of producing Solid Metal Sheets by Electro-deposition suitable for Compass Cards, Stencils, and Openworked Flat or Curved Articles for Decorative or other uses. W. J. Reynolds, London. Eng. Pat. 12,880, September 22, 1887. *6d.*

The design of the article required is painted upon a piece of glass, then those parts not thus covered are acted on by fluoric acid and their surface thus lowered. The acid and paint are removed and the unbitten parts roughened by emery on a suitable surface. Blacklead dusted on will adhere only to the roughened parts and the metal will therefore be deposited in a plate of the required design.—E. T.

Improvements in Galvanic Elements or Batteries. C. Lütcke and P. George, Berlin, Germany. Eng. Pat. 9206, June 23, 1888. *8d.*

The outer cell of this battery is, in shape, like an inverted jam jar; the negative electrode, placed in a porous pot, and the positive electrode surrounding the latter, all occupy the portion above the neck. The neck itself acts as a reservoir for any depolarising solution that may diffuse through the porous pot, or for any refuse from the zinc. The porous pot may be provided with an overflow pipe leading into the reservoir, to guard against danger from osmosis. A second negative electrode may be placed in the neck to utilise any such depolariser, which is, however, for the most part destroyed by the zinc refuse. A permeable partition of woollen tissue or such material may be placed between the zinc and porous pot to intercept suspended impurities from the zinc.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

PATENTS.

Improvements in the Manufacture or Purification of Cotton-seed Oil. George Tall, Chester. Eng. Pat. 8947, June 23, 1887. *6d.*

Crude cotton-seed oil is agitated with solution of monocarbonate of soda, and, after the separation of this by subsidence, with lime water, or with a bleaching agent such as a hypochlorite; instead of the treatment with lime, desiccated fuller's earth may be employed. If the oil is intended for food, it is washed with pure water, and then heated to the boiling point of the latter until it becomes bright.—W. L. C.

Improvements relating to Purifying Compounds for Textile Materials and to Washing Powders. C. Williams, London. Eng. Pat. 15,774, November 17, 1887. *6d.*

Calcium or other mineral phosphate is calcined, with addition of bisulphate of sodium during the last stage of the operation, and the product dissolved in hot caustic soda in the proportion of $3\frac{1}{2}$ to 4 equivalents of soda to one equivalent of phosphoric acid present. Then oleic acid or other fat or oil is added in sufficient quantity to neutralise the excess of free soda. The mass is filtered by means of a filter-press, and the residue washed with saturated steam. The liquor is evaporated until it becomes pulverulent, and, whilst still warm, finely-divided aluminate of soda is added, and the mass well mixed. Finally, a certain proportion of silicate of sodium solution, saturated with hydrogen peroxide, is incorporated with the mixture, and the whole dried. The intermediate and final products are applied for cleaning woollen, silk, and vegetable fibres.—W. E. K.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Preparation of Ultramarine by the Wet Method. F. Knapp. J. Prakt. Chem. [2], **38**, 48—64.

In previous communications (this Journal, 1886, 238, and 1887, 40) various methods for the production of ultramarine by the wet method have been described by the author. "Liver of sulphur" is an essential principle in these processes, whereas the bodies it acts on with production of ultramarine vary within wide limits, to mention only silica, borate of alumina, or calcium phosphate.

"Liver of sulphur" may be prepared by heating equal parts of sulphur and soda until gas ceases to be evolved from the melt, at temperatures just sufficient to keep the mass melted. Now, if this mixture be heated rather higher, more sulphur is evolved. It is this sulphur which plays an important part in the production of ultramarine. On dissolving such a melt in water and diluting, a small quantity of a fine black powder separates after standing some time. This is washed superficially with water, then treated with KCN to remove traces of ferrous sulphide, which would decompose the black body. This latter the author regards as a black modification of sulphur. When dry, and examined microscopically, the black powder has a metallic lustre, but is not crystalline. It is insoluble in water, alcohol, ether, CS_2, or fatty oils. When heated in a flat basin, the black powder evolves SO_2, and on igniting further, burns with a bright flame, leaving no residue. Heated in a glass tube, closed at one end, to the highest attainable temperature of a Bunsen burner, practically no change is observed. It is not attacked by boiling caustic alkalis, is not dissolved by H_2SO_4, HCl, HNO_3, or aqua regia, but it is readily decomposed by fusion with NaOH and $NaNO_3$. On dissolving the melt in water, $BaCl_2$ produces a copious precipitate.

To this black powder is due the apparently green colour of concentrated solutions of "liver of sulphur." In presence of ferrous sulphide, black sulphur is converted into yellow sulphur. The former is always produced when yellow sulphur is suddenly heated considerably over its boiling point. Thus, on dropping a grain of sulphur on a previously heated porcelain lid, a black spot remains after the excess has volatilised. The production of black sulphur is greater when the sulphur has previously been mixed with substances to which the black sulphur readily adheres. Ferrous sulphide possesses this property in an eminent degree, and "Spence-metal" is really a mixture of this substance with black sulphur. In exceedingly thin layers black sulphur has a fine blue colour. This property becomes apparent when it is dissolved. Thus, on melting common salt and adding sulphur, black drops form, which disappear on prolonged fusion. When the melt is clear it is poured out, when it solidifies to a light blue transparent cake. Several very interesting cases of a similar description are given. If pieces of sulphur are dropped into a platinum crucible, heated to dull redness, black drops form where the sulphur falls, which rapidly volatilise, leaving a black crust, whilst the vapour is condensed on the hot sides of the crucible, producing distinct blue marks.

When "liver of sulphur" is dissolved in water, part of the black sulphur separates out, another part remains in solution. The latter colours calcium phosphate blue, owing to a deposition of black sulphur in thin layers. Gelatinous silicic acid or alumina are only coloured after previously heating with sodium sulphide, on account of their surfaces not offering a sufficient attraction for the deposition of the sulphur. It is therefore the black sulphur present in the "liver of sulphur" which is essential for the production of ultramarine in the wet way.

When "liver of sulphur" is prepared from potash instead of soda, no black sulphur separates on dissolving the melt in water. It appears that black sulphur is insoluble in melted "liver of sulphur" from potash, and therefore separates on the surface during the melt where it is oxidised. No ultramarine can therefore be produced from this "liver of sulphur," and it is interesting to note the analogy existing between this case and that of the dry method for the production of ultramarine, where the substitution of potash for soda entirely prevents the formation of the colour.—A. R.

PATENTS.

New Process of Manufacturing Retene from Resin Oil. W. L. Wise, London. From the "Actien Gesellschaft für Chemische Industrie," Rheinau, Germany. Eng. Pat. 13,366, October 3, 1887. 4*d*.

Resin oil is heated in the presence of about one-third of its weight of sulphur, in an iron vessel, until the formation of hydrogen sulphide is entirely finished. The retene $(C_{18}H_{18})$ is now obtained by distillation, or by extraction by means of suitable solvents.—E. G. C.

A Process for and Materials used in the production of a Substitute for Gutta-Percha. H. Siebert. Leipzig, Germany. Eng. Pat. 13,671, October 8, 1887. 6*d*.

India-rubber is intimately mixed with a resin, or a résinous substance; or, eventually, a material used for artificial rubber, such as balsam of sulphur, or so-called volcanic oil, may be mixed with a substance easily melted, as paraffin, stearine, wax, &c.—E. G. C.

Improvements in making White Lead. A. Orr, Glasgow. Eng. Pat. 15,406, November 11, 1887. 6*d*.

Litharge is mixed with an equal quantity of water in any suitable vessel, preferably one which will withstand an internal pressure of 5 or 6 pounds more than that of the atmosphere. A small quantity of acetic acid is added, and carbonic acid is injected into the mixture, which is well stirred or agitated. Propionic, butyric, valerianic, or nitric acid may be substituted for the acetic acid.—E. G. C.

An Improved Preservative Composition or Polish. Patrick Hanlon, London. Eng. Pat. 6336, April 28, 1888. 4*d*.

The ingredients used are refined white wax, bees' wax, oil of turpentine, oil of origanum, oil of rosemary, and saffron.
—E. G. C.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENT.

Improvements in the Means of Preventing the Formation or Development of Injurious Germs of Animal or Vegetable Life, applicable to the Treatment of Hides or Skins, and to the Manufacture, Preparation, and Preservation of other Materials and Substances liable to be affected by such Germs. C. Collin and L. Benoist, both of Paris, B. Nicholson, South Norwood, and T. Palmer, Sevenoaks. Eng. Pat. 15,766, November 17, 1887. 6*d*.

The use of mercuric iodide as an antiseptic is claimed, either alone or in conjunction with various other antiseptic compounds, such as eucalyptus, thymol, carbolic acid, &c. It is preferred to use potassic iodide as solvent with or without the addition of some of the salts of soda or potash or of an acid which does not precipitate the mercury.
—E. E. B.

XVI.—SUGAR, STARCH, GUM, Etc.

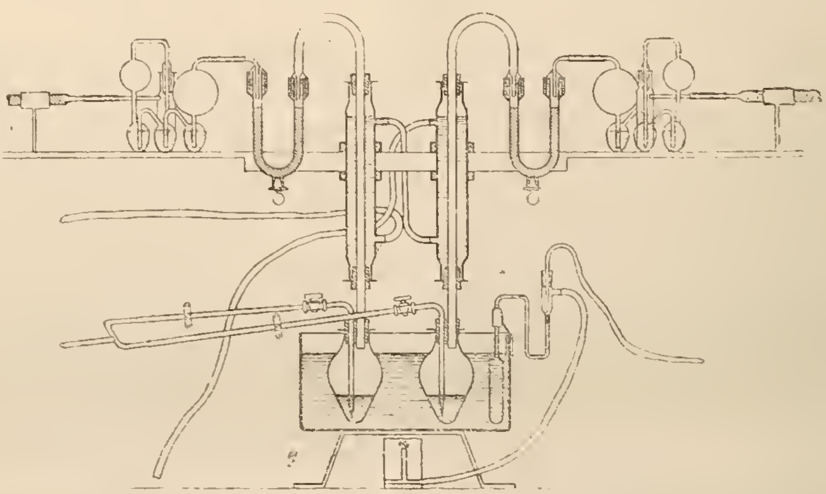
Sugar Fermentation and the Estimation of Carbonic Acid. Dingl. Polyt. J. 269, 73.

The exact ratio between the products of fermentation and the sugar fermented has not been sufficiently determined.

M. Jodelbauer (Zeitschrift des Vereins für Rübenzucker indust. 38, 308) has determined the conditions under which constant results may be obtained. These are :—

1. *a.* The use of a well-developed yeast.
    b. The use of a fixed percentage of yeast, which must never exceed 50 per cent.
    c. The exclusion of free oxygen. This retards the growth of the yeast.
    d. The use of a suitable nutritive medium containing albuminoids.
2. The best temperature is 34° C.
3. A concentration of 8 per cent.
4. The product of fermentation most easily estimated is the carbonic acid.
5. Cane sugar and dry maltose give 49·04 per cent. carbonic acid. Dextrose yields 46·54 per cent.
6. The time of fermentation depends on the type of sugar. Cane sugar requires double the time necessary for dextrose and maltose.

The quantity of sugar contained in the substance must be found by a preliminary trial; a portion corresponding to 2 grms. of sugar must be taken for analysis. It is dissolved in 25 cc. water and 1 cc. of Hayduck's nutritive medium (containing 0·025 grm. potassium dihydrogen phosphate, 0·0085 grm. crystallised magnesium sulphate, and 0·02 grm. asparagine) added and 1 grm. clean fresh yeast, previously dried by putting it on a porous clay plate. The apparatus used is shown below. A pear-shaped fermentation flask of 200 cc. capacity is connected by means of a doubly bored caoutchouc stopper with an inverted condenser and a tube for passing hydrogen. This tube is drawn to a jet and passes to the bottom of the flask. The upper part of the condenser tube is bent downwards and is connected with a U tube filled with glass beads and strong sulphuric acid. This is connected with a Geissler's potash bulbs and a calcium chloride check tube. The fermenting flask is kept at 34° C. by means of a water-bath and Soxhlet regulator. The fermentation goes on in a stream of hydrogen. After 20 hours (40 hours in case of cane sugar) the hydrogen is turned off and the liquid in the flask boiled for about 5 minutes, and then a current of air passed for about 20 minutes.—H. T. P.



Isodulcite. Emil Fischer and J. Tafel. Ber. 21, 2173.

On boiling isodulcitecarbonic acid with hydriodic acid, a fatty acid is produced as well as a lactone. The former is identical with normal heptylic acid. It follows that isodulcite contains a normal carbon chain and an aldehyde group, and is therefore an homologue of arabinose. The formula is either—

$CH_3.(CHOH.)_4COH$, or $CH_2OH.CH_2.(CHOH)_3COH$.

Isodulcite resembles dextrose and galactose as regards the difficulty with which it is attacked by nascent hydrogen, in distinction to levulose and mannose, both of which contain ketone, but no aldehyde groups, and are readily acted upon by nascent hydrogen. An improved method for the production of isodulcitecarbonic acid is also given.
—A. R.

The Use of Bone-Charcoal in Decolourising Dark Sugar Solutions. E. Bauer. Zeits. f. angew. Chem. 1888, 385—390.

The details of a series of experiments in connexion with this subject are given, the results of which lead to the following conclusions :—(1.) That the percentage absorption of the sugar diminishes with the concentration. (2.) Both mechanical movement and the form in which the charcoal is employed affect the result. (3.) The salt contents of the molasses do not diminish the absorption. (4.) The absorption is complete in about 20 minutes. In the first few minutes the action is naturally strongest, and it afterwards diminishes gradually. (5.) Inversion of the sugar is not produced, or only to a minute extent, and does not influence the diminution in the polarisation. (6.) A hydrochloric acid solution does not diminish the absorption of the colouring material, but causes a comparatively much smaller quantity of sugar to be taken up. This is probably due to the acid filling up the pores of the charcoal, and not to the difference in the character of the invert sugar. (7.) A regularity in the absorption in different products is not observable. It is greater in pure sugar solution than in molasses. (8.) The property possessed by acetic acid of preventing the absorption of the sugar and not that of the colouring-matter, may be used to compensate the error introduced by the use of bone-charcoal in the colour-apparatus.—A. W.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Adulteration of Sherry.

In the last issue of the United States Consular Reports the Consuls at Cadiz and Jerez de la Frontera return to the subject of the adulteration of sherry, on which they recently reported most unfavourably (see the *Times*, January 21). Mr. Ingraham, of Cadiz, sends a translation of a circular from the Spanish Minister of the Interior to the civil governors of the provinces, directing prosecutions against the makers and vendors of adulterating wines, in accordance with a Royal Decree against adulteration. Adulterated wines are thus defined in the decree :—Natural wines which contain (1.) Impure industrial alcohol and alcohol from husks (*cascara*) if they are not rectified and purified. (2.) Salicylic acid and other antiseptic substances. (3.) Foreign coloured substances, those derived from the products of pit coal (*sic*), as well as of vegetable or other origin. (4.) Artificial glucose, sugar from flour, or new wine. (5.) Glycerole. In a report on the trade in sherry for last year, Mr. Ingraham says :—" Old houses admit that the demand for low-priced wines compels them to yield reluctantly and compete for the market by using Berlin spirits for rectification at one-half the cost of Spanish grape alcohol, which is sold at 25*l.* to 30*l.* a butt, according to vintage, while German alcohol is selling at 13*l.* a butt under sharp competition and on long credit." Eleven thousand butts of this spirit were imported into Cadiz in 1886 and consumed in the province, the total average vintage of which was 75,000 butts. The mayor of Jerez declares that all the misfortunes of the wine-growers arise from the use of the industrial spirits; that the cellars are " mysterious laboratories, whose secrets no one is allowed to penetrate ; " and that the spurious usurps the genuine wines. It is said that only four gallons of spirit are used in a butt of wine, but the proportion to import to the vintage is as 11 to 75, and Cadiz only imports about one-twentieth of that annually imported into Spain.—W. S.

The Examination of Lavender and Rosemary Oil for Excise Purposes. H. Eckenroth. Chem. Zeit. **12**, 955.

In order to cover the unpleasant smell of denaturated alcohol, the German Government has permitted the addition of lavender and rosemary oil, which oils must previously be submitted to the examination of chemical experts. No official tests being prescribed by Government, the author recommends the following tests :—1. *Lavender oil.* It should be colourless or very slightly yellow, and have a specific gravity of 0·885 to 0·895. It must be miscible with 90 per cent. alcohol in any proportion. 10 cc. of the oil and 10 cc. of alcohol of 0·895 sp. gr. should give a turbid mixture, whereas the mixture with 30 cc. should be clear. 5 cc. of the oil, shaken with a few grains of magenta, should remain uncoloured. 90 per cent of the oil must distil below 210° C. 2. *Rosemary oil.* The oil must be colourless or slightly yellow. 10 cc. of it, mixed with 15 cc. of 90 per cent. alcohol, should give a clear solution. 5 cc., shaken with a few grains of magenta, should remain uncoloured. 90 per cent. of the oil must distil below 175° C.—S. H.

On Pneumatic Arrangements in Malt-Houses. G. Foth, Wochenschr. f. Brauerei **5**, 490.

The current of air, saturated with steam, which is blown or aspirated through the malt, fulfils the double purpose of regulating the temperature and bringing the malt into contact with a sufficient quantity of air. If by some oversight the temperature in the malt-house sinks too low it is customary to interrupt the admission of air. In this way a dangerous accumulation of carbonic acid may take place, and the author is of opinion that it would be better to make the amount of air admitted independent of the temperature. This can be easily done by passing air saturated with steam through a main channel, from which branch pipes issue to the different malt tanks. The air may be a little warmer than it is applied in the tanks, and by means of a refrigerator the temperature of the air in each branch pipe may be regulated at will.—S. H.

What is Brandy? Elsner. Zeits. f. angew. Chem. 1888, 380—382.

The above question is discussed at some length, and attention drawn to the want of uniformity in the proposals by chemists as to the requirements of a true brandy. The author is in favour of the definition in the Pharmacopœia :—" Distillation product of wine ; a clear yellow liquid of agreeable spirituous smell and taste. The alcohol obtained from it by distillation must be free from fusel oil and not acid. Sp. gr. 0·920 to 0·924. The percentage of alcohol should be between 46 and 50 per cent. by weight." To this definition must, however, be added a small quantity of extract, not more than 0·5 per cent. Imitation brandy usually leaves an ash containing lime, chlorine, sulphuric and phosphoric acid. As regards chemical tests, the albumen test is considered to be frequently faulty.—A. W.

Denaturation of Spirit in Germany. Zeits. f. angew. Chem. 1888, 401.

Makers of the general denaturation agent are permitted to add to every litre 40 grms. of oil of lavender or 60 grms. of oil of rosemary. It is illegal—

1. To remove, or partially remove, the denaturing body from the spirit, or to add substances having an influence on its taste or smell.
2. To sell spirit which has been treated as in 1. Dealers are compelled to have a copy of the rules fixed in a prominent place in their business premises.
3. Manufacturers may also use 5 per cent. wood spirit instead of the general agent or the pyridine bases.
4. Varnish and polish makers may use 0·5 per cent. turpentine for the purpose.
5. In the manufacture of certain glazes spirit may be denaturised with 20 per cent. of a solution of 1 part of shellac in 2 parts of 95 per cent. alcohol.
6. (*a.*) In the preparation of the alkaloids, medicinal extracts, chloroform, iodoform, chloral hydrate, sulphuric ether, acetic ether, collodion, tannin, salicylic acid and its salts, white lead, and acetates, the spirit may be denaturised with 0·5 per cent. turpentine, or 0·025 per cent. animal oil, or 10 per cent. sulphuric ether.

   (*b.*) For making coloured varnishes 0·5 per cent. turpentine or 0·025 animal oil.

   (*c.*) For making spirit used in the analysis of sugar beets in sugar manufactories, 0·025 animal oil.
7. For the preparation of acetic ether, besides the denaturation of the spirit, as in 6. (*a.*), the ultimate destination of the acetic ether must be indicated.
8. For the preparation of vinegar spirit may also be denatured with 200 per cent. acetic acid of 3 per cent., or with 30 per cent. acetic acid of 6 per cent., 70 per cent. water, and 100 per cent. beer. It is also allowable to use besides the vinegar 100 per cent. genuine wine instead of the beer and water.

—H. T. P.

On the Employment of Green Malt and Maize Malt for the Manufacture of Yeast. Zeits. f. Spirit. Ind. **11**, 187.

Green malt is regularly used in Denmark and Sweden for the manufacture of yeast with the best results. G. Francke further recommends the employment of maize malt, as maize is able to withstand without injury a high temperature during sprouting.—S. H.

PATENTS.

Improvements in Apparatus for Filtering Alcoholic Beverages. Alfred de Geinlue, Bordeaux. Eng. Pat. 13,034, September 26, 1887. 8*d*.

This invention relates to an improved method and apparatus for the clarification or filtration of wines and other fermented liquors at ordinary pressure, by means of which the whole of the filtration is carried on in an atmosphere of carbonic acid gas, the atmospheric air being entirely excluded.

The specification is accompanied by explanatory drawings of the different parts of the apparatus.—J. H.

The Manufacture of a New or Improved Saccharum for the use of Brewers, Distillers, and Vinegar Makers. J. W. Bailey, Greenock, and J. A. R. Greaves, Burton-on-Trent. Eng. Pat. 9305, June 26, 1888. 6*d*.

This substance, which the patentees term "laevo-maltose," is stated to consist of equal proportions of invert sugar and a specially prepared glucose, containing from 40 to 45 of maltose.—J. H.

Improvements in the Process of Alcoholic Fermentation. V. d'Ostachiewicz and L. de Gerlicz, Paris. Eng. Pat. 9401, June 27, 1888. 4*d*.

In the ordinary process of the manufacture of rum direct from sugar-cane juice, during fermentation lactic and acetic acid are generally produced in greater or less proportions. In order to obviate this, as well as to increase the yield of alcohol, the patentee proposes to add to the fresh cane-juice oxalate or sulphate of ammonia at the rate of 2 grms. to every 10 litres of juice. The materials are thoroughly stirred, and the juice commences at once to ferment, the fermentation being completed by the sixth day for juice containing 9 to 20 per cent. of sugar. This substance may also be used in the fermentation of other vegetable juices containing sugar, such as beet juice, as well as in the production of alcohol from potatoes and all kinds of grain, the sulphate of ammonia being added to the wort in the proportion of 30 to 50 grms. to every 100 litres of wort, according to its density.—J. H.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

Contributions to the Knowledge of Grain and Bread. M. Popow. Monit. Scient. [4], **2**, 826—830.

The value of grain and rye depends on the nutritive constituents they contain, viz., the starch and nitrogenous bodies. The other constituents are of little importance.

The average composition of Russian wheat and rye is given below :—

—	Moisture.	Nitrogenous Matters.	Fat.	Non-nitrogenous Bodies.	Cellulose.	Ash.	Nitrogen in Dry Substance.
Wheat (44 analyses)	11·92	18·25	1·57	64·82	2·23	1·71	3·14
Rye (15 analyses) ..	12·78	13·15	1·72	68·65	1·80	1·90	2·40

Wheat is distinguished from rye by the character of its nitrogenous bodies, which consist chiefly of gluten.

The author proves experimentally that the diastase of rye and wheat exists only in the kernel or starchy portion, and that none is present in the husk or outer covering of the aerospire.

No zymase is present in either rye or wheat.

The bread most eaten in Russia is that made from rye.

Four varieties of rye flour are sold in Russia :—

1. Ordinary, made from the whole grain, is consumed by the bulk of the population and the army.
2. With the husk removed. Contains 90 per cent. of the grain.
3. The sifted flour. Contains 70 per cent. of grain.
4. The starch flour. Contains 60—65 per cent. of grain.

The average composition of Russian bread is given below; the results represent the average obtained from the analysis of 16 samples from Kharkow, and 10 of rye bread from different parts of Russia.

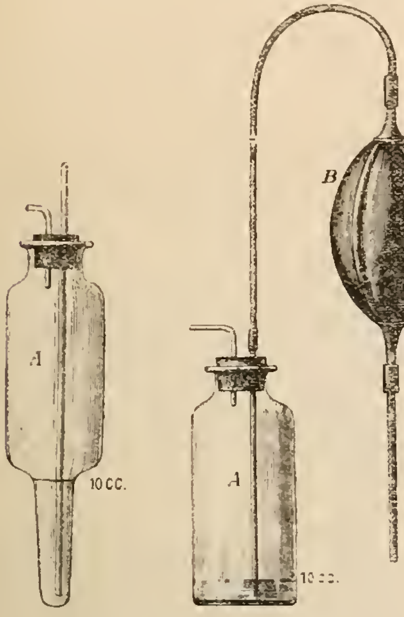
—	Moisture.	Acidity.	Fat.	Nitrogenous Substances.	Ash.	Sugar.	Starch, Dextrin, and Gum.	Cellulose.	Nitrogen in Dry Substance.
Wheaten bread (sugar)	28·09	0·16	1·46	10·50	1·00	2·29	56·23	0·19	2·338
Wheaten bread (made of best flour, fine bread)............	34·69	0·20	0·32	10·68	1·11	0·38	52·03	0·26	2·662
Wheaten bread (common, called household bread).....	39·01	0·65	0·50	12·65	1·56	1·92	42·65	0·93	3·315
Rye bread (town)	43·20	0·62	0·50	8·09	1·50	1·08	43·58	1·22	2·293
Rye bread (country)..........	36·09	1·01	0·67	7·66	1·60	1·19	49·81	1·64	2·040

—H. T. P.

(*B*)—SANITARY CHEMISTRY.

New Method for the Determination of Carbonic Acid in Air for Hygienic Purposes. G. Lunge and A. Zeckendorf. Zeits. f. angew. Chem. 1888, 395—399.

The apparatus shown is ¼ actual size. It consists of a bottle A, marked at 10 cc., and connected by tubing to an india-rubber reservoir B. This is worked two or three times, the open end being in communication with the air to be examined. The stopper is then removed, and 10 cc. of the reagent quickly run in. The contents of the pump are now forced slowly through the solution, which must be vigorously shaken, especially at the end of the operation. The pump must be refilled and emptied until the solution ($\frac{1}{500}$ normal sodium carbonate, containing 0·02 phenolphthaleïn per litre) in the flask is decolourised. This solution is not stable, and must be made every day by diluting 2 cc. of a $\frac{1}{10}$ normal solution of sodium carbonate, containing 1 grm. phenolphthaleïn per litre, to 100 cc. with boiled water. The percentage of carbonic acid is then obtained from the following table :—



No. of Fillings of Pump.	Per Cent. Carbonic Acid.	No. of Fillings of Pump.	Per Cent. Carbonic Acid.	No. of Fillings of Pump.	Per Cent. Carbonic Acid.
2	0·30	11	0·087	20	0·062
3	0·25	12	0·083	22	0·058
4	0·21	13	0·08	24	0·054
5	0·18	14	0·077	25	0·051
6	0·155	15	0·074	28	0·049
7	0·135	16	0·071	30	0·048
8	0·115	17	0·069	35	0·042
9	0·110	18	0·066	40	0·038
10	0·09	19	0·064	48	0·030

These numbers apply only to an apparatus of the dimensions given in the illustration. For a different apparatus they must be found by careful experiments with air of known composition.—H. T. P.

PATENTS.

Improvements in the Deodorisation and Disposal of Sewage and in Apparatus therefor. A. H. Curling, Norbiton, and J. Dunbar, London. Eng. Pat. 10,904, August 9, 1887. 4*d*.

The sewage is received in tanks, where it may be treated with precipitating agents. The effluent water, when sufficiently purified, is run away and the concentrated sewage tapped off into moulds or trays and frozen. The blocks thus obtained are adapted for transport and are odourless. —E. E. B.

An Improved Deodorising, Decolourising, and Filtering Medium. O. Bowen, London, and J. Cobeldick, Stockwell Green. Eng. Pat. 11,393, August 20, 1887. 6*d*.

Shale from the limestone quarries of Lyme Regis, Dorsetshire, is mixed with ironstone and bituminous coal or coke and calcined. The proportions are shale, 60 parts by weight, ironstone or ore 25 parts, and coal or coke 15 parts. The calcined mass is crushed and used as a medium for filtering and deodorising sewage, dye waste, &c. The medium is revivified by calcination with a fresh supply of the above mixture.—E. E. B.

Improvements in Antiseptic or Disinfecting Compounds. W. P. Thompson, Liverpool. From G. C. W. Belcher, St. Louis, U.S.A. Eng. Pat. 7177, May 15, 1888. 4*d*.

Dry soap is reduced to a state of fine sub-division, and thoroughly mixed with any suitable disinfectant, deodorant, or antiseptic, such as copper sulphate or chloride of lime, in a granular form. The mixture is then pressed into blocks or cakes. Soap is preferred, but any similar cohesive material may be employed as matrix.—E. E. B.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

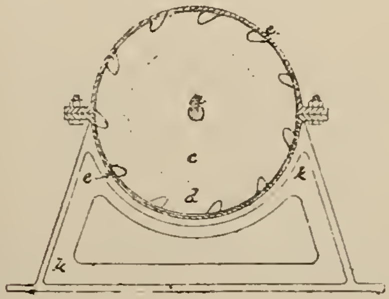
Improvements in the Manner, Method, or Mode of Treating Esparto Grass and other Fibrous Materials for Paper-making and other Uses. G. H. Mallary, London. Eng. Pat. 8861, June 20, 1887. 6*d*.

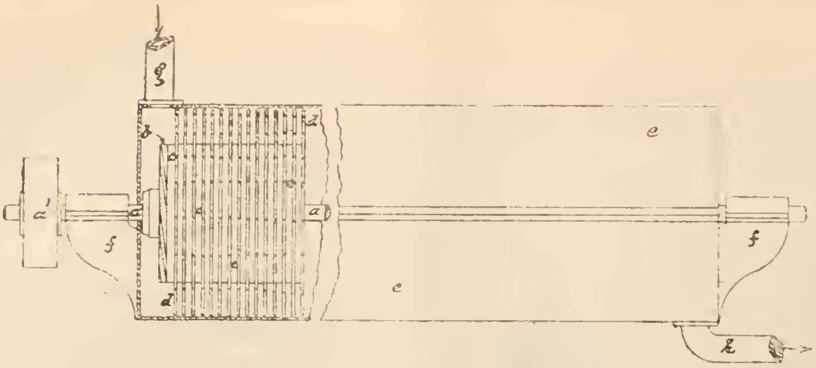
The esparto or other material is boiled with a lye prepared by heating together caustic soda, mustard oil, petroleum, and boracic acid.

In addition to the lye about 2 per cent. of magnesite is used.—E. J. B.

An Improved Machine or Apparatus whereby Fibrous Materials such as Esparto Grass may be reduced to Pulp for Paper-making and other Uses. G. H. Mallary, London. Eng. Pat. 8862, June 20, 1887. 8*d*.

The machine is shown in longitudinal elevation and part section in the figures.





The material to be reduced to pulp enters by the pipe *g* and is pushed forward through the machine by the action of a number of blades placed on the disc *b*. During its passage the material is reduced to pulp by the action of the serrated disintegrator plates *d*. The pulp is discharged by the pipe *h*.—E. J. B.

Improvements in or relating to the Treatment of Vegetable Materials to fit them for the Manufacture of Paper, Pasteboard, Threads, Tow, or other like Objects. P. E. E. Pesier, Paris. Eng. Pat. 12,762, September 20, 1887. 6*d*.

The method consists in macerating the fibrous material in successive baths of caustic alkali in the cold. It is finally treated with boiling water. The waste liquors are purified by precipitating the dissolved organic matter with a slight excess of hydrochloric acid. The precipitate thus formed may be used as manure.—E. J. B.

Improvements in the Manufacture of Paper Pulp. A. Wright, Glasgow. Eng. Pat. 12,903, September 23, 1887. 6*d*.

This invention relates to a method for the preparation of pulp suitable for the manufacture of printing and writing papers of superior whiteness and texture, from stable litter and dung. The first process consists in crushing the material between rollers for the purpose of expressing any liquid matters contained in it, and of bruising the knots and other hard portions of the straw. After this treatment the material is put into boilers and heated with caustic soda at from 40 to 50 lbs. pressure per sq. in., and finally washed in an ordinary breaker. In this state it is suitable for making coarse paper or straw-boards. If it is desired to prepare white paper the material must be bleached in the ordinary way. It is now transferred to the beaters, where it is reduced to the necessary degree of fineness. It is then ready to make into paper. On its way to the chest it passes over the sand tables, which in this case, instead of being about 3 inches deep, are made at least 7 inches. The greater depth allows the sand and gritty material a better chance of settling and being separated from the lighter pulp.—E. J. B.

Improvements in or connected with the Application or Utilisation of Acid Sulphate of Soda in the Manufacture of Cellulose and for other Purposes. W. P. Thompson, Liverpool. From S. Wolf, Stahlhammer, Germany. Eng. Pat. 13,004, September 26, 1887. 6*d*.

In the manufacture of cellulose wood is boiled with a solution of caustic soda, sodium sulphide, and sulphate of soda, the soda being recovered from the brown liquor by evaporation and calcination. To replace the soda lost in the process fresh sulphate of soda is added to the liquor before it is boiled down. The calcination with the organic matter dissolved out of the wood reduces the sulphate to sulphide of soda, the calcined mass consequently consisting of carbonate and sulphide of soda. As the sodium sulphide acts most efficaciously on the wood, this improvement consists in partially neutralising the brown liquor with *acid* sulphate of soda instead of adding neutral sulphate of soda as hitherto. A larger proportion of the soda is then converted into the sulphide upon calcination. If the commercial acid sulphate of soda contains too much free acid the addition of some of the calcareous mud obtained in causticising the crude leys is recommended.—E. E. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Preparation of Chemically Pure Hydrogen Peroxide from the Commercial Product. Mann. Chem. Zeit. **12**, 857.

Commercial hydrogen peroxide often contains hydrochloric, sulphuric, phosphoric, hydrofluoric acids, alumina, lime, magnesia, potash, and soda, derived from the water used in its manufacture, while baryta and traces of iron, copper, lead and manganese are sometimes found if it has been carelessly made.

When these last are present, the product is stable only if it be sufficiently acid, though even then it is less stable than in the absence of these impurities.

The pure substance is chiefly used as an antiseptic in the treatment of sores. The commercial liquid of about 3 per cent. strength is purified by the addition of about $\frac{1}{4}$ per cent. of concentrated phosphoric acid (preferably pure) to precipitate iron, copper, lead, and manganese, and prevent the subsequent formation of their peroxides which would otherwise take place. Saturated baryta water (hot or cold) is then added very gradually, until neutrality is reached; no excess must be used, or hydrated BaO_2 will be precipitated, which will induce decomposition of a portion of the hydrogen peroxide.

The clear liquid is now drawn off, and is poured into an excess of cold saturated baryta water, when hydrated BaO_2 is thrown down, and is then washed until no metal except barium can be detected in the washings.

The BaO_2 is then suspended in water and added drop by drop to a solution consisting of 100 parts of distilled water to 10—12 parts of pure conc. sulphuric acid until only traces of acid remain free; these are best removed by weak baryta water, for an accidental excess of BaO_2 will induce decomposition of some of the already-formed hydrogen peroxide, while an excess of BaO will have no such effect. The barium sulphate is allowed to settle, and the clear liquid drawn off, if found free from both barium and sulphuric acid.

The resulting product is about 3 per cent. strength, very stable, and of great purity.—B. B.

Reactions of Sulphonal. C. Schwarz. Pharm. Zeit. **33**, 405.

Both Vulpius and Ritsert have lately published a reaction for the detection of sulphonal, based on the conversion of the latter by potassium cyanide or sodium-amalgam to mercaptan, which is easily recognised by its characteristic smell. The same reduction can be more simply brought about by heating a mixture of powdered sulphonal and charcoal. If the vessel, wherein the heating is performed, be covered with moist litmus paper, the latter is quickly reddened by the vapours of formic, acetic and sulphurous acids, produced at the same time.—S. H.

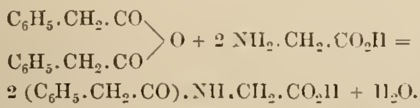
Phenaceturic Acid and its Derivatives. E. Hotter. J. Prakt. Chem. [2], **38**, 97—117.

Phenaceturic acid was first observed by Salkowski (Ber. **12**, 654) in the urine of rabbits and dogs fed with sodium phenylacetate. The discovery of phenaceturic acid in the urine of horses (Salkowski, Zeits. f. physiol. Chem. **9**, 229) was of importance as showing that hippuric acid also (in so far as this is developed from the albumen, and not from the aromatic substances), arises from pancreatic fermentation of albuminoid substances in the alimentary canal. After Salkowski had shown (Ber. **12**, 107 and 648, Zeits. f. physiol. Chem. **9**, 491) that the non-hydroxylated aromatic acids, phenylacetic and phenylpropionic, were products of albuminoid fermentation, it followed that these acids were formed in the alimentary canal, from albumen, and served as the source of hippuric and phenaceturic acids.

The present article deals with the synthetic formation of phenaceturic acid, and an examination is instituted into the properties of its derivatives.

Heating phenylacetic acid and glycocol to 160° (Dessaignes' method) gave negative results.

The method of Curtius gave very small yields. It consists in heating together a solution of phenylacetic anhydride in benzene and glycocol with inverted condenser.



$$\left.\begin{matrix} C_6H_5.CH_2.CO \\ C_6H_5.CH_2.CO \end{matrix}\right\rangle O + 2\,NH_2.CH_2.CO_2H =$$
$$2\,(C_6H_5.CH_2.CO).NH.CH_2.CO_2H + H_2O.$$

The heating was continued for about 10 hours, the benzene distilled off, the residue dried in vacuo, and the dried mass extracted with ether. The extracted residue was dissolved in hot water, clarified by charcoal and allowed to evaporate. On recrystallising from alcohol cubical crystals, having the melting point 142°, were obtained.

The method of Baum, however, was made with various modifications to give as high as 30 per cent. to 50 per cent. of the theoretical yield. According to this method 15·5 grms. of phenylacetyl chloride, cooled to —15°, were gradually added to a well cooled and strongly alkaline solution containing 8 grms. of glycocol. The whole was kept well shaken and as cool as possible. The resulting product was dissolved in caustic soda (16 grms. NaOH) and partially evaporated. Phenylacetic and phenaceturic acids were precipitated with hydrochloric acid and dried, and the phenylacetic acid dissolved out by extraction with ether. The phenaceturic acid was dissolved in hot water, the solution decolourised by charcoal and the acid allowed to crystallise. It crystallises from alcohol in cubical crystals and melts at 143°. Heated to 190°—200° it decomposes. It is difficultly soluble in ether and in cold water and likewise in benzene, somewhat difficultly in hot chloroform, but easily soluble in hot water, alcohol, and acetic ether. It is more soluble in water than hippuric acid. The synthetically prepared phenaceturic acid is perfectly identical with that obtained in the physiological experiments.

After recrystallising from water the mother-liquors evaporated were found to contain, besides phenaceturic acid, an acid analogous to the hippurylamidoacetic acid obtained by Curtius.

Of the salts of phenaceturic acid are described the calcium salt, $(C_{10}H_{10}NO_3)_2Ca\ 2\ H_2O$, the silver salt, $C_{10}H_{10}NO_3.Ag$, the copper salt $(C_{10}H_{10}NO_3)_2Cu.H_2O$, the lead salt $(C_{10}H_{10}NO_3)_2Pb.H_2O$, the zinc salt $(C_{10}H_{10}NO_3)_2Zn$.

The ethers of phenaceturic acid correspond, in chemical and physical properties, with those of hippuric acid. As in the case of the hippuric acid ethers the melting point is lowered with increase in the number of carbon atoms, and the ratios of solubility correspond to those of the hippuric acid ethers.

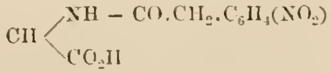
The methyl ether, $C_{10}H_{10}NO_3.CH_3$, may be prepared from methyl iodide and the silver salt. It crystallises in needles melting at 86·5°, is very soluble in hot alcohol and chloroform, easily in warm ether and benzene, but insoluble in carbon disulphide.

The ethyl ether is prepared in a similar manner to the methyl ether. It crystallises in broad prisms melting at 79°.

The normal propyl ether crystallises from water in broad rectangular leaflets melting at 31°.

The amide, $CH_2.NH(COCH_2C_6H_5)CONH_2$, crystallises from alcohol in iridescent plates, melting at 174°. It is obtained by allowing one part of the methyl ether to stand with 4—5 parts of ammonia (sp. gr. 0·884 = 36 per cent. NH_3) in a closed vessel.

Nitrophenaceturic acid,—

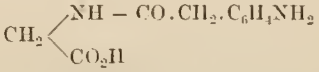


$$CH \left\langle \begin{matrix} NH - CO.CH_2.C_6H_4(NO_2) \\ CO_2H \end{matrix}\right.$$

is prepared by acting on well cooled phenaceturic acid with nitric and sulphuric acids. It melts at 173° and is not soluble in hot benzene or ether, difficultly soluble in cold water and alcohol, easily soluble in hot water and alcohol as well as in ammonia and caustic alkalis.

Nitrophenaceturic acid heated for some hours with concentrated hydrochloric acid yields *p*-nitrophenylacetic acid and glycocol; the nitro group takes thus a similar position to that obtained by the nitration of phenylacetic acid.

Amidophenaceturic acid,—



$$CH_2 \left\langle \begin{matrix} NH - CO.CH_2.C_6H_4NH_2 \\ CO_2H \end{matrix}\right.$$

is obtained by dissolving nitrophenaceturic acid in yellow ammonium sulphide and passing sulphuretted hydrogen. Heated to 200° it is decomposed without melting.

Fruitless attempts were made to obtain phenacetylglycollic acid from phenaceturic acid, but only phenylacetic acid was obtained.

The author and several colleagues took for several days doses of 3 grms. of sodium phenylacetate. The urine gave only hippuric acid, and no trace of either phenylacetic or phenaceturic acid.—T. L. B.

The Constituents of Calamus-Roots. H. Thoms. Ber. **21**, 1912—1920.

The roots are extracted with petroleum-ether, to remove ethereal oils, and then subjected to a prolonged treatment with alcohol. The residue is dried, the filtrate evaporated on the water-bath, and the vitreous mass which remains extracted with cold water. This solution contains a certain tannic acid, which can be separated with lead acetate. The filtrate from the lead salt, after removal of excess of lead, is treated with potassium-bismuth iodide, and after filtering the solution is neutralised with sodium carbonate. The solution is again filtered, and well shaken with animal charcoal. The latter, after filtering, is dried on filter-paper, then extracted with ether. The residue from the latter solvent consists of a light yellow balsam of aromatic smell and bitter taste. In it are embedded crystals of sulphur, the presence of which the author cannot account for. The residue which remains after extracting the roots with alcohol is treated with water, to which it imparts an acid reaction. On adding double the volume of alcohol to the filtered solution a white flocculent body, vegetable mucilage, separates out. From the filtrate, after evaporating and mixing with alcohol, a crystalline mass is deposited. This consists of potassium and sodium sulphates and possibly also contains acid tartrates. The aqueous solution obtained on filtering off from the animal charcoal probably contains glucose.

By evaporating the aqueous and alkaline solution over sulphuric acid, acorin, the bitter principle of the calamus roots, is obtained. It has a neutral reaction and is free from nitrogen. Water extracts a small quantity of a substance of strong bitter taste, and this solution becomes turbid on adding a trace of sulphuric acid, a strong odour of an ethereal oil becoming at the same time apparent. The author believes that acorin is not a glycoside. Alkaline extracts of calamus roots, when heated, emit an odour of trimethylamine. This is due to the cholin contained in the roots.—A. R.

Piperidine. E. Lellmann and W. Geller. Ber. **21**, 1921.

Five grms. piperidine were heated in a sealed tube with 22 grms. nitrobenzene for four hours at 250°—260°. Excess of the latter as well as azobenzene were removed with aqueous vapour after acidifying with sulphuric acid, the residue was then made alkaline, and the bases distilled over and collected in water acidified with HCl. The distillate contains pyridine, aniline, and ammonia.

On allowing a solution of equal volumes of piperidine and water to drop into a boiling alkaline solution of chloride of lime, and then distilling with aqueous vapour, a very volatile body—*piperylene-nitrogen chloride*, $C_5H_{10}NCl$—distils over. Under a pressure of 22 m.m. the colourless oil boils at 52°, with slight decomposition.—A. R.

On certain Lepidine Derivatives. B. Heymann and W. Koenigs. Ber. **21**, 2167—2172.

This research was undertaken with a view to preparing the oxybenzyllepidines, as their composition coincides with that of homapocinchene, obtained from cinchonine.

First the unsaturated compounds $C_9H_6N.CH:CH.C_6H_4OH$ were obtained from lepidine and o- and p-oxybenzaldehyde. The meta derivative was prepared, by means of the nitro-derivative, from m-nitrobenzaldehyde and lepidine. These three oxybenzylidene-lepidines were then reduced with HI, glacial acetic acid, and phosphorus to the saturated state. Though p-oxybenzyl-lepidine resembles homapocinchene, it is not identical with it. The striking difference between the three synthetical oxybenzyl-lepidines and homapocinchene is the fact that the former are readily decomposed in the potash-melt into the corresponding oxybenzoic acids and lepidine, whereas the latter remains unchanged.—A. R.

On αγ-Dimethyl-p-Toluquinoline. W. Pfitzinger. J. Prakt. Chem. [2], **38**, 40—48.

This base is prepared by saturating 30 grms. paraldehyde and 40 grms. acetone with dry HCl gas and cooling well with ice. After standing 12 hours, the mixture is added slowly to 65 grms. *p*-toluidine and 130 grms. fuming HCl, and then heated several hours on the water-bath. After removing excess of acetone and aldehyde the solution is made alkaline and distilled with aqueous vapour, when *p*-toluidine comes over first and then the quinoline base, almost pure. The latter is purified by means of its picrate. From hot aqueous solution the base separates as an oil on cooling, which soon solidifies to white needles, melting at 63°—64°. The crystals contain water of crystallisation. The anhydrous base is obtained by drying over H_2SO_4. It boils at 277°—278°, and the distillate solidifies on cooling to large transparent plates. The base has an odour resembling peppermint. Several salts are described, also the methyl iodide additive compound.—A. R.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

The Photochromatic Properties of Silver Chloride. G. Staats. Ber. **21**, 2199.

In continuation of his researches (Ber. **20**, 2322) on the action of sunlight on silver plates, which had previously been subjected to the action of ferric chloride, the author has made attempts to isolate the various coloured substances for the purpose of studying them microscopically. It was thought probable that the other colours might be obtained in a similar manner to that in which Carey Lea obtained red (Amer. J. Science [3], **32**, 349). By precipitating the ammoniacal solution with ferrous sulphate solution, neutralising with sulphuric acid, and boiling first with nitric, then with hydrochloric acid, the red was obtained in the case of all the colours. As this same colour is obtained on the silver plate by warming, in the case of each colour, the result may be considered due to the action of heat.

On dissolving off from the silver plate by dilute ammonia and evaporating off the ammonia, the colours were no longer recognisable.

The amorphous masses obtained from hydrochloric acid solutions likewise gave no variations of colour.

The colours thus remain only so long as the surface is undisturbed by solvents.

By allowing extremely thin silver plates to float for 10—12 seconds on ferric chloride solution, and then dissolving the silver in nitric acid, the red and blue colours were obtained, and were the same whether viewed by transmitted or reflected light.—T. L. B.

PATENT.

Improvements in the Preparation of Films for Photographic Purposes in Monochrome or Polychrome. J. Brown, Kingston-on-Thames. Eng. Pat. 12,521, September 15, 1887. 4*d.*

A sheet of paper is coated with gelatin, rendered insoluble; when dry, it is again coated with liquid caoutchouc to which has been added mineral oil, grease, or wax, this is also covered with a layer of collodion, which is followed by a coating of gelatin, finally, this top layer of gelatin receives a film of silver bromide emulsion. The layer of gelatin is sometimes omitted, when the silver bromide emulsion follows the collodion. After the monochromatic image is obtained on the film the colours are placed on the surface, and, when dry, the film is transferred to a rigid support, such as card, glass, &c., and the temporary paper support removed. —O. H.

XXII.—EXPLOSIVES, MATCHES, Etc.

On the Explosive Decomposition of Picric Acid and Nitro-compounds. Berthelot. Bull. Soc. Chim. Paris **49**, 956—959.

The violence with which picrates explode under the influence of a blow or of heat has long been known, and it has been supposed that picric acid behaves in the same way. Of late, however, doubts have been expressed as to whether picric acid can explode if merely heated, and various experiments have been made upon the subject in France and England. *See* this Journal, 1887, 835.

If a small quantity of picric acid be heated over a moderate fire in a crucible, or even in an open bottle, it will melt, then give off vapours, which catch fire upon contact with air and burn with a sooty flame without exploding, and if the burning liquid be poured on to a cold surface it will soon go out. A small quantity carefully heated in a tube closed at one end can even be volatilised without any apparent decomposition. It is thus obvious that picric acid is much less explosive than the nitric ethers, such as nitroglycerin and gun-cotton, and very considerably less than the nitrogen compounds and fulminate of mercury.

It would, however, be quite erroneous to assume that picric acid cannot explode when simply heated. On the contrary, the author has proved experimentally that this is not the case. If a glass tube be heated to redness and a minute quantity of picric acid crystals be then thrown in, it will explode with a characteristic noise. If the quantity be increased so that the temperature of the tube is materially reduced, no explosion will take place at once, but the substance will volatilise and explode, though with much less violence than before, in the upper part of the tube. Finally, if the amount of picric acid be still further increased it will undergo partial decomposition and volatilise, but will not even deflagrate. Nitrobenzene, dinitrobenzene, and mono-, di-, and tri-nitronaphthalene behave similarly, the violence of the explosion increasing in proportion to the amount of oxygen in the compound.

The manner in which the compound will decompose is thus dependent on the initial temperature of the decomposition, and if the surrounding material absorb the heat as fast as it is produced by the decomposition, there will be no explosion and no deflagration. If, however, the absorption is not sufficient to prevent deflagration, this may so increase the temperature of the surrounding materials that the deflagration will end in an explosion. Further, if in this manner an explosion were started at an isolated spot, it would extend throughout the mass, giving rise to a general explosion.—E. E. B.

PATENTS.

Improvements in Explosive Compounds and Safety Cartridges for Blasting Purposes. C. D. Abel, London. From H. Schnoeneweg, Dudweiler, Germany. Eng. Pat. 4713, March 29, 1887. 6*d.*

The patentee produces explosive compounds which give no flame on firing by mixing the ordinary explosives, consisting of nitro-compounds, with dry amorphous oxalic acid, or its salts, and "a carrier of oxygen"; or cartridges may be formed containing two separate concentric charges, the central charge being formed of the ordinary explosive compound and the outer annular one of the oxalic acid or oxalate. It is also claimed that the presence of oxalic acid and its salts prevents the spontaneous decomposition of the explosive.—O. H.

Improvements in Explosive Compounds. E. D. Müller, Cologne, Germany. Eng. Pat. 12,424, September 13, 1887. 6*d.*

In order to cool the explosive gas mixtures, the patentee proposes to mix various explosives, such as nitro-glycerin, with 15—65 per cent. of salts, containing more than 5 mol. of water of crystallisation, preferably soda crystals, the alums, the sulphates, &c. of sodium. These mixtures are formed into cartridges, and at the explosion, the water being converted into steam, cools the gases down to such an extent that an absolute security against the ignition of the explosive gases is obtained. For warm climates magnesium sulphate is preferable to soda crystals or Glauber salt, and different mixtures and salts are selected according to the advantages they offer in special cases.—A. R.

Improvement in Explosive Compounds. H. J. Allison, London. From A. S. Fitch, New York, U.S.A. Eng. Pat. 7497, May 22, 1888. 6*d.*

The object of this patent is the production of a blasting powder to consist of a mixture of ordinary granulated black blasting powder with nitro-glycerol, which shall preserve the granular form and structure of the former and not be reduced to a pasty, sticky, or deliquated mass during mixing. This is effected by mixing starch paste with the materials of the black blasting powder (charcoal and a nitrate), when on drying and granulating this powder possesses a cellular or honey-combed structure, and readily absorbs nitro-glycerol while retaining its full granular form.
—O. H.

XXIII.—ANALYTICAL CHEMISTRY.

A Wash-Bottle Valve. M. Wendriner. Chem. Zeit. **12**, 858—859.

The valve is an improvement on those devised by Söllscher (Ber. **17**, 1080) and Beutell (Chem. Zeit. **12**, 53), and has the same object, viz., to keep the delivery tube of the wash-bottle full of liquid, and thus avoid the spluttering that usually occurs at the beginning of each time of using.

Fig. 1.

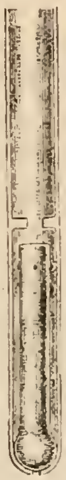
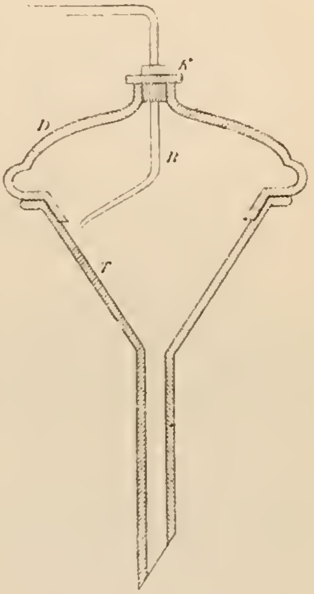


Fig. 2.



It consists of a small glass rod (*see* Fig. 1) with bulbed end, ground into the lower part of the delivery tube of the wash-bottle; it is kept concentric with this by small projections, and is prevented from rising more than a short distance above its seat by a glass ring fused into the delivery tube. Such a valve should fulfil the following conditions:—

(1.) It should keep the delivery tube full for 15 minutes at a time.
(2.) It should not throttle the stream of liquid appreciably.
(3.) It should not interfere with freedom in handling the wash-bottle.

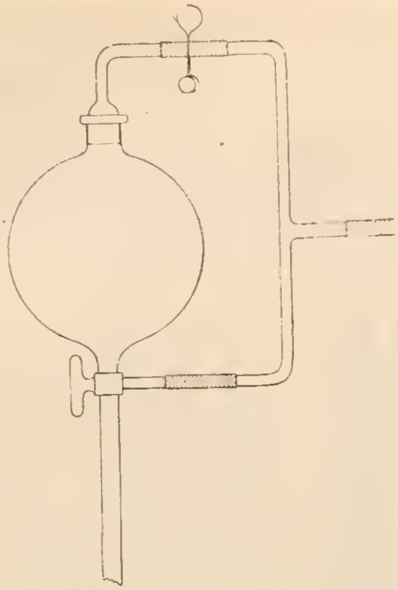
A wash-bottle fitted with this valve should have a third tube passing through the cork, nearly to the bottom, to serve as an inlet tube for air when the flask is inverted to pour from. When in use in its normal position the tube can be closed by a rubber cap or by the thumb.—B. B.

Convenient Filtering Arrangement. G. Neumann. J. Prakt. Chem. [2], **38**, 88.

The accompanying figure (*see* Fig. 2 above) shows a continuous washing arrangement. The cover D fits air-tight on the funnel T. Through the hole K in the cover passes the tube R slightly spirally bent, so that the liquid passing from it may run round the sides of the funnel. R is connected with a tube dipping into the liquid for washing, and the funnel is fitted to a filter flask.—T. L. B.

Dropping Funnel. G. Neumann. J. Prakt. Chem. [2], **38**, 89.

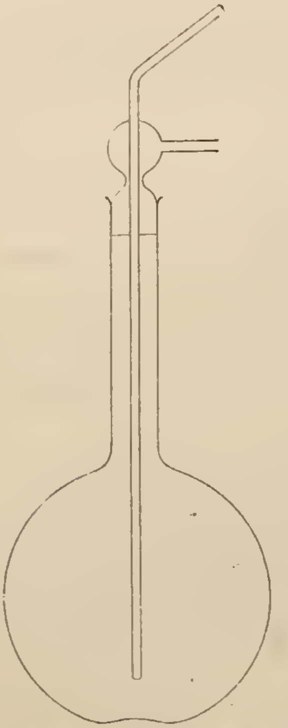
The funnel is fitted with a three-way cock, and where distillation is to be performed in any special atmosphere it is seen that the stopper to the distilling flask need have only one opening. Equality of pressure is also obtained through-



out, and hence liability to loss during the running in of the liquid is overcome. If liquid is to be poured into the funnel during the operation, a pinch-cock may be used, as shown, and the stopper then removed.—T. L. B.

Litre Flask with Fittings. G. Neumann. J. Prakt. Chem. [2], 38, 90.

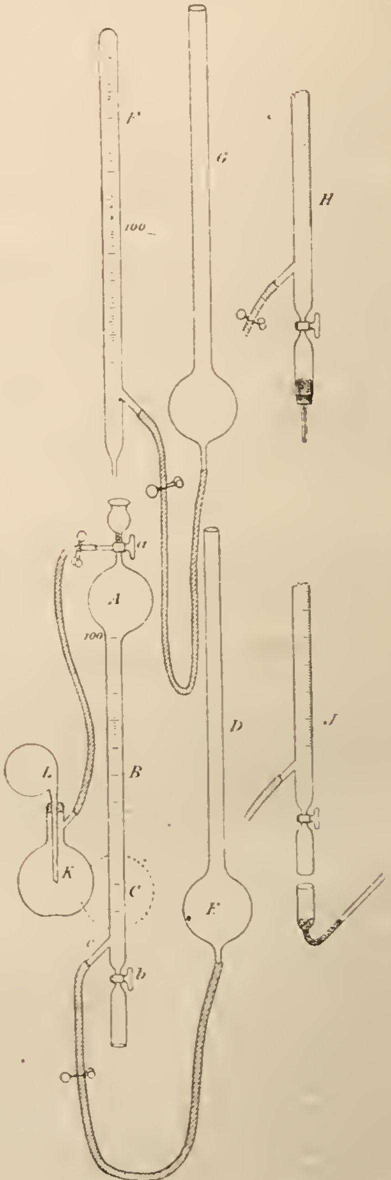
The apparatus is convenient in cases where the distillate, after being made up to a certain volume, is to be titrated.



Transference of distillate to another vessel is obviated.
—T. L. B

New Burette for Gas Analysis. G. Neumann. J. Prakt. Chem. [2], 38, 85.

The tube B is divided into $\frac{1}{10}$ cc., and is fitted at one end with a three-way cock *a*, and at the other end with a cock *b*. The bulb A has a capacity of 100 cc. and the tube B of about 80 cc. Surmounting the whole is a small funnel. By means of the side tube *c* and a caoutchouc tube, B is connected with D, a tube of the same diameter as B, and having a bulb E of about 100 cc. capacity blown at its lower end. The apparatus F G is so made that F may be fixed tightly into the funnel of B. If the amount of gas is less than is sufficient to fill the bulb A, F G is filled with water and fitted to B and transference to F carefully effected. In the case of larger quantities of gas it may be convenient to add to B a bulb C.



The apparatus may take the place of a Bunte's burette by inserting, below *b*, a caoutchouc stopper with capillary tube, and closing *c* by means of a pinch-cock (*see* H. in Fig.). Levelling may then be very easily performed by merely relieving the pinch-cock.

By fitting on a bent tube containing mercury (*see* J in Fig.) the apparatus may be used for nitrogen determinations.

By closing the cock *b* the apparatus may be used as a Lunge's nitrometer. The substance to be analysed is put into K, the liquid into the retort L, and these two then put together as shown.—T. L. B.

Graduation of Tubes for Measuring Gases. Berthelot. Bull. Soc. Chim. Paris, **49**, 959—960.

To check accurately the graduations of a tube it is filled completely with pure mercury, care being taken to remove any bubbles of air. A small piece of well-ground glass is then placed over the end of the tube and the whole weighed. The tube is then held with the sealed end upwards, and by momentarily raising a corner of the ground-glass plate a bubble of air rises into the tube, displacing a small quantity of mercury. The level of the mercury is then accurately noted by means of a magnifying glass or small telescope. The tube is weighed again, and the weight of the displaced mercury divided by its specific gravity at the temperature of the experiment gives most accurately the volume occupied by the bubble of air. The operation can be repeated eight or ten times in an hour, and the graduations of the tube thus checked from the top to the bottom. The author prefers that the graduations themselves should be made upon this principle instead of being merely checked by it.—E. E. B.

Impurities in Reagents. C. Krauch. Zeits. f. angew. Chem. 1888, 373—375.

The author discusses the purity of reagents sold as "purissimum," "pur," "de purat," &c., and shows that these terms, when applied to commercially pure chemicals, have really no definite meaning. The following is a list of the "puris" chemicals examined and the impurities found :—

Reagent.	Impurities.
Caustic potash..........	Alumina, chlorine, sulphuric, and nitric acids.
„ soda............	The same.
Ammonia...............	Pyridine, pyrrol, occasionally copper and zinc.
Sodium carbonate	Thiosulphate, arsenic, ammonia.
„ nitrite	Generally pure (100 per cent.).
Potassium nitrite	Generally very impure (80 to 90 per cent.).
„ nitrate........	Has been known to contain chlorate.
Sodium tungstate........	Chloride, sulphate, and carbonate of sodium.
Potassium chlorate	Has been found to contain lead.
„ sulphocyanide	Traces of iron and lead.
Lime....................	Silica, alumina, iron oxide, and sulphuric acid.
Platinum chloride	Often not completely soluble in alcohol.
Uranium nitrate.........	Occasionally much sulphate.
Molybdic acid	Always 10 to 20 per cent. of ammonium salts.
Ammonium molybdate ..	Frequently pure.
Hydrofluoric acid........	Usually not pure enough for analytical purposes.
Sulphuric acid...........	Five per cent. of ammonia has been found in "pure" acid.
Hydrochloric acid	Nearly always traces of arsenic, sometimes organic chlorides.
Tartaric and citric acids .	Traces of iron, lead, lime, and sulphuric acid.
Oxalic acid	Usually sulphuric acid, and once ammonia.
Methyl alcohol..........	One sample contained much acetone.
Ether....................	Petroleum ether, hydroxyl, aldehyde.
Ferro- and ferricyanides of potash	Usually pure.
Iodine	
Nitric acid...............	

The author, in conclusion, observes that most salts denominated in commerce "puriss," &c., are usually impure. B. Fischer states that he had found lead and sulphuretted hydrogen in hydrochloric acid, and tin in ammonia, and he, with Krauch, draws attention to the desirability of the use of standard methods both of preparation and analysis, so that the manufacturer shall know what it is desired that he should produce, and the buyer what impurities are likely to be present.—A. W.

Analysis of Crude Sodium Acetate. G. Neumann. J. Prakt. Chem. [2], **38**, 91—97.

Sodium acetate may be decomposed by hydrochloric acid or by sulphuric acid. In the former case, however, hydrochloric acid is carried over, and an error is thus introduced in the titration of the distillate; in the case of sulphuric acid part of this may be reduced to sulphurous acid by any carbon present, and an error introduced here likewise. Distillation with phosphoric acid is the most workable method, though at higher temperatures a little phosphoric acid may be mechanically carried over. The author uses the apparatus shown in the accompanying Figure.

(*See* Fig. at top of next page.)

The decomposition takes place in the flask *b*; the funnel *k* is such as is described (p. 644); the bent tube *e* is provided with an outlet tap, and contains glass wool. The condenser *d* connects with the $\frac{1}{2}$-litre flask *c*, fitted as described on p. 644. The small U-tube *f* contains methyl-orange solution, *g* contains pieces of glass moistened with sulphuric acid, and *h* and *i* are filled with soda lime.

About 2·5 grms. of the substance being introduced into the flask *b*, and a quantity of water into *c*, a slow current of air is passed; 30 cc. of phosphoric acid (sp. gr. 1·12) are then added from *k*, and distillation is commenced over a chloride of calcium bath, the temperature of which should not exceed 130°. The liquid distilled from *b* must be replaced by hot water added 25 cc. at a time till an acid reaction can no longer be detected at the outlet cock on *e*. At the end of $1\frac{3}{4}$ hour the distillation may be stopped. The increase in weight of *g* and *i* gives the amount of carbonic acid, and the acetic acid solution in *c* having been made up to half a litre, 50 cc. of it may be titrated.

The introduction of the methyl-orange tube *f* is necessary to ascertain that no acetic acid has been carried over from *c*. The carbon may be determined by means of sulphuric and chromic acids.

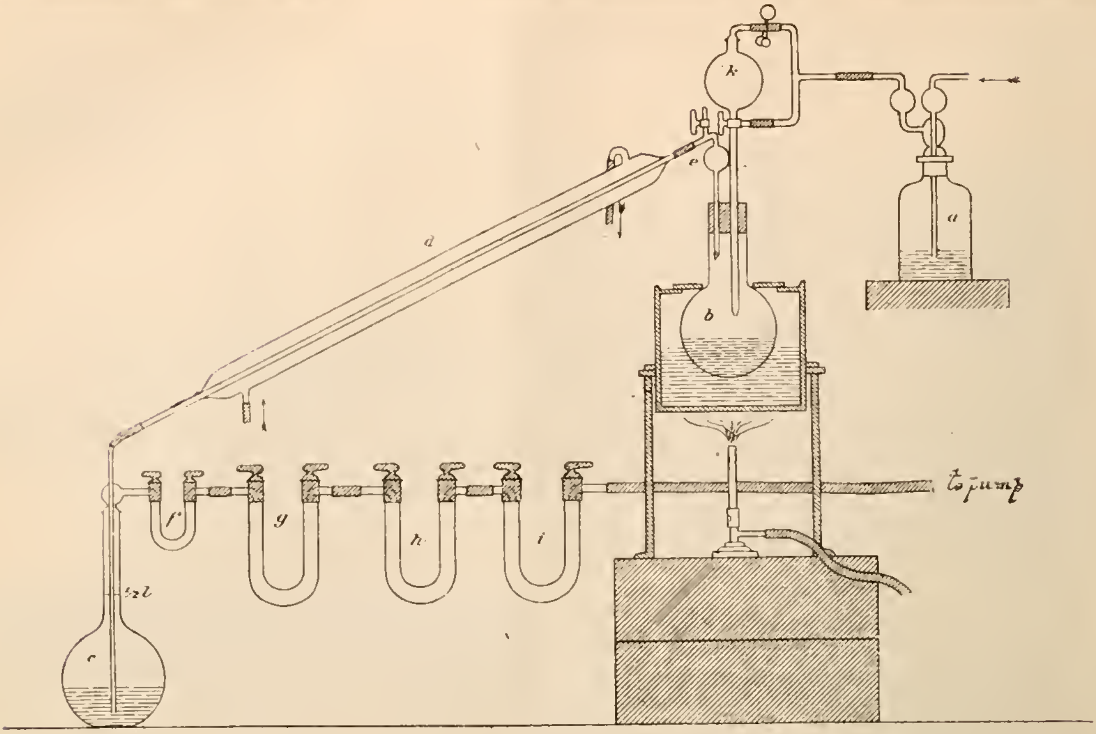
Another method is by ignition of sodium acetate, when sodium carbonate is formed, but the results obtained by this method are too high, owing to the existence of carbonate in the crude acetate and the formation of carbonate by the ignition of other impurities.—T. L. B.

The Estimation of Sulphur in Iron. C. Meineke. Zeits. f. angew. Chem. 1888, 376—380.

Details are given of the author's own plan of determining sulphur in iron by the sulphuretted hydrogen method. He dissolves the iron in dilute hydrochloric acid, and passes the evolved gases by means of a stream of hydrogen through dilute hydrogen peroxide (2·5 per cent.) containing a little caustic soda, and determines the sulphuric acid as barium sulphate. In some cases, however, this is not a correct method of determination, as a considerable proportion of the sulphur is not carried forward as sulphuretted hydrogen, but remains behind in the dissolving flask. Many instances are given showing the percentage of sulphur in the residue to be 30 per cent., in some cases 50 per cent., and in one case 100 per cent. of the total sulphur. To overcome this difficulty the author recommends the ensuing method based upon the following reactions :—

$$Fe + FeS + 2\ CuCl_2 = 2\ FeCl_2 + CuS + Cu$$
$$CuS + Cu + 2\ CuCl_2 = 4\ CuCl + S$$

5 grms. of the iron are dissolved by 50 grms. of copper-ammonium chloride in 250 cc. of water, containing 10 to



15 cc. hydrochloric acid. The solution is kept nearly boiling till all or nearly all the copper is redissolved, generally about 15 minutes, and filtered at once through asbestos. The residue is treated with a little chlorate of potash, 5 cc. nitric acid (1·4 sp. gr.), and 10 cc. hydrochloric acid (1·19 sp. gr.), evaporated to dryness, redissolved, filtered, and sulphuric acid precipitated with barium chloride.

The industrial application of the principles of the above reactions is suggested in connexion with copper extraction from burnt pyrites. The idea is to calcine half of the burnt ore with salt in the usual manner, lixiviate, and mix the extract with the uncalcined portion, by which means the cupric chloride reacts with the cupric sulphide and forms cuprous chloride, which is dissolved by the salt. The following four advantages are claimed for this process:—(1.) Saving of half the cost of roasting. (2.) Saving of nearly half of the hydrochloric acid. (3.) Saving of nearly half of the iron used in precipitating copper. (4.) The advantage gained by the insolubility of silver chloride in cuprous chloride.—A. W.

The Direct Estimation of Phosphoric Acid as Tribasic Calcium Phosphate. H. Tzschucke. Zeits. f. angew. Chem. 1888, 383—385.

If a solution of neutral calcium chloride is precipitated by ordinary sodium phosphate, the following reaction takes place:—

$$3\ CaCl_2 + 2\ Na_2HPO_4 = Ca_3(PO_4)_2 + 4\ NaCl + 2\ HCl.$$

The tribasic precipitate thus formed is transformed into the neutral salt by the hydrochloric acid, and according to the strength of the solution and the time the acid is allowed to act, so are precipitates of various composition obtained, some of the phosphoric acid again passing into solution. If, however, the solution be previously rendered strongly ammoniacal, the tribasic precipitate does not change. The proposed method of analysis is as follows:—To the solution of phosphate is added hydrochloric acid in sufficient quantity to prevent any precipitate forming when excess of chloride of calcium is added. The tribasic phosphate is then precipitated by the addition of a large excess of ammonia, the solution is diluted with twice its volume of cold water, filtered, and washed with cold water. The precipitate is weighed as the tribasic calcium phosphate. The presence of much silica, fluorine, or magnesia would cause the result to be too high, and the method is recommended as affording a rapid means for a preliminary determination.—A. W.

Note on the Determination of Carbon in Iron. G. Weissmann. Chem. Zeit. **12**, 858.

O. Gmelin's process (Oesten. Ztschr. f. Berg-und-Hüttenw. 1884, 708) is satisfactory in the case of irons easily soluble in chromic mixture; for difficultly soluble irons that require 15 or 20 minutes boiling, the author recommends the addition of a condenser. 1 grm. of the iron in the form of turnings is treated with 10 or 12 cc. of a saturated solution of CrO_3, and then 200 cc. of sulphuric acid (sp. gr. 1·62—1·66) are added. No premature evolution of CO_2 takes place under these conditions. 50 cc. of sulphuric acid (sp. gr. 1·09—1·10) are then run in, the flask gently heated, and the CO_2 absorbed by potash-pumice, or by the apparatus recommended by Strohmer (Chem. Zeit. Repert. **10**, 33). The method is rapid, and needs little attention. In the case of grey irons the portion for analysis should be taken in the manner prescribed by Jüptner (Handb. f. Eisenhütten-Chemiker 1885, 9; *see also* Chem. News **55**, 231).—B. B.

Decolourisation of Tincture of Litmus in Closed Vessels. R. Dubois. Bull. Soc. Chim. Paris, **49**, 963—964.

It is well known that tincture of litmus loses its colour completely when kept in a closed bottle, and that the blue colour is restored when fresh air is admitted. No satisfactory explanation of the phenomenon has hitherto been given, and the author finds that it is due to the action of a ferment, which becomes anaerobic in a closed vessel, and reduces the blue colouring-matter to a readily oxidisable leuco derivative. If some tincture of litmus be sterilised by means of mercuric chloride or by boiling, and be then sealed up, no decolourisation ensues.—E. E. B.

Possible Errors in the Estimation of Tannin. v. Schroeder, Tharaud. Dingl. Polyt. J. **269**, 38, 82.

The author has adopted the following method of analysis for a large number of samples of tannin containing extracts:—

The weighed quantity of extract (3—30 grms.) is washed with hot water into a litre flask, the flask filled three-quarters with water, and the mixture digested for one hour on the water-bath. In all cases the solution so made is perfectly clear at a boiling temperature. The liquid is now made nearly up to the mark and cooled by immersion in cold water, and then allowed to stand for a few hours to equalise the temperature. It is then filtered. In all cases a reddish-brown precipitate is formed on cooling. The total solids are then determined by evaporating 50 cc. or 100 cc. to dryness and weighing. The weighed residue is burnt and the ash weighed. The sum of the dissolved bodies and moisture subtracted from 100 leaves the insoluble substances. The tannin is estimated by Löwenthal's method and also by absorption with hide powder. For this latter purpose 200 cc. of the solution are treated with 10 grms. hide powder for half to one hour, filtered through linen and digested 24 hours more with 4 grms. fresh hide powder and filtered, first through linen and then through filter-paper. 50 cc. or 100 cc. of the filtrate are evaporated and weighed and the ash determined. A blank experiment is made with hide powder and distilled water.

In all his experiments the author finds that the percentage of insoluble bodies increases with the concentration of the solution used for analysis, and that it is accompanied by a corresponding decrease in the percentage of tannin. This he proves to be due to the variable precipitation of tannin soluble with difficulty, and to the absorption of tannin by filter-paper. From strong solutions paper absorbs more than from dilute, and the time of contact also influences the absorption. As regards the deposition of difficultly soluble tannins, the greater portion is deposited during the last stages of the cooling. This precipitate is appreciably soluble in excess of cold water. As it is desirable to find a maximum of tannin, the author recommends the use of dilute solutions, rapid cooling and rapid filtration through thin filter-paper, using a moderate surface. The author also advises the use of the indirect method of estimating tannin by weight, and states that he has obtained far more concordant results by its use than by Löwenthal's method. —H. T. P.

The Determination of Nitrogen in Nitrogenous Superphosphates. P. Zipperer. Chem. Zeit. **12**, 955.

Andouard's statement that nitrogenous superphosphates undergo a partial decomposition at 25° to 30° C., with the loss of a portion of nitrogen, is, in the author's opinion, not confirmed. If superphosphates are carefully prepared, and contain no free sulphuric acid, no loss of nitrogen takes place, even at the temperature of boiling water. On the other hand, it is well known that a more favourable result, as regards soluble phosphoric acid, is obtained if the superphosphates contain from 1 to 2 per cent. of uncombined sulphuric acid. If in such samples the nitrogen be estimated by the Schlösing-Grandeau method, too little nitrogen will be found, as the method prescribes the concentration of the aqueous extract, whereby a loss of more or less nitrogen is inevitable. The author's method of proceeding avoids this inaccuracy. 10 or 20 grms. of the substance to be tested are treated in a mortar in the usual manner. The mass is then put into a litre flask, which is filled up to the mark. It is allowed to stand for two hours (being shaken from time to time), and 500 cc. are filtered through a dry filter. This is carefully neutralised with sodium hydrate, free from nitrogen, using phenolphtaleïn as an indicator. After neutralisation the solution is diluted with water to 1,000 cc., shaken, and filtered. 100 cc. of the filtrate are evaporated to dryness in a platinum capsule, the residue is taken up with a little water and sulphuric acid, and the nitrogen therein estimated by the Schlösing-Grandeau method, or, better still, by means of Lunge's nitrometer. The amount of the original substance to be weighed out for the test should be regulated so that about 35 cc. of nitric oxide are obtained by the gasometric method.—S. H.

New Books.

Fortschritte der Theerfarbenfabrikation und Verwandter Industriezweige, 1877—1887. An der Hand der Systematisch Geordneten und mit Kritischen Anmerkungen versehenen Deutschen Reichs-Patente. Dargestellt von Dr. P. Friedländer. Privatdocent an der technischen Hochschule zu Karlsruhe i. B. Berlin: Verlag von Julius Springer, 1888. London: H. Grevel and Co., 33, King Street, Covent Garden.

Large 8vo. volume, bound in paper cover. Price 24 M. (1*l.* 4*s.*). It contains Preface, Table of Contents, 599 pages of subject-matter, a Register of the Numbers of the German Patents recorded, as also of the Applications for Patents, covering two pages, an alphabetical Index of the holders of Patents, covering 4¼ pages, and finally, a complete alphabetical Index, covering 8 pages.

The classification of the matter of the Contents is as follows:—

Intermediate products of the Tar Industry (1 to 29 pages). The Triphenylmethane Colours (pages 30 to 123). Indigo Blue, Isatine and the Indole Derivatives (pages 124 to 154). Quinoline-, Quinoxalin-, Phenylpyrazol-, and Pyrrol-compounds (pages 155 to 225). Salicylic Acid and Phenolcarbonic Acids (pages 226 to 240). Colours from Diphenylamine and its Derivatives (pages 241 to 298). Anthracene Colours (pages 299 to 313). Phthaleins (pages 314 to 320). Nitro-colours (pages 321 to 332). Nitroso-compounds (pages 333 to 340). Azo Colours (pages 341 to 554). Colours of various composition (pages 555 to 565). Organic Compounds of various composition (pages 566 to 596). Appendix. The work gives a clear and precise account of all that has been done in Colour Chemistry between the years 1877 and 1887.

Chemisch-Technisches Repertorium. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie mit Hinweis auf Maschinen, Apparate, und Literatur. Herausgegeben von Dr. Emil Jacobsen. Berlin, S.W., 1888. R. Gaertner's Verlagsbuchhandlung - Hermann Heyfelder. Schönebergerstrasse 26. London: H. Grevel and Co., 33, King Street, Covent Garden.

This quarterly report on the progress of Chemical Technology takes the form of an 8vo. volume, bound in paper cover, furnished with numerous illustrations, and a full alphabetical Index for the annual set at the end of the last quarter's issue of each year. The matter is classified as follows:—(1.) Building Materials, Cements, and Artificial Stone. (2.) Colours, Dyeing, and Printing. (3.) Coal-tar Products. (4.) Fats, Oils, Illuminating, and Heating Materials. (5.) Fermented Drinks. (6.) Tanning, Leather, and Glue Manufacture. (7.) Textiles. (8.) Glass and Earthenware. (9.) Wood and Horn. (10.) India-rubber. (11.) Cements. (12.) Lakes, Varnishes, and Paints. (13.) Metals. (14.) Foodstuffs. (15.) Paper. (16.) Photography. (17.) Bye-Products, Refuses, Manures, Disinfectants, and Sanitary Science. (18.) Soaps. (19.) Explosives, Matches, &c. (20.) Preparation and Purification of Chemicals. (21.) Chemical Analysis. (22.) Apparatus, Machinery, Technical Electricity, Thermotechnology. (23.) Adulteration of Trade-Products, &c. (24.) New Books. The last number issued of these Reports is that for the second quarter of 1887.

Sewage Treatment, Purification, and Utilisation. A Practical Manual for the Use of Corporations, Local Boards, Medical Officers of Health, Inspectors of Nuisances, Chemists Manufacturers, Riparian Owners, Engineers, and Ratepayers. By J. W. Slater, F.E.S., late Editor of "Journal of Science." Author of "Manual of Colours and Dye Wares." London: Whittaker and Co., Paternoster Square. George Bell and Sons, York Street, Covent Garden. 1888.

This is an 8vo. volume, bound in cloth, price 6*s.*, containing 267 pages of subject-matter, and 4 pages devoted to an alphabetical Index. Following the Preface and Introduction we find the subject-matter classified as follows in 20 chapters:—Chap. I. Sewage; Nature and Composition. Chap. II. How, When, and Where is Sewage Injurious? Chap. III. Disposal and Treatment of Sewage. Chap. IV. Water-carriage in General—Sewer Gas—Dangers of Escape into Houses, &c. Chap. V. The Bazalgette System a failure in London. Chap. VI. Irrigation, its Principle and Conditions, &c. Chap. VII. Modifications of Irrigation. Chap. VIII. Filtration, Structure of Filter Beds, &c. Chap. IX. Precipitation, &c. Chap. X. Deodorising. Chap. XI. Destruction of Sewage. Chap. XII. Promiscuous Methods. Chap. XIII. Self-purification, &c. Chap. XIV. Detection of Sewage Pollution in Rivers, &c. Chap. XV. Recognition of Purification in Sewage Tanks, &c. Chap. XVI. Precipitation Mud, Methods of Drying, &c. Chap. XVII. Sewage Manures, Errors regarding these. Chap. XVIII. Sewage Legislation, &c. Chap. XIX. Sewage Patents. Chap. XX. Discussion on Dr. Tidy's Paper before the Society of Arts, May 5th, 1886. The work is illustrated with four wood engravings.

Trade Report.

(From the Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

ITALY.

Customs Decision.

Mr. J. G. Kennedy, Her Majesty's Chargé d'Affaires at Rome, writing under date of the 6th August last, states that the Italian College of Customs experts have decided that "fonacetina" (which in its composition has great analogy with "acetanilida" and "antifebrina") shall be classified with "Alkaloids not described."

Modification of Customs Duties on Chemicals.

Mr. J. G. Kennedy, in a further despatch, dated the 9th August last, encloses copy and translation of a Royal decree modifying the Italian Customs duties on chemicals. The following is a copy of the translation in question:—

"The following changes are introduced into the General Customs tariff approved by the law of July 14, 1887, to take effect from August 1, 1888:—

No. in Tariff.	Classification of Articles.	Rates of Duty.	
30	Acids:		Lire.
l	Acetic acid (including common vinegar), containing of pure acetic acid:		
	1. Ten per cent. or less	Quintal	15
	2. More than 10 per cent., but less than 50 per cent.	„	90
	3. Fifty to 100 per cent.	„	180
m	Crystallised acetic	„	200
51	Other chemical products:		
a	Saccharine	Kilog.	10
b	Not specified	Quintal	4

Surtax on Alcohol employed in certain Chemical Compositions.

A further despatch, dated the 8th August last, from Mr. J. G. Kennedy, encloses translation of a notice issued by the Director-General of Italian Customs on the 23rd July last, respecting a surtax to be levied on alcohol employed in the composition of anatherine water, chloral hydrate, and syrup of sarsaparilla. The following is a copy of the translation in question:—

"For guidance of the Custom house authorities notice is given that, on the importation in the kingdom of the anatherine water of Dr. Popp, of chloral hydrate, and of syrup of sarsaparilla, is to be levied respectively the surtax of 33 lire, 144 lire, and 24 lire per quintal for the alcohol employed in the manufacture of the said composed medicaments in accordance with the decisions taken by the Superior Board of Health, pursuant to Art. 4 of the law, July 14, 1887."

SWITZERLAND.

Classification of Articles in Customs Tariff.

Quintal = 220·4 lbs. avoirdupois. Franc = $9\frac{6}{10}d$.

The following decisions affecting the classification of articles in the Swiss Customs tariff were given by the Swiss Customs authorities during the month of July last:—

Liquid extract of quebracho wood.—Category 16. Duty, 30 centimes per quintal.

Solid extract of quebracho wood.—Category 17. Duty, 1 franc per quintal.

PORTUGAL.

Prohibition of Import of Saccharin.

A despatch, dated the 18th August last, has been received from Sir G. F. Bonham, Her Majesty's Chargé d'Affaires at Lisbon, enclosing copies and translation of a decree which had been published in the *Official Gazette*, prohibiting the importation into Portugal and the islands, except under certain specified conditions, of saccharin and of such articles of food into the composition of which it enters. The following is a copy of the translation of the decree in question:—

"Article 1. The importation of saccharin, whether pure or mixed with any article, and likewise of any articles of food that may contain the same, into the continental part of the kingdom or into the adjacent islands, is prohibited, except under the conditions set forth in the following article.

"Article 2. Chemists will be allowed to import this product after having obtained the permission of the Government, who must take the advice of the General Board of Customs.

"§ For the intents and purposes of this article, importers will have to make a petition stating the amount of saccharin which they wish to import and through which Custom house they wish to do so."

VICTORIA.

Proposed Modification of Customs Tariff.

The following is a list of drugs now dutiable under the Customs tariff of Victoria, but which it is proposed to admit free of duty on and after the 1st January 1889:—

Carbolic acid, oxalic acid, picric acid, aloes, cannabis Indica, faba amara, grains of Paradise, bromide of potassium, iodide of potassium, and quassia.

EXTRACTS FROM BRITISH AND FOREIGN CONSULAR REPORTS.

ITALIAN TRADE FOR THE FIRST HALF OF 1888.

Mr. J. G. Kennedy, Her Majesty's Chargé d'Affaires at Rome, in a despatch, dated the 15th August last, gives some statistics of Italian trade for the first six months of the current year, extracted from a publication recently issued by the Italian Customs Department. The following is an extract from the despatch in question:—

"These statistics have been specially compiled with a view to show the effect upon Italian international commerce of the tariff war with France; consequently the trade movement of January and February is separated from that of the other four months.

"In drawing conclusions from these statistics, one must take into account the extraordinary amount of goods imported during the last quarter of 1887. in anticipation of the higher duties of the new General Customs tariff.

"The total value of imports during the six months under consideration amounted to 24,187,000*l.*, being less by more than 5,000,000*l.* as compared with the same period in 1887.

"The value of exports is given at 19,230,000*l.*, being less by 1,297,000*l.* than in 1887.

"The values of imports of sugar, coffee, and colonials were less by about 800,000*l.*, and those of cereals, flour, and rice by about 1,000,000*l.*

"Textiles show a diminution of more than 1,800,000*l.*, but imports of raw material (cotton, jute, &c.) greatly exceeded that of 1887.

"Cotton tissues of ordinary qualities were less by 35,000 quintals, and tissues of wool, combed, by 7,000 quintals. Silk tissues, which mainly come from France, show a falling off of 100,000 kilos., of the value of about 480,000*l.* sterling.

"Lesser quantities were also imported of timber, wood, and its manufactures, which come mainly from Austria, and of iron manufactured articles which come chiefly from Great Britain and Germany.

"These statistics prove a lesser diminution in French imports than had been anticipated, and it is known that large quantities of French textiles enter Italy as Swiss goods or as contraband.

"In some trade articles Great Britain would seem to have benefited by the war tariff established against France. British imports have increased in chemical products, such as acids, soda, and potash, nitrates, resins, soaps, and varnish; also in fancy hardware, stearines, oils, cements, clocks and watches, and in some classes of metals, as copper and brass manufactures, tin and lead, plates of iron, manufactured, raw iron worked, also wall papers, fancy woodwork, also in silk tissues and drawn silk, and in yarns of wool, hemp, and jute; but the statistical tables show a general and considerable diminution of British imports in pig iron and manufactured goods of iron and steel."

TRADE NOTICES ON DRUGS AND SEVERAL CHEMICAL PREPARATIONS, BY GEHE AND CO., DRESDEN.

Chem. Ind. **11**, 333.

Ammonia Salts.

Ammonia salts are firm owing to the rise in price of sulphate. The carbonate forms an exception, as English traders make cheap offers in the German market, and thus prevent a rise of prices.

Antifebrin.

The consumption for medical purposes steadily increases, and the article is in great demand for export.

Antipyrine and Phenacetin.

These two preparations are still in great favour, and are evidently medically applied in the most varied manner.

Arsenic.

Arsenic ore is at present rather scarce, and arsenic preparations have accordingly risen in value. This is especially the case with arsenious acid, both in lump and flour, whereas metallic arsenic can be had in sufficient quantities. The production, import and export, of arsenic in the past three years was as follows:—

—	Production.	Import.	Export.
	Tons.	Tons.	Tons.
1885.............	1,823	811	718
1886.............	1,571	854	572
1887.............	1,756	315	638

The consumption has, therefore, considerably decreased in the last year.

Borax and Boracic Acid.

The import and export showed the following figures:—

——	Import.	Export.
	Tons.	Tons.
1886.............................	4,297	1,758
1887	2,374	801

The consumption for industrial purposes cannot have decreased to any large extent, and it is therefore probable that manufacturers preferred Californian and Chilian calcium borate to the boracic acid from Toscany.

Quinine and Quinine Bark.

Owing to the action of New York speculators, the price for quinine rose last December from 40 marks to 70 marks per kilo. Gradually the American demand lessened, and prices soon went back to 46 marks per kilo. The present stock of quinine bark is estimated thus:—

	Bales.
In London	60,000
In Paris	7,000
In New York	2,000

which quantities, calculated as containing 2 per cent. of quinine, correspond to 138,000 kilos. of quinine sulphate, which, along with last year's stock of the finished article, is about equal to the yearly consumption of the world. Under these circumstances, the prospect of a rise in the price of quinine is not very encouraging.

Potassium Chloride.

The demand for this chemical in the past year was very high, and the first four months of the present year showed an increasing demand. In May it diminished so much that the syndicate of the manufacturers resolved to restrict their output from the 1st June to 25 tons per day. It is believed that only temporary conditions of the market caused this check, and that the demand will soon return again to its normal level.

Gall-nuts.

In the beginning of this year the stock was small. The price accordingly rose in London for China gall-nuts from 67*s*. to 72*s*. per cwt. After the arrival of the new harvest, the price quickly receded, and Shangai offered first quality at 50½*s*. per cwt. c. i. f. Hamburg, whereas an inferior quality was considerably cheaper. Turkey gall-nuts rose towards the end of last year from 58*s*. to 64*s*. per cwt., since then they are again quoted at 58*s*. Hamburg imported—

—	In 1886.	In 1887.
	Boxes.	Boxes.
China gall-nuts	6,150	9,500
Turkey gall-nuts	3,215	3,320

Glycerin.

Towards the end of 1886 a syndicate was formed, which bought up the whole stock of pure and crude glycerin, in order to obtain the control of the market. The price soon rose over 100 per cent., but a decreasing demand compelled the syndicate to reduce the price by 15 per cent. in April.

Gum Arabic.

The war in the Soudan and the anarchy still prevailing there had an injurious influence on the production and export of African gum. The shipments became gradually less, and at last ceased altogether, especially as far as the best gum from Cordofan is concerned. For industrial purposes Australian and East Indian gum has now taken the place of the African article. It is a matter of course that the scarcity of African gum caused the price to rise tremendously. Only a few months ago 340*s*. per cwt. were paid for an inferior quality, and even 600*s*. per cwt. for the best kind, whereas in 1883 the prices were 55*s*. and 100*s*. respectively.

Iodine.

The export of iodine from Iquique, Pisagua, and Tocopilla was estimated in 1887 as 1,600 quintals, whereas the sales in Europe are said to have amounted to 5,300 quintals of a value of 300,000*l*. It therefore appears there are still large stocks in Europe, which restrict a free development of this manufacture.

Copper.

The price of copper sank to a very low level in October 1887, and copper was quoted in London at 38*l*. 10*s*. per ton. A powerful French syndicate then undertook to monopolise the sale of this metal, and within less than two months the price rose from 39*l*. to 85*l*. per ton. How long this artificial rise will be maintained is at present difficult to say.

Opium.

The opium harvest has been very satisfactory, and if the remainder of last year's stock be added, the quantity on sale is so large as to justify the present low price. Improvements in the cultivation and new plantations have increased the production very largely, whereas the consumption has, if anything, decreased, partly owing to new synthetic soporifics.

Oxalic Acid.

The high price of last year fell 5 per cent. at the end of the year.

Mercury.

The speculative movement in the metal market screwed up the price of mercury from 7*l*. to 11*l*. within a few days. Large additional supplies from abroad, however, soon put the price back to its former position. Recently Russian mercury appeared in the market, as also a product of Austrian and Californian origin. These new sources will probably prevent in the future an arbitrary rise in value.

Nitre.

Since the dissolution of the convention of South American nitre manufacturers, the import of nitre into Europe has increased, and so has also the consumption, especially for manurial purposes. The import into Germany for the first four months of the present year amounted to 150,436 tons.

Shellac.

The shipments from Calcutta to London in the past year were 55,002 boxes, of which 46,585 were consumed, and the remainder increased the 1886 stock from 60,011 to 68,428 boxes. The price was therefore falling, until in November, owing to speculation, the price rose from 10*s*. to 15*s*. per cwt. New supplies from Calcutta quickly brought prices back to an even lower position.

Tartaric Acid.

The trade in tartaric acid showed little life during the past few months. Large stocks on hand prevent a hardening of prices.

Tin.

This metal shared the fate of copper, and a "ring" of financial speculators, which had the control of the tin market, put up prices in December 1887 from 100*l*. to 180*l*. per ton. In order to remain masters of the situation the syndicate had to buy up 15,000 tons of tin, but the continued supplies of tin from Banca and Billiton assumed such enormous proportions, that the syndicate found it beyond their power in April 1888 to continue their purchases, and the "bull" movement suddenly collapsed. The price of tin sank within two days from 170*l*. to 80*l*. per ton.—S. H.

ON THE DEVELOPMENT OF THE STASSFURT INDUSTRY DURING THE LAST FEW YEARS.

Borsche. Chem. Ind. **11**, 297.

The past five years have been for the Stassfurt industry a period of quiet development. A new shaft, the Hercynia at Vienenburg, has been added to the six older ones, and two new Solvay works are being built at Thiedenhall and Jessnitz, which will commence operations in the course of this year. No important improvements have been introduced in the preparation of potassium chloride from carnallite. Lately the firm of Solvay and Co. have taken out patents for the treatment of carnallite and kainite by a dry method, but these processes have not yet been tried in practice.

Special attention has been given to the boiling down apparatus by covering the pan and utilising the steam given off. The fire-places, which are arranged for brown coal, have been altered to be suitable for the use of gaseous fuel, and the consumption of fuel has been thereby reduced. Since the middle of last year the daily work amounted to 2,750 tons of carnallire. The price of potassium chloride is still unaltered, viz.:—13·40 M. per 100 kilos. and 80 per cent. KCl. For the manufacture of sulphates kainite is exclusively used, and in addition to the known methods new processes have been patented by Dupré, Borsche and Brünjes, Precht, and Nahnsen. The first product, potassium magnesium sulphate, is in all cases the same; the crystallised material contains 41 per cent. to 42 per cent. SO_4K_2, and the calcined 48 per cent. to 50 per cent. SO_4K_2. The prices were 7 M. and 8·50 M., respectively, per 100 kilos. The daily consumption of kainite for this purpose was from 175 to 200 tons. The potassium magnesium sulphate forms the raw material for the manufacture of potassium sulphate. The attention of chemists has been greatly occupied with attempts to make hydrochloric acid and chlorine from magnesium chloride. Of all the patented processes none has been worked in Stassfurt on such a scale as to be a pronounced success. Nevertheless, it is well known that all the great works of Stassfurt and neighbourhood are experimenting in this direction, and the next few years may form an epoch in the history of the chlorine industry. One large works is about to put up an extensive plant for the manufacture of hydrochloric acid by a secret process. The Société Anonyme, which worked Engel's potassium carbonate process, has suspended operations, but the "Vereinigte Chemische Fabriken" are erecting a large works for the manufacture of potassium carbonate by the Borsche-Brünjes patent process.—S. H.

MISCELLANEOUS TRADE NOTICES.

WOOD-OIL INDUSTRY OF SWEDEN.

The industry of manufacturing oil from wood becomes every year more and more important in Sweden. Those parts of the timber which have hitherto been supposed to be useless, such as the stumps and the roots, are no longer left in the forests, but are subjected to various processes by which not only wood-oil, but turpentine, creosote, acetic acid, charcoal, and tar, are obtained from them. *La Nature* states that the wood-oils now commonly produced in Sweden cannot be burned in ordinary lamps, as the great quantity of carbon which these oils contain makes them smoke. They need special lamps, not unlike the ordinary photogene lamps, which latter can easily be adapted to the use of wood-oil. Mingled with photogene in certain proportions, the wood-oil can even be employed in ordinary lamps. It costs 55 centimes the litre. It is not liable to explode, and lasts 35 times longer, during consumption, than photogene. The wood-oil for lamps is almost entirely manufactured from pines and firs. In Sweden there are about 30 factories, producing at this moment nearly 40,000 litres of wood-oil.

LIQUEFIED GASES.

Some new regulations which have been published concerning the transport of liquid carbonic acid and nitrous oxide gases may be of interest to English export agents. It is ordered that the liquids must be filled into wrought-steel or wrought-iron vessels previously tested to a pressure of 250 atmospheres. The taps must be secured by special caps. The cylindrical form is not allowed unless it be designed in such a manner as to counteract the tendency to roll along plane surfaces. Carbonic acid gas will be also allowed if the pressure does not exceed 20 atmospheres, and it is to be kept in vessels similar to those above described; these latter must have been subjected to a pressure at least one and a half times as great as that which the contents will exert. Acids are also considered worthy of more attention as regards transport, and now, though they may be still stored in carboys, yet the hay or straw in which the vessel itself is packed must be impregnated with solution of calcic chloride, sodic sulphate or chloride, or ferric chloride, so as to diminish its tendency to ready inflammability. Other directions are given, but these apply only to Continental railway companies.—*Chemist and Druggist.*

THE EXPORT OF BASIC SLAG TO GERMANY.

It appears that English agriculturists fail to appreciate the value, or rather do not understand the excellent fertilising qualities of basic steel slag. On the Continent, on the other hand, large quantities of this slag ground up are used for manurial purposes. So much so, that large quantities of it are exported from this country to different parts of Germany. If in the hands of the German agriculturist the basic slag is found beneficial, and it pays to have it sent over from this country, it surely would be to the interest of English farmers to make more free use of it. We suppose it is another instance of the inertia of the English mind—slow to adopt a new thing, even though good. This wholesale exportation of basic slag is a striking instance of want of appreciation of a good thing. For a long time past it would appear that great quantities of basic slag have been going away from the North-Eastern Steelworks, and perhaps other northern basic steel establishments also, to the order of German importers, where it is ground to exceeding fineness and sold for manurial and other purposes. And now it is announced that the Staffordshire Steel and Ingot Iron Company, Limited, Wolverhampton, are taking the same course. Some time ago this company went to much expense to lay down grinding plant, but experience has proved that the demand from the English market has been insufficient to consume anything like the whole make, and now the company have obtained orders from Germany to export this product direct to the Fatherland in the raw state. It is intimated that the Germans will take very nearly all the company can produce, and at the present time a stock of 12,000 tons of unground slag and 900 tons of ground slag is about being despatched from the Staffordshire Works. It is estimated that at the present time Germany is grinding up something like 500,000 tons of basic slag per annum.—*Mechanical World.*

GERMAN CHEMICAL INDUSTRY.—REPORTS OF THE GERMAN CHAMBERS OF COMMERCE.

The production of the German chemical industry, which represents an annual payment of 62,000,000 marks (3,100,000*l.*) in wages, has again risen during the past year, while its manufactures have been consumed by the various trades without any difficulty whatever. A gradual improvement in the state of affairs was noticed as compared with former years, inasmuch as the prices of many raw materials, as well as those of many manufactured articles, experienced a sensible rise, which, however, according to the report of the Chamber of Commerce for Upper Bavaria, in the majority of cases depended less upon natural than upon artificial circumstances, viz., upon the formation of conventions. It is quite true that increased competition often necessitated manufacturers working at very modest profits; indeed some few articles show a reduction in prices. The reports of the Chambers of Commerce are unanimous in complaining bitterly that the exports to certain countries, which at one time were so important, more especially to Russia and Austria, have been so extraordinarily hampered by the present conditions of the duties. Thus, according to the report of the Konigsberg Chamber of Commerce, the trade in technical drugs and chemicals, which at one time was so brisk, has now lost almost all its importance since the Russian duties, so repeatedly raised, were in July 1886 increased to almost prohibitive rates for most chemicals. The "Silesia," a union of chemical manufacturers, according to the report of the Breslau Chamber of Commerce, complains that its former somewhat extensive export trade to Russia and Austria, owing to the restrictive duties imposed, has experienced a very important falling off, owing to the action of the duty laws, so that any remunerative business transactions being completed with these countries is almost entirely out of the question. Austria not only blocks the way with her heavy duties, but is entering into sharp competition with our home industry with the most varied articles, as, for instance, with mineral acids, glauber salts, &c., inasmuch as many of the manufactures, which, when imported into Austria, are subjected to a heavy duty, and are permitted to enter into Germany duty free. A removal of the disparities now existing with regard to the treatment of duties in the goods traffic to and from Austria appears to be urgently necessary. Necessitated by the conditions of duty that are being imposed, many firms are finding themselves compelled to curtail their manufacturing activity. As an instance we may cite that, according to the report of the Gorlitz Chamber of Commerce, the well-known manufactory of Theodore Schuchardt, which formerly worked two-thirds for technical and one-third for scientific and medicinal purposes has, in consequence of the law of 1879, so altered its production that for about the last four years it has worked three-fourths for scientific and medicinal and one-fourth for industrial purposes. The manufacture of tannin, tin preparations, dyeing and bleaching requisites, as well as some other technical chemicals, the firm has entirely given up. The reason of this is the entire cessation of the exports to Russia, and partial cessation of the exports to Austria—a consequence of the new policy of protective duties.

In spite of all scarcity, Leblanc soda has declined still more, which, according to the commercial report of the "Rhenania" Chemical Works (report of the Chamber of Commerce for Aix la Chapelle and Burtscheid), is to be ascribed to the circumstance that the ammonia-soda works of the German soda manufactories are continually increasing their production, while they are also offering serious competition to the older works as regards caustic soda and soda crystals. According to the report of the Buckau Chemical Works (report of the Magdeburg Chamber of Commerce), the manufacture of Leblanc soda is in a state of hopeless decline, and will very soon have to be entirely suspended by this firm. Against this, however, the demand from the ammonia-soda produced at their Stassfurt works, as well as for the caustic soda and soda crystals obtained from the same, has become so brisk that the erection of a second system could be effected without leading to any accumulation of stocks of soda. The "Silesia" union of chemical manufacturers report that ammonia-soda, owing to the convention of the manufacturers, in spite of a very important production, has experienced a considerable improvement in price. As regards caustic soda, however, the convention launched out to the disadvantage of the united manufacturers. The few producers not belonging to the union obtained a rapid sale, at prices which were but very little below those of the convention, while the members of this latter association were checked both with regard to sales and production. In consequence of this, the convention has not been renewed for 1888. The chief supplies for covering sales of caustic soda fell, as usual, to the lot of the English makes, which have not been able to be suppressed in spite of the import duty of four marks per 100 kilos. The home requirements of potash have been almost entirely supplied by German makes at somewhat higher prices than those of last year. If, owing to the union of the manufacturers, the production has been drawn within certain limits, nevertheless, in view of the report of the Buckau Chemical Works, the sales of caustic and calcined potash could not have been made without the sacrifices which have undoubtedly been connected with free and open competition in this article.

According to reports from the Freiberg Chief Mining Bureau, the sales of all kinds of sulphuric acids have been effected at lower prices during the year; while in 1886 the average price was 1·915 marks (1*s.* 10¾*d.*) per cwt., in 1887 it only reached 1·415 marks (1*s.* 5*d.*) per cwt. Again, the report of the Hagen Chamber of Commerce indicates the position of sulphuric acid during the entire year 1887 as having been extraordinarily unfavourable, indeed the manufacture of sulphuric acid has again increased, judging from the report of the "oldest merchant in Berlin," especially through the continued condensation of the sulphurous acid escaping from the "wasting" of the zinc blende at the Rhenish-Westphalian furnaces. However, according to the report of the Buckau Chemical Works, during the last few months the depression has not been so great, inasmuch as at the fiscal smelting works a decrease in production has been resorted to. From the Cologne report we gather that since the reformation of the defunct association of Rhenish manufacturers prices have risen considerably, in some instances from 30 to 40 per cent. Muriatic acid and chloride of lime, which in consequence of the retrogression of the manufacture of Leblanc soda, has been offered in less quantities, met with a good demand, and according to reports from Berlin, Magdeburg, &c., at remunerative prices, especially as the importation of English chloride of lime became smaller. According to the Magdeburg report the manufacture of nitric acid has been less satisfactory. The business in nitrate of potash has, from the accounts of a manufactory situated in the Harburg district, kept very quiet, and no important alterations in prices have taken place as compared with those ruling during the previous year. The export trade to Russia and Austria has been completely stopped, owing to the heavy import duties imposed by these countries; indeed, owing to the Austrian saltpetre works being able to import their material duty free they have hampered the German trade very considerably. Rhenish manufacturers, in view of the report of the Cologne Chamber of Commerce, have had to encounter very great competition, more especially in the export trade. According to the report of "the oldest of the merchants of Berlin," chloride of potassium has met with a very active demand. The production in 1887 amounted to about 2½ million cwts. (125,000 tons), or about 350,000 cwts. (17,500 tons) more than in 1886. The total exports have risen from 579,982 (57,998 tons) to 774,570 double cwt. (77,457 tons), England and the United States of America being the principal consumers. "The oldest of the merchants of Berlin" states that the exportations of water glass have been limited to a rather small amount, while the home consumption for soap manufacture has retrograded, owing to which during the past year the manufacture has been curtailed. The treaties of commerce, as we are informed by the report of the Mannheim Chamber of Commerce, are unfavourable to this industry. Austria as a market is already closed, while Italy, in consequence of the new Customs tariff coming into force after 1888, will also cease to be a buyer. The prices of water glass have also fallen. The new industry of fluid carbonic acid produced by the compression of naturally occurring gas, is, according to the report of the Coblentz Chamber of Commerce, continuing to increase in importance.

The charcoal industry is reported by the Chemnitz Chamber of Commerce to be still anything but favourable. The restrictive duties in those countries to which it is exported have stopped the former active business, while the home consumption by no means keeps pace with the production. As an instance, we may mention that the former active trade in acetic acid with Belgium has all at once become impracticable, owing to the sudden raising of the duty. The demand for denaturing wood spirit was so brisk at the time of the new law regarding the spirit duties that, for the moment, the necessary supplies could not be obtained. As, however, the denatured spirit soon came into discredit with the consumers, the active demand for wood spirit only lasted for a very short time, and at the close of the year it came within an extremely narrow compass.

The course of business in manures (superphosphates and bone meal) was scarcely satisfactory, as, in spite of the continually rising prices of these products, the sales rather diminished than increased, which fact can be accounted for by the permanently increasing consumption of the Thomas slag.

The importation of superphosphate into Germany amounted in 1886 to 33,337 tons, in 1887 to 40,540 tons; the exports in 1886 to 26,484 tons, in 1887 to 44,087 tons. The position of the glue boiling industry was a very depressed one, having been seriously affected by the action of glue surrogates and of increased competition. Exportation to Austria and Russia was entirely stopped, owing to the raising of the import duties in those countries. Austria, on account of being able to procure the raw material on cheaper terms than Germany, can produce more cheaply, and is now supplying Germany with large quantities of glue, owing to which a depression in price has resulted.

The tar industry, according to the unanimous reports emanating from Berlin, Mannheim, Dresden, &c., during a long series of years, remained to some extent in a normal condition. The uninterrupted decline in prices of almost every tar product was finally followed by a pause in the declension, and even by a slight improvement in prices. Among the raw products of the tar colour industry, benzole, anthracene, and naphthaline, the two former experienced no inconsiderable rise in prices, while the latter declined in value. The demand for crystallised carbolic acid continuously exceeded the production of this article, in view of which a continuous rise in price must be noted. The prices of the main products, roofing tar and pitch, remained to some extent unaltered. The new laws regarding the spirit duties came to the assistance of this industry, inasmuch as the pyridine bases came within the range of the articles permitted to be used. In view of the necessity of obtaining the means of denaturing with the utmost rapidity, a new business sprang up in Mannheim, which, being carried on with the utmost celerity, supplied the whole of Germany for some time with the necessary ingredients.—*Oil, Paint, and Drug Reporter, New York.*

PRODUCTION OF METALS IN PRUSSIA IN 1887.

Products.	Amount.	Value.	
	Tons.	Marks.*	Dollars.
Pig iron	2,838,587	123,041,567	30,760,393
Charcoal pig	25,029	3,005,958	751,490
Spelter	130,445	36,583,650	9,145,913
Pig lead	88,806	21,012,403	5,253,101
Litharge	3,727	859,200	214,800
Copper (ingot)	18,381	16,132,807	4,033,202
Black copper	19	6,200	1,550
Copper matte	396	166,650	416,663
Silver, kilos	233,131	30,641,175	7,660,294
Gold, kilos	82	230,585	57,896
Nickel	254	1,018,000	254,500
Smalt	33	507,000	126,750
Cadmium, kilos	7,310	48,497	12,124
Chloride of tin	200	350,000	87,500
Bismuth	31	477	119
Antimonial alloys, kilos	44	21,823	5,456
Manganese	12	37,500	9,375
Arsenic	598	114,060	28,515
Sulphur	2,050	225,357	56,339
Sulphuric acid	267,750	8,716,473	2,179,118
„ „ fuming	20,204	472,594	118,149
Copperas	6,418	211,126	52,782
Sulphate of copper	1,808	495,803	123,951
Mixed sulphates of iron and copper	251	30,025	7,506
Sulphate of zinc	720	45,493	11,373
Sulphate of nickel	26	5,000	1,250
Coloured earths	322	12,267	3,067
Total, tons	3,406,080	243,991,690	60,997,923
„ kilos	240,554	..	..

—*Engineering and Mining Journal.*

* Mark counted at 25 cents.

ULTRAMARINE MANUFACTURE IN ENGLAND.

A *Times* correspondent gives some interesting particulars on the recent development of the manufacture of ultramarine in England. The principal ultramarine works have hitherto been in France and Germany, and they bought much of their raw material—white clay—in this country, where it is found in almost inexhaustible quantities, especially in the neighbourhood of Poole, in Dorsetshire. That ancient port is on the bank of the wide estuary of what was millions of years ago a great river, draining some vast continent, and hereabouts was swept down the *detritus* of argillaceous rocks and fine sand, forming the clay in which are found perfect casts of ferns and a plant like the eucalyptus of Australia. The clay was used by Wedgwood and his fellow-workers of the Staffordshire potteries, but besides this utilising of the clay for British potteries, which still goes on, it has been exported from Poole to foreign potteries from time immemorial, and of late years to France and Germany for the purpose of making ultramarine. Poole, therefore, has naturally been chosen as the fittest place to set up the new ultramarine works. The raw material is first treated in a so-called white chamber, where the grinding and mixing are done by a mill worked in the usual way by heavy stone vertical rollers moving round in a trough. The native powdery clay is here mixed intimately with common resin and soda, and when sufficiently fine is fit to be charged, by shaking and gentle pressure, into a crucible, which is cylindrical and about 18 inches high. The charged crucible is then sealed up ready for the furnace. This is very large, quadrangular in form, with closed chambers, the fire being below, and the heat communicated to the crucibles kept at a steady rose-red point for thirty-six hours, and then gradually reduced to the temperature at which the products can be exposed to the air and light without change. This cooling appears to be a matter of essential importance, for if the heat has not been fully maintained the colour is found to be green instead of blue. This condition, however, which is transitional, is found to be a permanent one under the influence of any degree of sunlight and exposure to the atmosphere, and consequently this green is made as well as the blue, and it is, in fact, a very beautiful colour, much resembling in tint and quality the colour known to artists as green cobalt. Of course, it is only useful as a pigment, while the blue is also largely employed by laundry blue makers, colour printers, paper stainers, &c. As it is necessary to produce the blue in the state of an impalpable powder and to abstract from it every impurity, it has to be washed in pure water by a method of constant stirring, when after a time the soluble matters are removed and the blue is suspended in the water. It has then to be collected and dried in large heated chambers, after which it is again brought into fine powder and submitted to the still finer sifting obtained by revolving sieves made of silk, through which the now impalpable powder finds its way. The ultramarine made at Poole is sold at the rate of 35*l*. per ton. We may add that last year 24,704 cwts. of ultramarine were imported into the United Kingdom from Germany alone, and that the total exports of ultramarine from the latter country were 103,470 cwts.

A SALT SYNDICATE.

The *Northwich Chronicle* states that all the Cheshire salt works have been provisionally acquired by a London syndicate, represented by Messrs. Fowler and Co., solicitors, Westminster, and negotiations are proceeding favourably to purchase all the less extensive works situate in Worcestershire and Durham. The vendors take one-third in shares. The capital required, provisionally fixed at 3,000,000*l*., has been subscribed in advance many times over. In the allotment, preference will be given to those connected with the salt trade and to those who have suffered losses through the subsidence of land owing to brine-pumping. Owing to the monopoly thus created, it is expected that the price of common salt, now 2*s*. 6*d*. a ton, will rise to 10*s*. Nearly two million tons are sold annually.

STATISTICS.

BOARD OF TRADE RETURNS.

Exports.

—	Month of August.	
	1888.	1887.
	£	£
Candles	12,969	12,765
Chemicals and chemical and medicinal preparations:—		
Alkali	122,061	135,223
Bleaching materials or preparations	50,341	45,439
Chemical manure	168,787	151,138
Medicines, comprising drugs and medicinal preparations	78,750	74,176
Other articles	215,873	186,303
Glass:—		
Plate	21,428	23,763
Flint of all kinds, and manufactures thereof	23,936	22,716
Bottles, &c.	33,728	31,248
Painters' colours and materials, unenumerated	128,839	125,694
Pickles, vinegar, sauces, condiments, and confectionery, unenumerated	105,244	95,623
Salt	39,405	51,059
Seed oil	114,927	106,758
Soap	38,530	34,459

Imports.

—	Month of August.	
	1888.	1887.
	£	£
Bark (Peruvian)	45,182	46,619
Chemicals, dye stuffs, and tanning substances:—		
Alkali	8,127	5,574
Bark for tanners' or dyers' use	13,362	10,033
Brimstone	19,583	7,862
Chemical manufactures and products, unenumerated	102,258	110,340
Cochineal	1,935	5,474
Cutch and gambier	95,276	65,363
Dyes (coal tar):—		
Aniline	22,936	21,978
Alizarin	19,303	22,461
Other coal tar dyes	1,246	418
Indigo	13,267	12,616
Madder, madder root, garancine, and munjeet	1,492	1,410
Nitre, cubic (nitrate of soda)	86,557	73,445
Saltpetre	31,603	19,658
Valonia	28,638	36,162
Drugs, unenumerated	69,332	51,470
Guano	25,621	46,951
Gum:—		
Arabic	20,992	18,392
Lac, seed, shell, stick and dye	20,337	30,216
Gutta percha	29,913	6,323
Oils and fats:—		
Cocoanut	25,521	9,556
Olive	64,831	77,307
Palm	100,115	106,678
Paraffin	37,712	38,711
Petroleum	200,673	136,251
Seed of all kinds	26,569	22,808
Tallow and stearin	105,727	107,951
Train, blubber, and sperm	41,575	50,362
Turpentine	56,681	81,216
Quicksilver	178	7,530
Resin	22,274	22,178
Seeds:—		
Linseed	324,778	407,211
Rape	22,780	18,817
Tar	8,737	23,281

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

11,888. W. H. Northcott, London. Machinery for compressing air and other gases. August 17.

12,112. T. Smith. *See* Class II.

12,142. R. Brough, Sunderland. An apparatus for automatically forcing and relieving liquids or gases when under pressure or otherwise. August 23.

12,188. T. Cain, London. Means and appliances for economising fuel, increasing the heating properties of the products of combustion in furnaces, and preventing the escape of black smoke. August 23.

12,254. C. E. D. Winssinger, Liverpool. Apparatus for agitating or mixing solids with liquids. Complete Specification. August 25.

12,318. J. Jardine and J. Ferguson, Glasgow. Gas and air reversing valves for regenerative, smelting, and other furnaces or purposes. August 27.

12,357. R. A. Robertson, Glasgow. Centrifugal apparatus, applicable for filtration. August 28.

12,384. E. Rutzler and G. W. Blake. Improvements in thermostats. Complete Specification. August 28.

12,391. S. M. Lillie, London. Evaporating apparatus. Complete Specification. August 28.

12,753. C. Latarche, London. Improvements in means and apparatus for evaporating, concentrating, and distilling liquids, and condensing the vapours produced therein. Complete Specification. September 4.

12,784. B. E. R. Newlands. *See* Class XVI.

13,005. W. H. Grindley and W. S. Hensley, London. Improvements in or relating to pyrometers. September 8.

13,263. O. Imray.—From W. Lorenz, Germany. Improved method of and apparatus for working pressure pumps. September 13.

* COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,266. A. T. Clarkson. Valves for regulating the flow of gases under pressure. August 25.

14,120. W. Bergh. Centrifugal apparatus for separating fluids of different specific gravities. August 25.

14,153. E. N. Henwood. Apparatus for injecting liquid hydrocarbons into furnaces. August 25.

15,064. E. L. Pontifex. Cooling and refrigerating machines. September 15.

15,066. E. L. Pontifex. Apparatus for cooling and refrigerating. September 15.

15,066A. E. L. Pontifex. Apparatus for cooling and refrigerating. September 15.

15,322. H. E. Newton.—From the Maschinenbau Actiengesellschaft vormals Breitfeld, Danek, and Co., Austria. Filter presses. September 15.

15,429. T. Newman. Filters. September 15.

1888.

1921. L. Gismondi. Filter presses. September 8.

9136. J. Jackson. Pressure and vacuum gauges. September 1.

9548. C. Howe and J. H. Beckwith. Apparatus for distilling water, applicable for heating purposes and for feeding boilers. September 8.

10,237. R. C. Sayers. Filters. September 8.

10,655. C. D. Abel.—From Langen and Hundhausen. Method and apparatus for treating with liquids granular substances or substances in a state of magma. September 15.

10,993. S. Birkett and J. Robinson. Nozzles of filter-press taps. September 8.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

12,112. T. Smith, London. Improvements in machinery or apparatus for extracting coke from coke ovens, or other purposes of the like kind, such as the extraction of lime from lime kilns. August 22.

12,281. J. Cunningham, London. Improvements in machinery or apparatus for charging gas retorts. August 25.

12,370. S. de la Grange Williams. *See* Class IX.

12,377. G. Frank, London. Improvements in artificial fuel. August 28.

12,518. H. S. Maxim, London. Improvements in apparatus for naphtholising or carburetting illuminating and other gas. August 30.

12,532. J. Balbirnie, Sheffield. A new form of hot blast, and other improvements applied to liquid fuel and gaseous fuel, and the apparatus they subserve, or are associated with, for the production of heat and light. August 31.

12,606. L. Mond and C. Langer, Liverpool. Improvements in obtaining hydrogen. September 1.

12,733. H. C. Rew, London. Improvements in the art of manufacturing illuminating and fuel gas. Complete Specification. September 4.

12,877. J. Templeman, Glasgow. Improvements in the manufacture of fire-lighters and artificial fuel, and in means or apparatus employed therein. September 6.

13,050. O. Langberg, London. Improvements in apparatus for generating illuminating gas and gaseous fuel, and for burning the latter. September 10.

13,066. T. L. J. Quennesson, London. An improved manufacture of artificial fuel and other moulded blocks, and apparatus employed therein. September 10.

13,074. W. Kusnezoff, London. Improvements in apparatus for the purification of gas. September 10.

13,108. F. Fowkes, Manchester. Improvements in the manufacture of fire-lighters from waste products. Complete Specification. September 11.

13,147. L. Doms, London. Improvements relating to the carburetting or naphtholising of gas, and to devices or apparatus therefor. Complete Specification. September 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,085. H. J. Fenner and G. H. Fenner. Manufacture of naphthalene into forms suitable for use in illumination, and apparatus therefor. August 25.

14,325. H. C. Bull and Co., Limited, and H. C. Bull. Apparatus for producing and using "producer-gas." August 25.

15,293. J. A. Yeadon and R. Middleton. Apparatus for making perforated blocks of fuel or materials for smelting, &c. September 15.

17,558. W. H. Bennett.—From J. Lamy. Mixture and treatment of materials for enriching coal gas, and removing or preventing stoppage in ascension pipes. September 15.

1888.

11,161. G. L. Morris and W. T. Wilson. Apparatus for the generation of gas from hydrocarbon oils. September 8.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

12,286. J. N. Heidemann, London. Improvements relating to the treatment of colouring-matters. August 25.

12,563. J. Y. Johnson.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture of diethylmercaptol and of a sulphone therefrom. August 31.

12,796. O. Imray.—From the Farbwerke vormals Meister, Lucius and Brüning, Germany. Improvements in the production of green and bluish-green colouring-matters. September 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,464. G. Pitt.—From A. Weinberg, Prussia. A new class of diamido-compounds and azo-colours produced therefrom, and the process of producing the same. August 25.

15,154. C. D. Abel.—From G. C. Zimmer, Germany. Production of yellow, red, and violet colouring-matters from tetrazo-diphenyle and tetrazo-ditolyle. August 25.

15,374. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Production of red colouring-matters suitable for dyeing and printing. September 15.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATION.

12,682. J. Mactear, London. An improved process of preparing or treating vegetable fibrous material for obtaining fibre therefrom. September 3.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

10,155. W. P. Thompson.—From J. Kaufmann. Manufacture of fancy or two colour yarns and fabrics. September 15.

11,156. F. A. Owen. Wool cleaning apparatus. August 8.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

11,956. P. Lochtin, London. Process for brightening yarn and other goods which have been dyed with alizarin, anthra-purpurin, flavo-purpurin, cœrulin, and similar colouring-matters. August 18.

12,618. J. S. Ashworth, London. Improvements in and apparatus for drying and conditioning lengths of fabric previous to stentering the same in bleaching, dyeing, calico-printing, and other like operations. September 1.

12,670. H. E. Hounsell.—From G. A. Conant, Massachusetts. Improvements in bluing paper. September 3.

12,745. H. T. Everist, Kidderminster. Improvements in heating dye vats. September 4.

13,042. T. Hammond and T. Rouse, Manchester. Improved apparatus for washing, scouring, or bleaching clothes and fabrics, to be called "the double washer and bleacher." September 10.

13,175. W. E. Heys.—From C. Vandermeirssche, France. Improvements in apparatus for dyeing and similarly treating textile and fibrous materials in all stages of preparation. September 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,850. J. Lodge. Treatment of worsted tops and other slivers of fibre for the production of an evenly mixed dyed yarn. September 15.

15,022. J. Lodge. Apparatus for dyeing worsted "tops" and slivers of fibre. September 1.

1888.

1913. A. Herrmann, M. Herrmann, and E. Herrmann. Process for dyeing furs or skins. September 8.

11,420. H. Richmond. Apparatus for dyeing, scouring, bleaching, and otherwise treating yarn in cops. September 15.

11,501. J. C. Mewburn.—From La Société Jeannolle et Cie. Production of fast black colour in dyeing or printing fibres and fabrics. September 15.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

11,925. W. E. B. Blenkinsopp and F. M. Lyte, London. Improvements in the production of basic lead carbonate, chloride, phosphate, oxalate, silicate, borate, or other insoluble or sparingly soluble salts of lead. August 17.

12,135. C. Netto.—From C. Winkle, Germany. Improvements in the manufacture of artificial cryolite and similar compounds. August 22.

12,236. J. Werber and G. Hendry, London. Improvements in the rectification and concentration of acetic acid, and in apparatus therefor. August 24.

12,543. W. White, Cheshunt. Improvements in the manufacture of chloride of aluminium with other chlorides. August 31.

12,795. A. Sommer, London. Improvements in the manufacture and application of the compounds of chloride of sulphur with fatty bodies. Complete Specification. September 4.

13,070. B. Willcox.—From The Badische Anilin and Soda Fabrik, Germany. Improvements in and apparatus for the production and retention of chlorine in a liquid state, suitable for transport or storage. September 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,983. D. Herman. Manufacture of sulphate of soda, and apparatus therefor. August 25.

14,345. The Tyne Alkali Company, Limited, and T. Gibb. Manufacture of hydrate of baryta and of strontia. September 1.

14,345a. The Tyne Alkali Company, Limited, and T. Gibb. Treatment of solutions containing barium or strontium compounds, and obtainment of products therefrom. September 1.

14,653. W. F. R. Weldon.—From A. R. Pechiney. Apparatus for preparing oxychloride of magnesium. September 8.

14,654. W. F. R. Weldon.—From A. R. Pechiney. Apparatus for use in the process of dessicating oxychloride of magnesium. September 8.

14,997. J. Hanson. Treatment of alkali waste for use in the purification and deodorisation of sewage and impure waters or matters. September 8.

15,237. L. R. Bazin. Process and apparatus for conversion of phosphates into thermo-phosphates. September 1.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

11,989. W. J. Blenko, London. Producing wrinkled or rippled glass for ornamental purposes, glass tablets for advertising purposes, wall decorations, &c. August 20.

12,450. H. A. Paveley, London. Improvements in the utilisation of waste and other glass. August 28.

12,560. J. Kent, F. J. Beaumont, and A. W. Southey, London. An improved method for rendering visible lettering or ornamentation on glass-ware. August 31.

12,596. W. J. Temple, F. W. Rogers, C. W. Trotman, and T. F. Hobbs, Bristol. Improvements in the art of enamelling or decorating slate, marble, and such like material. September 1.

12,679. M. Green, London. Producing alphabetical letters and numbers for cementing to glass and other surfaces in imitation of gold and silver and jewels. September 3.

13,248. D. Rylands, Barnsley. Improvements in machinery for the manufacture of bottles or other hollow glass-ware. September 13.

13,259. W. R. Pullen, London. Mosaic work in crystalline glass, and means, modes, and processes for producing the same. September 13.

13,262. E. Dow, London. Improved apparatus for use in blowing or shaping glass bottles or the like. September 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,577. J. Emery and H. Lockett. Decorating pottery ware. September 8.

14,951. T. Minton, H. Minton-Senhouse, H. Minton Robinson, J. Clegg, and J. Lea. Printing on pottery and tiles. September 15.

1888.

10,481. H. Leak. Means of supporting pottery ware in kilns or ovens while being baked or fired. August 25.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

11,909. J. W. T. Stephens and R. Clark, London. Improvements in the manufacture of Portland cement. Complete Specification. August 17.

11,969. F. Siemens, London. Improvements in rotative furnaces or kilns for roasting, calcining, or otherwise treating granular or pulverulent materials, such as cement and ores. Complete Specification. August 18.

12,370. S. de la Grange Williams, London. New or improved burners for heating limekilns, and brick and other kilns by the combustion of gas, and for other like purposes. August 28.

12,681. C. R. Papineau and J. J. Lundy, London. Improvements in the manufacture of artificial asphalte. September 3.

12,841. A. J. Jack, London. Improvements in apparatus for the manufacture of cement. September 3.

13,211. J. Rust, London. An improved vitreous material for paving and other purposes. September 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,180. J. Hargreaves. Manufacture of cement. August 25.

15,065. F. Ransome. Manufacture of cement. September 8.

15,666. G. M. R. Layton. Manufacture of cement. September 15.

17,967. B. Gregory. Manufacture of blue bricks, tiles, and fire-bricks, &c. September 15.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

8410A. L. A. Groth.—From L. M. Pellegrin, France. Improved process for purifying metals. June 8. Originally included in No. 8410 of that date.

10,347A. C. C. Townsend, Madras. A new alloy. July 17. Originally included in No. 10,347 of same date.

11,859. F. W. Gerhard and T. Bantock, Wolverhampton. Improvements in the manufacture of aluminium. August 17.

11,860. F. W. Gerhard and T. Bantock. Improvements in the manufacture of dolominium. August 17.

11,861. F. W. Gerhard and T. Bantock. Improvements in the manufacture of calcium. August 17.

11,939. H. Ostermann and A. Prip, London. A new metallic alloy. Complete Specification. August 18, but antedated (under Sec. 103, Patent Act, 1883) February 16.

11,940. H. Ostermann and C. Lacroix, London. A new metallic alloy. Complete Specification. August 18, but antedated (under Sec. 103, Patent Act, 1883) April 20.

11,941. H. Ostermann and C. Lacroix. A new non-magnetic metallic alloy. Complete Specification. August 18, but antedated (under Sec. 103, Patent Act, 1883) April 25.

11,978. A. C. Cole.—From C. H. Wilder, United States. Improvements in and connected with moulds for making metal castings. August 18.

11,979. A. C. Cole.—From C. H. Wilder, United States. Improvements in and connected with moulds for casting ordnance and other metal articles. August 18.

11,980. A. C. Cole.—From C. H. Wilder, United States. Improvements in cases for use in casting ordnance or other hollow metal articles. August 18.

12,053. T. Slater, London. An improved metallic alloy suitable for coating iron and for various other useful purposes. August 21.

12,074. Le Comte E. de Rottermund, London. A new or improved process for extracting gold, silver, and other metals from refractory ores, sands, and residues. August 21.

12,101. J. Jenkins and B. H. Thomas, Bristol. An improved machine for use in the manufacture of tin, terne, and other metal-coated plates. August 22.

12,114. G. C. Fricker, London. Improvements in the treatment of metal sheets preparatory to coating the same with zinc or other metal. August 22.

12,202. J. B. Hannay and R. Tervet, Glasgow. Improvements in processes and apparatus for obtaining gold and other metals from ores. August 24.

12,208. W. P. Thompson.—From A. Rovello, Italy. Improvements in and apparatus for obtaining copper and other metals from solutions of the salts of same. August 24.

12,223. O. Bilharz, jun.—From O. Bilharz, sen., Germany. An improved process and apparatus for crushing, pulverising, and separating ores. August 24.

12,233. M. A. Howell, jun., London. Improvements in the manufacture of armour plates. August 24.

12,292. G. Allan and T. Turner, London. Improvements in moulds for the manufacture of steel castings. August 25.

12,293. G. Allan and T. Turner, London. Improvements in the manufacture of cast anchors and in moulds for casting anchors and anchor shanks of cast steel or other metal or alloy. August 25.

12,313. F. Bosshardt.—From J. Molas, France. Improvements in apparatus for detecting and announcing the presence of explosive gases in mines or other places. Complete Specification. August 27.

12,343. B. J. B. Mills.—From J. D. Bennett, United States. A new or improved process of obtaining aluminium. Complete Specification. August 27.

12,389. A. Gutensohn, London. A new or improved metallic alloy. August 28.

12,401. Baron A. W. S. van Oldrentenborgh and O. N. Orban, London. Improvements relating to the manufacture of iron and steel. Complete Specification. August 28.

12,459. O. Imray.—From V. Riatti, Italy. Improvements in the production of sulphide of aluminium and aluminium. August 29.

12,598. J. W. Summers and T. Sharp, Manchester. Improvements in apparatus for compressing scrap metal into blocks or slabs. Complete Specification. September 1.

12,626. H. W. Wallis, London. Improvements in the manufacture of sodium and potassium. September 1.

12,683. D. Hutton, London. An improved method of calcining pyrites and other gold bearing ores. Complete Specification. September 3.

12,768. R. F. Starkie and A. Copley, London. Extracting fine gold from auriferous ores or tailings by an improved process of amalgamation. September 4.

12,912. N. Lebedeff, London. A process for smelting metals from metallic oxides. September 6.

12,913. N. Lebedeff. Improvements in the manufacture of iron and steel or alloys thereof. September 6.

12,914. N. Lebedeff. Improvements in the manufacture or production of ferro-chromium, ferro-aluminium, ferro-manganese, and similar alloys. September 6.

12,937. R. C. Thompson, London. Improvements in and connected with the recovery of tin, spelter, solder, and like metals or alloys from scrap or refuse tin plate and other like coated metal wares. September 7.

12,982. C. F. Cocksbott and J. E. Jowett, Bradford. A new or improved method of and apparatus for obviating "pin-holes" and sponginess in cast brass or gun-metal shells for covering calendering, pressing, and other similarly covered rollers. September 8.

13,072. B. Willcox.—From La Société la Ferro-Nickel, France. An improved manufacture of metallic alloys. September 10.

13,117. J. Kleinpeter, London. Kleinpeter compound castings for chilled casting and steel armour plates, or chilled casting and ingot iron armour plates. Complete Specification. September 11.

13,125. W. White, London. Improvements in the manufacture of sodium and potassium. September 11.

13,159. W. J. Morgan, Birmingham. Improvements in fireless metallic alloys, and in the method of producing the same. September 12.

13,182. C. A. Burghardt, Manchester. Improvements in the reduction of zinc oxides. September 12.

13,234. L. A. Groth, London.—From O. Leprevost-Bourgerel and E. Pierron, France. Improved methods for extracting tin from the scraps which contain it. Complete Specification. September 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

12,458. H. Bird. Treating the residual spent iron liquors resulting from the manufacture of copper from burnt cupreous sulphur ores to obtain a certain oxide of iron therefrom, and apparatus therefor. August 25.

12,590. H. Lane. Shaping, forming, and manipulating metals. September 15.

12,887. W. P. Thompson.—From A. Schneider and Co. Hardening or tempering steel or steely iron. September 15.

14,356. L. Grabau. Production of fluoride of aluminium. August 25.

14,750. W. Lloyd. Lining or fettling of puddling and other furnaces employed in the manufacture and heating of iron and steel. September 1.

14,992. W. S. Simpson. Producing articles direct from fluid metal, and appliances therefor. September 8.

15,206. E. Smith and A. Smith. Toughening or carbonising steel wire for cards and other purposes. September 15.

16,346. H. B. Scott and W. Gentles. Tuyeres for blasts of furnaces and for agitating molten material. September 8.

16,347. H. B. Scott and W. Gentles. Smelting copper and lead ores, and arrangement of furnaces therefor. September 8.

17,495. J. H. Pollok. Wet method of extracting gold from crushed ores or other finely-divided auriferous material. August 25.

1888.

421. H. R. Lewis and C. B. Phillips. Extraction of metals from refractory, complex, and other ores. August 25.

4286. C. F. Croselmire. Extracting pure zinc from zinciferous ores. August 25.

6495. S. Pitt.—From A. C. Bradley. Manufacture of metallic oxides, and apparatus therefor. August 25.

10,657. J. Perino. Extracting zinc from pyrites containing blende, the waste of the same, and ores containing sulphide of zinc. September 1.

11,638. R. Main. Preparing pulverulent ores of iron and manganese for use in the manufacture of iron and steel. September 15.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

12.149. J. Hargreaves and J. C. Sewell, Liverpool. An improved electric battery. August 23.

12.155. R. Scott and C. R. Held. Huddersfield. A new or improved application of electricity to the manufacture of soap. August 23.

12.264. F. E. Elmore and A. S. Elmore, Cockermouth. Improvements in preparing metallic surfaces for the reception of non-adhesive electro deposits. August 25.

12,290. A. Schauschieff, London. Improvements in galvanic batteries. August 25.

12.453. W. P. Thompson.—From P. Diehl, United States. Improvements in apparatus for hardening and tempering by electricity. Complete Specification. August 29.

12.620. C. Marson, London. Electric secondary battery plates. September 1.

12.703. G. T. Jolland, London. An improved voltaic battery September 3.

12,706. W. P. Thompson.—From C. D. P. Gibson, United States. Improvements in storage battery plates. Complete Specification. September 3.

12,767. W. H. Scott, Norwich. Improvements in dynamo-electric machines. September 4.

12,887. R. H. Courtenay, London. An improvement in voltaic cells. September 6.

12,907. T. Parker and W. Lowrie, London. Improvements in dynamo-electric machines. September 6.

12,918. E. G. Rivers, Rosslyn Clevedon. An improved method and principle of constructing secondary batteries or accumulators. September 7.

13,000. T. M. Sargeant and O. R. Sivete, London. Improvements in electric batteries. September 8.

13,191. E. M. H. Andreoli, London. Electrodes for electrolytic operations. September 12.

13,192. E. M. H. Andreoli. Electrodes for bleaching vegetable substances by electricity. Complete Specification. September 12.

13,193. E. M. H. Andreoli. Bleaching paper pulp by electrolysis. Complete Specification. September 12.

13,194. E. M. H. Andreoli. Bleaching China grass, rhea, &c. by electricity. Complete Specification. September 12.

13,215. W. Clark.—From L. Maiche, France. An improvement in electrical batteries. September 12.

13,218. E. L. Berry and F. D'Arc, London. A method of preventing the deposition of crystals in the electrolytic fluids of electric batteries, the said method also allowing of the strength of such fluids being increased beyond their normal strength or that of ordinary saturated solutions. September 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

11,548. H. Tudor. Electrodes for secondary batteries. August 25.

12,437. R. E. B. Crompton and J. Swinburne. Dynamo-electric machines. September 8.

14,954. W. Terrill. Apparatus for use in the deposition or treatment of metals by electrolysis. August 25.

15,754. W. J. S. Barber-Starkey. Electrolytes of secondary batteries. September 8.

18,080. L. C. E. Lebiez and P. L. Verchère. Thermo-electric batteries. September 8.

1888.

3986. B. M. Drake and J. M. Gorham. Plates for secondary voltaic batteries. September 15.

10,954. E. H. Geist. Dynamo-electric machines. September 8.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

12,001. J. Crossley, Liverpool. Improvements in or appertaining to composition or soap used for cleansing and disinfecting purposes. August 20.

12,155. R. Scott and C. R. Held. *See* Class XI.

12,823. W. Woodhouse, London. Improvements in the manufacture of soap. September 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

12,314. H. Wiesinger and L. Rissmüller. Manufacturing soap free of water. September 15.

13,085. W. P. Thompson.—From La Société Industrielle des Glycerine et Acides Gras. Treatment and distillation of fatty matters or crude fatty acids to separate the fatty acids from the glycerin, and apparatus therefor. September 8.

14,129. T. H. Jones and E. O. Roberts. Liquid lubricating compounds. August 25.

15,490. J. W. Lord. Apparatus for expressing oil from substances. September 15.

15,491. J. W. Lord. Treatment of oils for their purification. September 15.

1888.

9161. A. Macqueen. Soaps and soap substitutes. September 1.

11,123. W. P. Thompson.—From A. Maggiorani. Manufacture of toilet requisites, powders, pomades, and soaps from alkaline earths. September 15.

11,545. C. H. Currie. Illuminating and lubricating oils. September 1.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

11,887. J. Casthelaz and S. Bruere, Manchester. Improvements in the manufacture of drying oils, varnishes, and driers. August 17.

12,252. J. Jones, Liverpool. Improvements in preparations or compounds for application to the surfaces of boots, harness, and other black leather objects. August 25.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,381. K. McLea and R. Punshon. Paint or varnish for iron, steel, metal, and tarpaulins. September 8.

16,894. S. J. Cluff. Improvements in blacking. September 1.

1888.

683. W. C. A. Holzapfel. An anti-corrosive composition for the protection of the inside of iron and steel vessels, bridges, piers, and other structures exposed to the action of the atmosphere or water. September 1.

10,426. R. W. E. MacIvor. Production of white lead or carbonate of lead, and apparatus therefor. September 8.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

12,015. J. Palmer, London. An improved solution and treatment for unhairing hides and unwooling skins. August 20.

12,393. H. J. Haddan.—From M. F. y Vilaseca, Spain. Improvements in the manufacture of decorative leather. Complete Specification. August 28.

13,135. A. J. M. Bolanachi and G. Delfos, London. Improvements in the treatment of skins. September 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1913. A. Herrmann, M. Herrmann, and E. Herrmann. *See* Class VI.

10,877. C. Klinik, F. Pinkowski, V. Bouk, and J. Glos. A machine for the preparation of leather. September 8.

XV.—AGRICULTURE, MANURES, ETC.

APPLICATION.

13,112. J. Bamber, London. Improvements in the mode of preparing ensilage, and in means for preserving same from decay. September 11.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATIONS.

12,645. A. N. Pearson, London. A new process and apparatus for treating soluble and partially soluble gums, so as to render them fit for industrial purposes. Complete Specification. September 1.

12,784. B. E. R. Newlands, London. Improvements in means or apparatus for drying slabs of sugar, applicable for heating and cooling other articles, and for analogous purposes. September 4.

13,084. G. Adant, London. Improvements in the manufacture of sugar, and in apparatus therefor. September 10.

13,129. O. Bluhme, London. Improvements in and relating to the filtration of beetroot juice in the process of making beetroot sugar, and in the after-utilisation of the filtering material after filtration has been effected. Complete Specification. September 11.

COMPLETE SPECIFICATION ACCEPTED.

1888.

10,216. H. Gugenheim. Manufacture of saccharine liquors for brewing, &c. September 8.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

12,642. A. T. Christophe, Paris. Improvements in the rectification of alcohol. September 1.

12,698. H. G. Grote, London. Improvements in the manufacture of alcohol. September 3.

12,850. H. H. Lake.—From W. Kuhn, France. Improvements relating to the treatment of beer, and to apparatus therefor. September 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,459. A. Brunn. Production of peptone and maltose or maltose substances. September 1.

14,548. J. F. Henderson. Manufacture of unfermented wine. September 8.

1888.

4143. M. L. Godefroy. Treatment of magmas for distillation. September 15.

9658. W. L. Horne. Process and apparatus for distilling alcohol from wine, cider, or other fermented fruit juices. September 1.

10,020. W. P. Thompson.—From C. Pfaudler. Treatment of beer or other fermented liquors. September 15.

10,216. H. Gugenheim. *See* Class XVI.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

12,704. F. Bauder, London. Improvements in and relating to the manufacture of cocoa or chocolate. September 3.

12,774. H. H. Lake.—From S. F. Van Choate, United States. An improved composition and devices for facilitating the use thereof, chiefly designed for preserving animal and vegetable substances. Complete Specification. September 4.

B.—Sanitary Chemistry.

11,997. T. G. Hardie, Burnley. Rapidly precipitating the solids held in suspension, and deodorising and purifying and rendering the liquid parts of towns' sewage potable. August 20.

C.—Disinfectants.

12,001. J. Crossley. *See* Class XII.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1888.

7535. B. Willcox.—From H. Salzer. Preserving meat and other food articles. September 15.

11,086. J. A. F. Feuchères. A substitute food for horses and cattle. September 1.

B.—Sanitary Chemistry.

1887.

13,943. J. H. Porter, G. Porter, and J. Porter. Improvements in filtration in relation to "Clark's Process" and other processes. September 1.

14,656. T. Glennie. A new system of sewage disposal. September 15.

14,997. J. Hanson. *See* Class VII.

15,939. W. Webster, jun. Apparatus for the electrolytic treatment of sewage and other impure liquids. September 15.

1888.

8627. W. Oliphant. Apparatus for liquid purification. September 8.

C.—Disinfectants.

1887.

14,864. W. B. Giles and A. Shearer. The manufacture and application of new antiseptic and disinfectant substances. September 8.

15,564. A. Boake, F. G. A. Roberts, A. Shearer, and W. B. Giles. Manufacture of antiseptics. September 15.

15,668. W. J. Cooper. Improved antiseptic or disinfectant. September 15.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

12,190. C. Weygang, Child's Hill. Improvements in the manufacture of ordinary and of waterproof papers, boards, &c. August 23.

12,502. W. Hall, London. Improvements in apparatus for straining paper pulp and the like. August 30.

12,586. C. Hudson and J. S. Hudson, Stockton-on-Tees. Improvements in the manufacture of air and damp resisting paper or cardboard boxes, cases, &c. September 1.

12,682. J. Mactear. *See* Class V.

13,212. L. Groezinger, London. A process for producing extract of hops, and for the preparation of a beverage or beverages therewith. September 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

10,050. F. B. Howard. Articles manufactured from pulp, and apparatus used therefor. September 8.

10,598. K. M. Tata. Improvements in writing paper. September 15.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

12,179. C. Liebermann and F. Giesel, London. Improvements in the treatment of amorphous alkaloids obtained in the preparation of cocaine. August 23.

13,169. C. W. E. Kolbe, London. Improvements in the manufacture of salols. September 12.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

12,538. J. Freeman, London. Improvements in flexible photographic negatives or pictures, and in apparatus connected therewith. August 31.

13,149. J. W. Newall, London. An improved method of determining the sensitiveness of photographic plates. September 12.

XXII.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

12,697. G. Trench, London. Improvements in pyrotechnic signals for use at sea. September 3.

12,826. H. Brock, London. Improvements in and means for exhibiting fireworks. September 5.

12,871. W. Balch, London. An improvement in shells for signalling at sea and other purposes, and apparatus for discharging the same. September 6.

12,898. O. Imray.—From H. von Dahmen, Austria. A new or improved explosive. September 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,159. F. L. Tirmann and H. Tirmann. Percussion fuses, especially applicable for use in mines affected with fire-damp. September 1.

14,390. R. Morris. An electric firing fuse or primer. September 1.

14,470. M. Settle. Cartridges for blasting in mines or other places where inflammable gases are present. September 1.

1888.

3759. E. Kubin and A. Siersch. Explosives especially adapted for use in mines. September 8.

5027. R. S. Lawrence. Shells containing high explosives, protecting the same, and fuses therefor. September 15.

6498. J. W. Graydon. High explosive shells, and method of preparing the explosive charge therefor. September 1.

8995. E. L. Zalinski. Dynamite and similar shells, and fuses therefor. August 25.

9073. G. A. Farini. Improvements in cartridges. August 25.

Printed and Published by EYRE and SPOTTISWOODE, East Harding Street, London, E.C., for the Society of Chemical Industry.

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Members are hereby advised that the subscription of 25s. for 1889 falls due on January 1st next. The Council having resolved to enforce Bye-law 29, only such members as have paid their subscriptions will be entitled to receive the Journal next year. Cheques and orders should be made payable to the Honorary Treasurer, E. Rider Cook, and forwarded to him at Bow.

Notice is hereby given that the numbers for January, 1882, 1883, and 1886, and February and April, 1886, are exhausted, and no orders for those copies can be executed.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

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SESSION 1888-89.

The first Meeting of the Section will take place on Monday, November 5th, 1888.

Papers to be read by—

Mr. J. Heron. "On a new form of Polarimeter."

Mr. C. T. Kingzett. "On the Comparative Antiseptic Values of various Substances."

Mr. Thos. T. P. Bruce Warren. "The Adulterations of Oils and Methods of Detection."

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the Durham College of Science, October 10th, 1888.

T. W. STUART IN THE CHAIR.

ON THE TEES SALT INDUSTRY.

BY T. W. STUART, CHAIRMAN.

Until recently the alkali manufacturers of the Tyne obtained the whole of their salt supplies from Cheshire, from whence the high cost of transit placed them, in this respect, at a considerable disadvantage as compared with those manufacturers whose works are situated in Lancashire. The rapid development of the salt industry on the Tees of late years, resulting in a substantial reduction in the price of salt on the Tyne, constitutes such an important boon to the alkali manufacturers of this district, that I have thought a paper on the subject would not fail to interest the members of the Society. This reduction in the cost of salt has come to the manufacturers in this district at a time when the competition between the Leblanc and ammonia-soda processes has been most severely felt, and when a considerable reduction in the cost of production by the Leblanc process was urgently required. The discovery, therefore, of the bed of rock salt at Middlesbro', and the development of the most approved mode of winning it, have proved of great importance to the soda industry on the Tyne, where it has had a home from the time when Lord Dundonald and Mr. Losh commenced their operations at Walker in the year 1796.

When the British Association met at Newcastle in 1863, the discovery of salt at Middlesbro' was announced, and the early commencement of a new industry in the form of salt manufacture as an addition to the industries on the Tees was fully anticipated. Messrs. Bolckow and Vaughan commenced boring for water in their works in 1859, with the view of obtaining a supply for their boilers and for other purposes, and continued boring till 1862, when, at a depth of 1,200 feet, a bed of rock salt, 100 feet thick, was discovered. They endeavoured to win the salt by sinking a shaft shortly after, in order to work the mineral by a regular system of mining, but the influx of water was so great that the undertaking was ultimately abandoned. Nothing more was done to develop the deposits till 1874, when Messrs. Bell Bros. sank a borehole in the land adjoining their ironworks at Port Clarence, on the north side of the Tees, where they found the bed of rock salt at a depth of 1,127 feet and 65 feet thick. Deterred by the experience of Messrs. Bolckow and Vaughan, who had expended a large sum of money in their attempts to win the salt by mining, Messrs. Bell Bros. allowed the question to rest in abeyance till 1881, when, at the suggestion of Mr. Thomas Bell, they adopted the plan in operation at Nancy in the east of France, but of which he had then no knowledge, and in the following year, 1882, they commenced the manufacture of salt at Port Clarence. Messrs. Bell Bros. were, therefore, the pioneers of this new and important industry. Some time afterwards, Messrs. Bolckow, Vaughan, and Company, Limited, commenced operations at Middlesbro' and at Eston, while the Newcastle Chemical Works Company, Limited, and the Haverton Hill Salt Company—now the South Durham Salt Company, Limited—established works on the north side of the river. In 1886 Messrs. C. Tennant and Partners, Limited, and the Jarrow Chemical Company, Limited, jointly erected works at Haverton Hill to supply their alkali works on the Tyne, the Newcastle Chemical Works Company, Limited, having established their works with the same object.

The bed of rock salt has been proved to exist over an area rather more than 4 miles long by 2¾ miles broad, or about 12 square miles, and allowing for its known unequal thickness, each square mile is estimated to contain 100,000,000 tons of salt. This not only proves the large extent of the deposit, but also dispels any anxiety for the future of the Tees salt industry.

The most northerly borehole is at Greatham, where the salt was found at a depth of 889 feet from the surface; the most southerly at North Ormesby, in Yorkshire, a distance of rather over 4 miles, where the bed is 1,340 feet from the surface. The borehole at the eastern extremity is at Eston, at a depth of 1,563 feet, and the most westerly at Haverton Hill, a distance of about 2¾ miles, at a depth of 797 feet, from which it will be seen that the bed dips to the south and east. The borehole at Greatham is at present the most northern in which the salt bed has been proved, and it has recently been ascertained by a borehole at Seaton Carew that the bed disappears between Greatham and that point.

The thickness of the bed of rock salt is variable, but the average of the wells in operation may be taken at 80 to 90 feet.

The following shows the particulars of 14 borings in which the thickness of the salt and depths from the surface are given:—

—	Depth to Rock Salt.	Thickness of Main Bed of Rock Salt.
	Ft. in.	Ft. in.
Bolckow and Vaughan. Middlesbro'	1,200 0	100 0
Bolckow, Vaughan, & Co., Lim., do., 1886.	1,220 0	66 0
„ „ „ Eston	1,569 9	81 0 E.
Bell Bros., Lim., Port Clarence trial hole	1,127 7	65 0
Newcastle Chemical Works Co., Lim., Cowpen Marsh No. 1	1,091 0	112 9
„ „ „ „ 2	1,087 0	115 4
„ „ „ „ 3	1,089 6	101 6
„ „ „ „ 4	1,102 0	90 6
C. Tennant & Pts., Lim., & Jarrow Chemical Co., Lim., Haverton Hill No. 1	928 7	72 11
„ 2	920 4	79 7
Greatham Salt Boring Co.	889 0	57 2 N.
North Ormesby	1,340 11	79 1 S.
Sandfield, Haverton Hill	797 0	80 10 W.
Average	1,104 9	84 9

E. = Most easterly point at which salt has been found.
N. = „ northerly „ „ „
S. = „ southerly „ „ „
W. = „ westerly „ „ „

The three following holes have been drilled to the depth indicated without finding salt:—

	Depth.
	Ft. in.
Stone Marsh, Haverton Hill	1,000 0
Seaton Carew	1,410 0
Newcastle Chemical Company's Works	1,190 6

It is impossible to give an analysis showing the average composition of the rock salt, as it contains a considerable quantity of earthy matter distributed in layers throughout its mass. Its variable composition, however, has been demonstrated by the examination of many samples, which have been found to contain from 40 per cent. up to 98 per cent. sodium chloride. In actual working this earthy matter is left in the cavity of the well when the salt is dissolved, and causes no inconvenience, unless in time it may cover the surface of the rock salt, and to some extent impede the action of the water in forming the brine.

In the accompanying section of the rocks, passed through in boring No. 1 well, at the works of Messrs. Tennant and Jarrow Chemical Company, Haverton Hill, it will be seen that we have first about 83 feet of soil, sand, clay, &c., which is succeeded by a bed of water-bearing red sandstone, 500 feet thick, containing thin seams of marl. From this very thick bed of sandstone an inexhaustible supply of water is obtained, and from which all the brine on the Tees is produced, as will be more fully explained when the working of the brine wells is described. Below the sandstone there is a bed of red marl about 300 feet thick, containing thin beds of sandstone and veins of gypsum, then 9 feet of anhydrite, and immediately above the bed of rock salt, 23 feet of saliferous marls, known as "Rotten Marls," which have given great trouble to the salt manufacturers by falling into the cavity formed by the removal of the salt, and destroying the lining and suction tubes of the wells. The rock salt at this point is 928 feet from the surface, and 73 feet thick; and below this there are thin beds of hard stone, gypsum, &c. With the view of ascertaining the presence of coal, of which 5,000,000 tons are annually consumed in and near Middlesbro', Messrs. Bell Bros. continued the boring in one instance to 250 feet below the salt, when they found gypsum, magnesian limestone, then limestone, and again gypsum, and rock salt interstratified with marl, and in a bed of rock salt were obliged to stop. The presence of this magnesian limestone lent colour to the belief that the coal might be below, but when they found small beds of salt it was clear that they had still the prospect of great thickness of red sandstone to pierce, and the diameter of the bore having been reduced to one inch, they were compelled to desist at 1,355 feet from the surface. At 1,313 feet, and while in the limestone, they found considerable quantities of gas evolved, of which the following is the analysis:—

Methane or marsh gas, CH_4	76·9
Ethane, C_2H_6	6·3
Nitrogen, N	16·8
	100·0

In the Seaton Carew boring it was proved that the salt did not exist, and magnesian limestone was reached at 522 feet. While proceeding further in this borehole in search of coal, the thickness of magnesian limestone passed through was 878 feet, and which is said to be the thickest section of this strata yet reached.

The accompanying map of the salt district, for which and for other valuable information I am indebted to Mr. Thomas Bell, of Durham, H.M. Inspector of Mines, shows the known extent of the bed and the position of all the boreholes that have been put down. A good bed has been proved at Eston in the east, and North Ormesby in the south, while the salt may possibly extend beyond these points. At Haverton Hill, in the west, it is of good workable thickness, but in the works of the Newcastle Chemical Works Company, Limited, and at Stone Marsh it was absent, while between Greatham and Seaton Carew, in the north, the bed disappears. It is, therefore, probable that the northern and western boundaries of the bed have now been proved.

Having described the history and extent of this important bed of rock salt, we come now to the industrial part of the question and a description of the American methods of winning the salt, the success of which is now fully established, and without which the development of the salt industry on the Tees would have been greatly retarded, if not wholly arrested.

Of the 47 holes that have been bored, the Cumberland Diamond Boring Company, who had a monopoly of this work, have bored about 32. By this system of boring a hollow cylinder 18 feet long with diamonds firmly fixed at the bottom edge, called the "crown," is driven by steam power, and made to rotate on the rock being drilled through, while water is run down the boring at the same time. When a core of sufficient length is cut in this manner it is brought up, and the operation repeated till the hole is bored to the required depth, and a core representing the entire section of the rocks passed through is produced, either for inspection or analysis. The borehole is then fitted with lining tubes, pump, &c., the drilling apparatus removed, and the permanent pumping arrangements erected. If, however, anything goes wrong with the well and the tubes require to be drawn for repairs, the permanent pumping arrangement must be removed, special plant again fitted, and the tubes drawn by a very slow process.

Up to 1886 nearly all the wells in operation were bored by the Diamond system, but the high prices charged by the boring company, coupled with the slowness and cost of restoring wells destroyed by the fallen marls, had the effect of very seriously retarding the development of the salt industry, and stopping its further progress, and it became obvious to those who required wells bored that a quicker and cheaper method of drilling, constructing, and repairing the wells must be found. At this juncture experienced men were brought over from the American oil fields to introduce the American system of drilling in its entirety by the Newcastle Chemical Works Company, Limited, Messrs. C. Tennant and Partners, Limited, and the Jarrow Chemical Company, Limited, jointly. These three companies resolved to attempt a reduction in the cost of drilling and repairing brine wells by trying a system which was new to England though old to America, and the American drillers, with that energy and ingenuity characteristic of their nation, drilled a well 1,000 feet deep in three weeks, a work which required three months to accomplish by the Diamond system, and with a correspondingly large reduction in cost. The anticipations of the three companies named have been so fully realised that the American system has completely superseded the Diamond method, and has even been adopted by the Cumberland Diamond Boring Company. The introduction of this system of boring having proved of such importance to the Tees salt manufacture as to mark an epoch in its short history, I trust a brief description of it may prove interesting, referring those who wish to study it minutely to the excellent illustrated catalogue of the Oil Well Supply Company, Limited, Bradford, and Oil City, Penn., U.S.A., who will gladly send a copy on application. The American system of well drilling is an adaptation of steam power to the method practised for ages in China, but developed by most ingenious improvements in detail. Although South Durham is the only place in England where it has been employed, the extent of its applications may be gathered from the fact that in the American oil and salt fields the enormous number of over 75,000 wells have been drilled since 1859, at a cost of at least 200,000,000 dollars. The great depths to which wells may be drilled may also be gathered by the fact that a well belonging to Mr. George Westinghouse, jun., and situated in the eastern part of Pittsburg, was drilled to a depth of 4,618 feet, nearly a mile, and which is the greatest depth yet reached in America. The American system of drilling requires considerable practice, but when acquired, it is rapid, economical, and very simple in operation, consisting merely of drilling through the rock with a string of tools, which reduces it to a coarse powder suspended in water, then removing this detritus by means of a sand pump, the two operations being alternately repeated till the required depth is attained.

The first thing to be done is to erect the "rig," as it is called in America. This is constructed entirely of hemlock timber, and consists chiefly of derrick, bull wheel, sand pump reel, band wheel, walking beam, engine, and engine house.

The derrick is about 74 feet high, and 20 feet square at the base, and about 3 feet square at the top, where two pulleys are fixed, one for the drilling tools, and the other for the sand pump. By means of a belt, power is transmitted from the engine to the band wheel (J), then to the walking beam (M), which communicates the perpendicular up and down motion to the rope which carries the drilling tools. The bull wheel (E), with its shaft, is used for rapidly withdrawing the drilling tools, and is driven by an endless rope from the band wheel. The sand pump reel is employed for working the sand pump by friction off the band wheel. The drilling tools consist of "rope socket," "sinker bar," "jars," which are two flat links, "auger stem," and "bit." All these tools screw into each other, and form a string of drilling tools about 60 feet long, and weigh about 18 cwt. The function of the "jars" is most important, for when the "bit" becomes fast in the rock a few blows never fail to loosen it, and allow the drilling to proceed. The "temper screw" is a most ingenious tool for connecting the rope supporting the drilling tools to the "walking beam" while drilling, and when disconnected the tools are drawn out and into the interior of the derrick by the "bull wheel." The whole of the rig and tools are shown on the accompanying drawings, and more particularly by the working model on the table. Having erected the rig, the first operation in American drilling is to insert the "drive pipe" through the sand, soil, &c. to the red sandstone, and its function is to prevent the soil, &c. from running in while drilling. This is a ¼-inch steel pipe, 8 inches diameter, or according to the intended size of the well, and at the bottom is fitted with a sharp steel shoe, and on the top with a cap to prevent damage to the pipe by the wooden maul with which it is driven down, and for which a temporary arrangement is constructed. Then commences the operation of drilling, that part of it by which the earthy material is removed from the "drive pipe" being called "spudding." As has already been explained, the American system simply consists of two operations, viz., drilling through the rock with the string of tools about 60 feet long, and weighing 18 cwt., having a "bit" at the lower extremity. These tools have their up and down motion communicated to them by the "walking beam" driven by the engine, and as the "bit" passes through the rocks the tools are lowered by the "temper screw."

The drilling is always done in the presence of water, which on the Tees is obtained from the red sandstone, and when about four feet of the rock has been penetrated in this manner the tools are withdrawn and suspended in the derrick. The second operation consists of removing the detritus or pounded rock lying at the bottom of the hole in the form of a thin cream. This is removed by running the sand pump down several times. The pump is an iron tube fitted with a plunger and valve projecting past the bottom, so that when it reaches the bottom the valve is opened and, by the upward motion of the plunger, the detritus is effectually removed. By this very simple plan of alternately using the drilling tools and sand pump, the red sandstone, marls, and rock salt are penetrated to the required depth. Difficulties, of course, sometimes arise which have to be met and overcome and which delay the rate of drilling, but a well 1,000 feet deep and eight inches diameter has been drilled by the American system in three weeks; and when it is pointed out that a well 1,000 feet deep is just about equal to seven times the height of Earl Grey's monument in Newcastle, the extraordinary rapidity with which the work is accomplished will be understood. This is further exemplified by the fact that the first well drilled by the Diamond system at Port Clarence for Messrs. Bell Bros. took nearly two years to reach the salt. The cost for labour alone by the American system for an 8-inch well may be taken at about 6s. per foot, or about one-fourth the cost originally charged by the Diamond Boring Company. It sometimes happens that the "bit" becomes detached in drilling, or the rope breaks, by which the whole of the tools are lost in the well. Here, again, the ingenuity of the Americans is brought into play by the use of fishing tools, which have been cleverly constructed to meet every possible emergency, and while vexatious delays occasionally arise in very difficult cases, usually the lost tools are recovered in a few hours, or at most a few days.

The rock salt contains a considerable quantity of gas at high tension distributed in cavities throughout its mass, which not only accounts for the effervescence of the brine when pumped, but also, while drilling, causes a frequent outburst of water, which it forces several feet into the air for many hours together. This gas has been examined by Professor Bedson, who found it to consist of—

Marsh gas	2·05
Nitrogen	97·95
	100·00

Having drilled the well to the bottom of the salt, the next operation consists of tubing it and constructing the pumping arrangements for drawing the brine to the surface. A steel lining pipe, perforated where it passes through the sandstone and through the salt, is inserted from the surface to the bottom of the salt, then the suction pipe, also perforated at the bottom, is placed in the lining pipe, and the pump connected with the walking beam at a distance of about 240 feet from the surface, so that the brine will rise easily above it. One great advantage of the American rig is the fact that it serves a three-fold purpose. It is, in the first instance, used for drilling the well, then for working it. The same engine, walking beam, &c. are employed for pumping the brine, while the drilling appliances are invaluable in drawing the tubes when necessary to repair the well. The derrick not only holds the tools suspended while the well is being drilled, but it also holds the suction pipe in lengths of 60 feet or more, which greatly facilitates their withdrawal for examination and repair: while with the Diamond boring system, the drilling, pumping, or repairing gear require to be respectively constructed over the well, which involves considerable cost and delay.

When the well is fitted ready for work it is usual to pump the discoloured brine to waste for a day or two, and thence to the reservoir when clear. At first the water employed for dissolving the rock salt and producing the artificial brine was obtained from the stells in the neighbourhood of the salt works, but the organic matter it contained so retarded the evaporation of the brine that its use was discontinued, and Darlington water was then poured down the annulus formed by the inside of the lining and outside of suction tubes. Now, however, the supply of water is exclusively derived from the sandstone which runs through the perforations in the lining tube and down the annulus to the rock salt below. The supply of this water is apparently inexhaustible, and the following is its analysis, viz. :—

	Grains per Gallon.
$CaCO_3$	21·59
$CaSO_4$	5·27
$MgCl_2$	9·14
$MgSO_4$	6·36
Na_2SO_4	33·33
SiO_2	0·74
Fe_2O_3 and Al_2O_3	0·74
	77·17

This water is now not only utilised for the production of brine, but it is also employed for the general works supply for feeding boilers, washing hurdles, and for the ash pits. At the works of Messrs. Tennant and the Jarrow Chemical Company, Limited, a water well was drilled into the water-bearing sandstone alongside a brine well, and only 12 inches from it. The brine well, of course, reaches the bottom of the salt at about 1,000 feet from the surface, while the water well is drilled into the sandstone only. While these two wells are only 12 inches apart, the one produces excellent brine, and the other an unlimited quantity of water for the general works supply, by which an important annual saving is effected for Darlington water which would be otherwise used. When a new well is commenced, the surface of rock salt exposed for solution is necessarily small, and its productive power limited to an hour or two pumping per 24 hours. As the water from the sandstone flows down the annulus to the rock salt the heavy brine sinks to the bottom of the cavity, and partly protects the rock salt at that point. The water or less saturated brine floats on the top, and thus solution of the salt takes place at the top of the bed, by which a cavity is formed shaped like an inverted cone. As the brine is pumped from the bottom of this cavity, the water flows down the annulus from the sandstone, and thus the process of producing artificial brine is continued, while the cavity becomes larger, and its productive power increased as the surface of the rock salt is enlarged. The water from the red sandstone rises to within 20 feet from the surface in the annulus, and pressing on the brine below, forces it up the suction pipe, supporting a column of brine five-sixths of its own height. Thus a column of water 1,200 feet deep in the annulus will force the brine up the pump tube 1,000 feet, which leaves only 200 feet for the brine to be drawn to the surface, and which is accomplished by fixing the pump a few feet below the level of the brine. The brine pumps are driven at from 10 to 12 strokes per minute, and continued until the strength is reduced to say 24 per cent., when it is allowed to stand for the further formation of brine. This is repeated till the strength and quantity gradually increase, and in the course of a few months wells will yield good brine 18 hours per day, and in some cases pump continuously night and day except on Sundays. The quantity of salt produced from each well per week depends upon its size and age. The feeling amongst salt manufacturers on the Tees is to erect small wells and more of them, so that the loss of a well is not of great importance, and the wells now constructed are 8 inches diameter, though the salt and oil wells in America are 5½ inches in diameter.

Excepting when a fall of marl occurs, by which the brine is rendered slightly red, it reaches the surface clear, bright, and very effervescent, due to the presence of a gas chiefly consisting of nitrogen. The average strength of the brine produced from eight wells at the works of Messrs. Tennant and the Jarrow Chemical Company, Limited, contains 25·8 per cent. of salt, or about 40° Twaddell, while saturated brine is 26½ per cent.

The artificial brine produced on the Tees, averaging, say, 25½ per cent., is rather weaker than the Cheshire natural brine, which contains from 26 to 26½ per cent. of salt, and which is produced by long contact of the water with the rock salt.

At this point I should like to call your attention to what has all along been a very serious difficulty in the development of the Tees salt industry, and a source of both loss and anxiety to salt manufacturers there. It has already been pointed out that the cavity formed at the bottom of the wells is shaped like an inverted cone. When a well has been in operation a few months, and the salt forming the support for the marl immediately above is removed by solution, these marls fall into the cavity with such force as to bend or break the lining and suction tubes above the top of the salt bed, and water is pumped up instead of brine. Costly wells have been in this way completely disabled, and, in some cases, after considerable sums have been expended in attempting their restoration, they have been altogether abandoned. This is a difficulty which should be well recognised by those who in future risk capital in winning salt on the Tees. Some believe that the power exerted by these falling marls is so great that no lining or suction tubes can be made sufficiently strong to withstand it, and, acting on this belief, lining tubes have in some cases been altogether abandoned. Others, on the contrary, and amongst these are Messrs. Tennant and the Jarrow Chemical Company, Limited. have adopted the plan of lining the wells with the best ½-inch steel tubes, and while both these plans are on their trial, experience, so far, is on the side of the latter plan. At the works named, two wells, lined with ⅜-inch steel tubing, both broke down in this way, but were soon restored, and have since given no trouble, while six other wells lined with ½-inch steel tubing have worked from 12 to 18 months without the slightest hitch. Further experience will determine whether ½-inch steel tubing is sufficiently strong to withstand the falling marls, or whether tubing of ⅝-inch or even ¾-inch steel must be used. The difficulty of dealing with mishaps of this kind at such great depths as, say, 1,000 ft., will be readily understood, but whatever form the construction of the wells ultimately takes, it is quite certain that the difficulty associated with their restoration has been so minimised as to remove to a large extent this source of anxiety, for here again the American system of drilling has proved of the greatest value. By means of the ingenious tools already referred to, difficulties which were formerly considered insurmountable have up to the present time been overcome, the fallen marls drilled through, the suction tubes inserted in their old position at the bottom of the rock salt, and the well recovered. From all this it will be seen that not only has the introduction of the American system on the Tees resulted in greatly reducing the cost of drilling and improving the pumping appliances, but it has placed in our hands means of repairing wells with comparative ease, and of thus removing a grave difficulty which at one period threatened to paralyse the further development of this important industry.

Going back to the brine which we described as having been pumped to reservoirs, where suspended matter is allowed to settle, we come now to the manufacture of salt, which will be briefly described. The operations are apparently very simple, but considerable practice is required to overcome difficulties in detail. The method of manufacturing which has been so long practised in Cheshire has been adopted in its entirety on the Tees. The brine is evaporated in iron or steel pans which vary in size in different works, but for common salt, the chief product of the Tees salt manufacture, 70 ft. long by 24 ft. wide and 18 ins. deep, may be taken as an average. The evaporation is done by bottom heat, the pans being set on four longitudinal flues with a fire to each, and the flame traverses the whole length of the pan, which it leaves at a temperature of 500° to 600° F. As the salt forms, it is raked to the side of the pan, the bottom of which at that point is protected by what is called the dead flue. Every second day the pan is drawn, and the salt thrown with perforated shovels upon the hurdles, which are of wood caulked like a ship's deck, and so constructed with a fall that the brine drains back into the pan. As all brines are saturated solutions of sulphate of lime, in the manufacture of salt, this sulphate of lime, with salt, forms a hard crust on the bottom of the pans, which retards evaporation and causes great wear and tear on the plates over the fires, especially, and which constitutes an important item in the cost of manufacture. Every four or five weeks the pans are laid off to remove this scale, which in that time will accumulate to 2 or 3 ins. thick. Nearly all the salt manufactured on the Tees is known as common salt, and used in the alkali works on the Tyne. To produce that quality, about 10 cwts. of South Durham small coal is consumed, costing just now about 4*s.* per ton, and the labour for working the fires and pans, and loading the salt into waggons, amounts to about 1*s.* per ton. The cost for carriage in the railway company's waggons to the Tyne is 2*s.* 9*d.* per ton, against 9*s.* 6*d.* from Cheshire, and by water to the Tyne, 1*s.* 6*d.* per ton, including all river dues.

Although common salt is chiefly produced on the Tees, yet the South Durham Salt Company, Limited, manufacture the other varieties such as fishery, curing, table, butter, &c., samples of all of which are on the table, and it is admitted that the quality of the brine and the various salts produced on the Tees are all quite equal to the products of Cheshire. The fineness or otherwise of the grain in the different varieties of salt depends simply upon the temperature at which the brine is kept during evaporation. The higher the temperature the finer the grain, and the lower the temperature the larger is the crystal. The different kinds of salt are divided into boiled and unboiled. The fine-grained salt, such as butter, cheese, block, and domestic salts, are made in short pans of about 35 feet long, and kept at 224° F., the boiling point of saturated brine, the pans being drawn twice daily. Block salt is made by filling this salt into wooden moulds and drying in stoves with the waste heat from the pans, while superfine salt is produced by grinding these boiled salts. The loose fine salt is shipped mostly to India and Burmah, where about half a million tons go annually. The consumption of coal per ton of these fine-grained salts is about 14 cwts. Unboiled salts, such as common and fishery, are produced at temperatures below the boiling point of brine. For common, the brine is kept at about 160° to 190° F., and the pans drawn every two days, whereas for the larger grained or fishery, the brine is evaporated at about 130° to 160° F., and the pans drawn every four or five days. Extra fishery working at 100° to 110° F. and in long pans seven to eight days, large-grained bay salt is worked at 75° to 80° F. and drawn every three or four weeks.

At this point permit me to direct your attention to a very curious fact connected with this manufacture. For special qualities of fine salt mechanical pans are employed to a limited extent, but apart from this, the whole of the various kinds of salt described are made in the ordinary open pan with bottom heat. This method of evaporation is precisely the same in principle as that employed by the Romans in Cheshire, excepting that they used leaden pans, 6 feet square, while we now employ steel or iron pans of large dimensions; and, notwithstanding the countless number of patents that have been granted for improvements in evaporating brine, the ordinary pan which has been in use for centuries still not only holds its own against all comers, but is still almost exclusively employed in producing the two million tons of salt annually manufactured in the United Kingdom.

The rapid development of the Tees salt industry is shown by the fact that in 1886, 98,000 tons were produced, while in 1887, 136,000 tons were made. During the same year the consumption on the Tyne was 116,486 tons, from which it will be seen that the productive power in South Durham now exceeds the consumption by the alkali manufacturers in this district.

The following shows the number of the firms now producing salt on the Tees, with their number of wells and pans respectively:—

Name of Firm.	No. of Wells.	No. of Pans.
Bell Brothers, Limited	8	19
Newcastle Chemical Works Company, Limited	8	22
South Durham Salt Company, Limited	7	11
C. Tennant and Partners, Limited, and Jarrow Chemical Company, Limited	8	20
Total in county of Durham	31	72
Messrs. Bolckow, Vaughan, and Company, Limited, Yorkshire	2	9
	33	81

The importance and extent of the manufacture of salt may be gathered from the statement that in 1887 about two millions of tons were produced in the United Kingdom, nearly three-fourths of which was manufactured in Cheshire; and in the same year the following quantities were exported:—

Quantity of Salt (Rock and White) exported from the United Kingdom, 1887.

Country to which Exported.	Tons.
Russia	10,065
Sweden and Norway	19,872
Denmark	29,819
Germany	24,924
Holland	27,716
Belgium	33,356
West Coast of Africa	32,533
British East Indies	323,704
Australasia	37,595
British North America	75,288
United States of America	172,951
British West Indies	5,401
Foreign West Indies	132
Chili	3,960
Brazil	6,032
Other Countries	15,365
Total	818,713

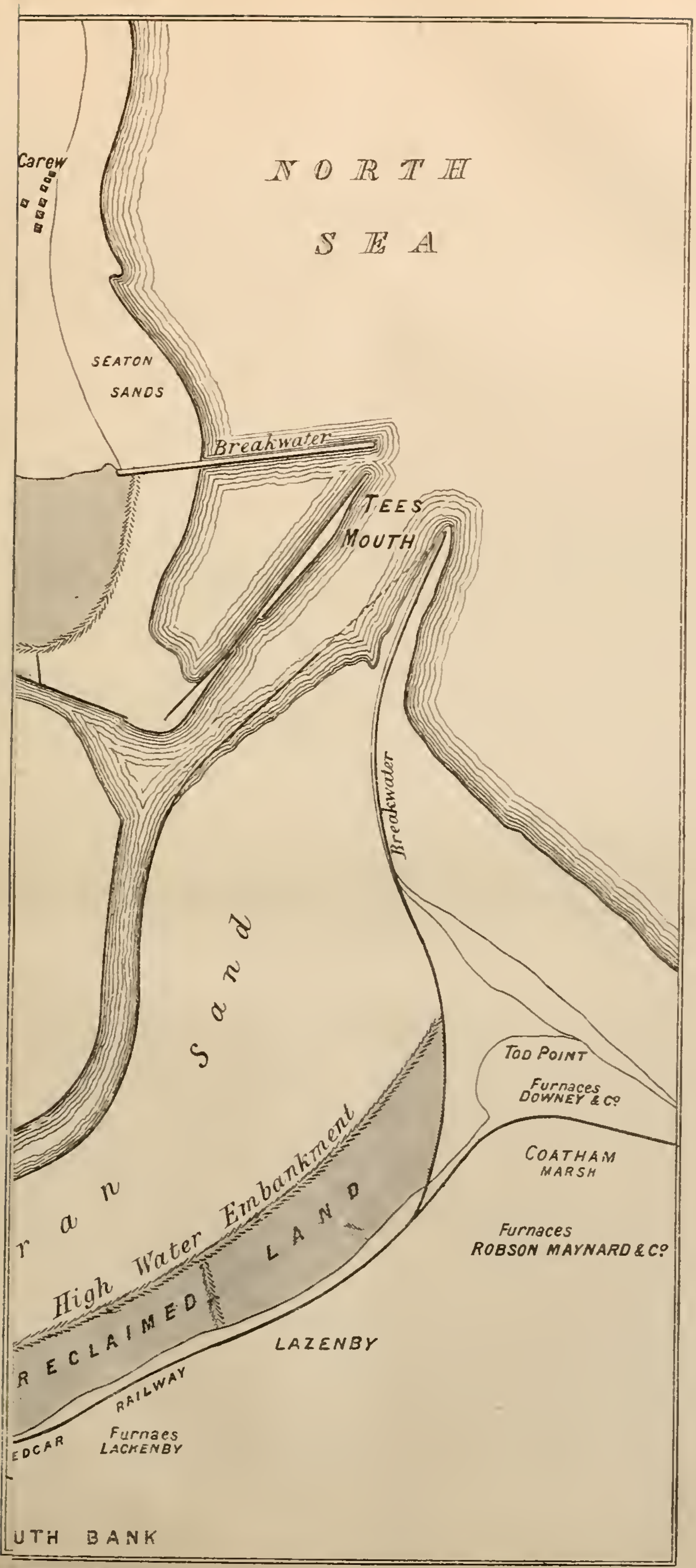
From the above it will be seen that out of two million tons made about 800,000 tons were exported, and that the British East Indies and America were our chief customers.

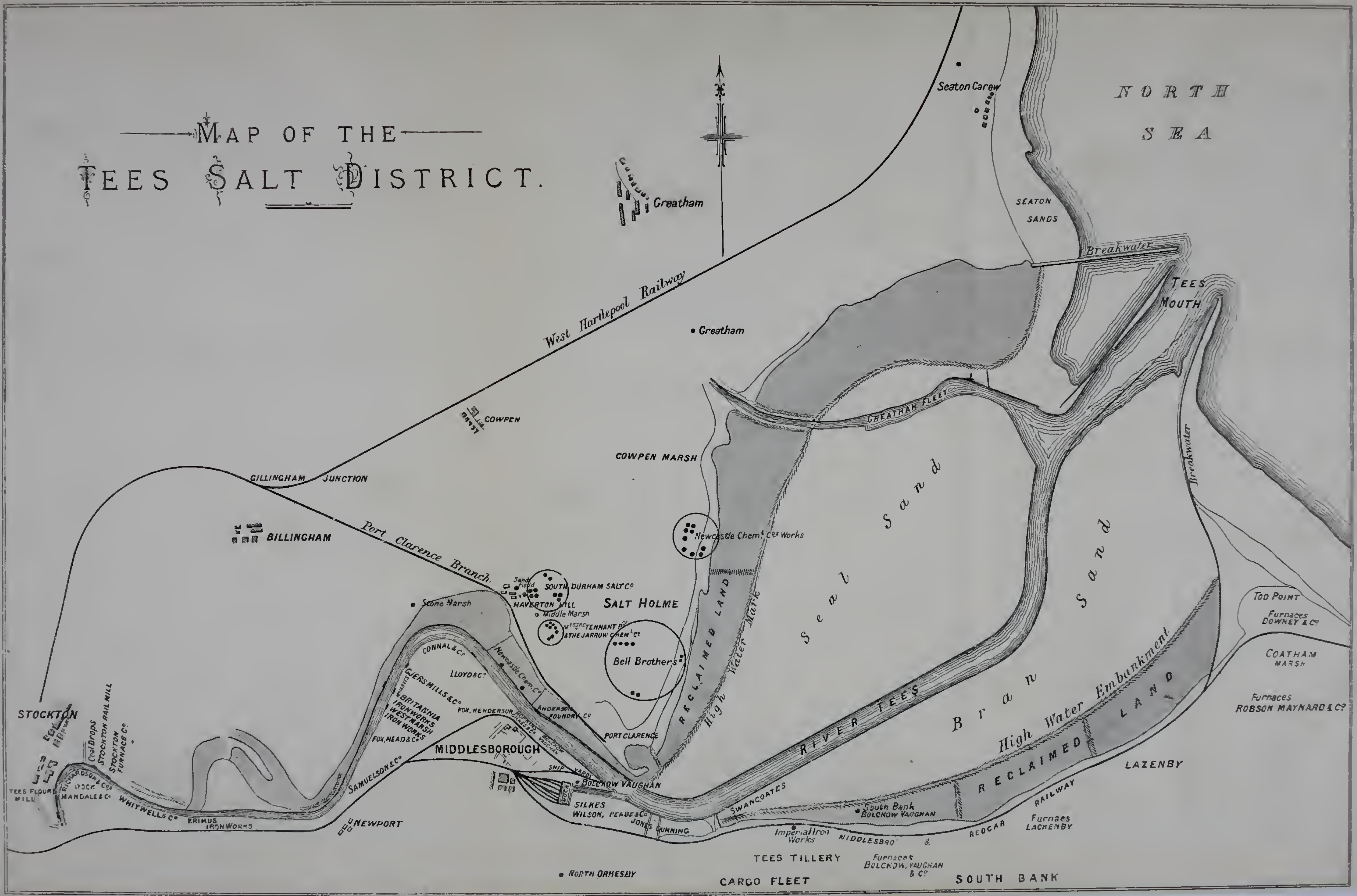
Although 136,000 tons made on the Tees in 1887 bears a very small proportion to the two million tons made during that year in the United Kingdom, and particularly as compared with Cheshire, it proves that substantial progress has been made notwithstanding the great difficulties that have been encountered in the development of this new salt field—difficulties which have no parallel in the much older and much more important district of Cheshire. At this point we may with interest compare the manufacturing conditions in each place. In Cheshire natural brine is found at a depth of 120 to 150 feet from the surface, or is obtained by flooding old rock salt mines. There the rain water easily finds its way to the salt, which it readily dissolves, and the brine runs for miles on the surface of the rock salt or "rock head," as it is called, and it is only necessary to sink a shaft this short distance to obtain the natural brine. On the Tees the conditions are altogether different in two essential points. There is no natural brine, and the rock salt is at about 10 times the depth. The rocks immediately overlying the salt are impervious to the water contained in such quantities in the sandstone above the marls, and from which the brine is artificially produced, as has already been fully described. Per ton of salt made, the cost for the deep brine wells on the Tees is more than Cheshire; how much more could not be easily estimated. On the Tees we have had great difficulties with the subsidences at the bottom of our wells, but it is believed that this has now been largely overcome, whereas in Cheshire they have subsidence of the surface, and possibly the one may be regarded as a set-off against the other. On the Tees small coal for evaporating costs now about 4*s.* per ton, against 5*s.* in Cheshire, and the quality is better. In the Middlesbro' district the works are situated on a navigable river and close to the seaboard, where ships or steamers come alongside the works and have their cargoes of salt loaded either for export or home comsumption at, say 3*d.* per ton, while in Cheshire the salt is loaded into steam barges, brought down the River Weaver into the Mersey, and transhipped at Liverpool at a total cost of 2*s.* 3*d.* per ton, or 2*s.* more than on the Tees, which constitutes a large item upon such a low-priced article as salt. From these facts it will be seen that, excepting the cost of boring and constructing brine wells, the manufacturing conditions are all favourable to the Tees.

The question of the subsidence of the surface in the neighbourhood of Middlesbro' has caused and is still causing anxiety, and building societies are somewhat averse to advancing money on new property there. In Cheshire subsidences occur where there is a run of water over the rock salt and where the salt is dissolved. This may be miles away from where the brine is actually pumped, and when the water is completely saturated with salt it, of course, may run for a long distance without doing any further damage. Subsidences therefore in Cheshire occur where the rock salt is dissolved by the run of the water over the "rock head," and may be at uncertain distances from the brine wells. On the Tees the conditions are altogether different. We have no such runs of water over the rock salt. The brine is made artificially at the bottom of the wells only, and subsidences can only occur in the immediate vicinity of the wells themselves, and the salt manufacturers thus become the first sufferers. Even this is highly improbable, for the enormous thickness of sandstone above the salt, amounting to 500 to 600 feet, will, it is believed, be amply sufficient to form a strong arch over the cavities, and thus effectually prevent any falling of the surface. This subsidence question therefore need cause no anxiety in our day, nor for many generations to come.

We have thus traced the Tees salt industry from its infancy through its various difficulties to its present stage of development. We have seen how Messrs. Bolckow and Vaughan discovered the bed of rock salt in 1862 unexpectedly while searching for water, and how, after considerable expenditure, they abandoned their efforts to sink a shaft and win the salt by a regular system of mining. Deterred by these unsuccessful efforts, the whole question rested in abeyance for 12 years till 1874, when Messrs. Bell Bros., who ultimately became the pioneers of this industry, bored near their iron works at Port Clarence, on the north side of the river, and after boring nearly two years, at last found a good bed 65 ft. thick.

The excessive cost of boring, and the difficulty of obtaining brine at this great depth, induced Messrs. Bell Bros. to do nothing further in the matter till 1881, when Mr. Thomas Bell suggested the French plan of pouring water down to the rock salt, which has been fully explained, but of which at that time he had no knowledge. After seeing this method in operation, they adopted it at Port Clarence, and began to make salt in 1882. At first they used the water from the "stells," as they are called, or small streams running through their property, but the organic matter contained in it gave endless trouble by causing the pans to "skim over," and thus effectually retarding the evaporation of the brine. This difficulty was surmounted by using the Darlington water, and then they saved the cost of this by utilising the water from the sandstone, which is now exclusively used for the formation of the artificial brine. They also introduced the Diamond boring system, which was so perfected that the salt could be reached in about three months, and they have applied waste blast-furnace gas to several of their salt pans. Then followed a period when other works were constructed, and by severe competition the price of salt fell very considerably. It was then felt that the high cost of boring by the Diamond system, and the inadequate means in existence for restoring wells that had collapsed, were likely to paralyse the further development of this industry. At this juncture Messrs. Allhusen, Tennant, and the Jarrow Chemical Company jointly resolved upon bringing over experienced drillers from America, where, since 1859, 75,000 oil and brine wells had been drilled, although this method of drilling had never before been used in this country. We have seen how completely successful the working of the American system has been, not only in reducing the time of reaching the salt from three months to three weeks, with a corresponding reduction in cost, but in giving us the ingenious "rig" which serves the three-fold purpose of drilling, pumping, and restoring collapsed wells with comparative ease, and thus removing the difficulties which at that time seriously threatened the further extension of this industry. We have thus seen how, step by step, difficulties which at the time seemed well nigh insurmountable have been overcome, and how these firms have, by their capital, skill, and enterprise, contributed each their share to the development of the salt industry, which has been such a boon to Tyne alkali manufacturers, and which has added one more important manufacture to those already existing on the Tees.


Carew
NORTH SEA
SEATON SANDS
Breakwater
TEES MOUTH
Breakwater
Sand
ran
High Water Embankment
RECLAIMED LAND
TOD POINT
Furnaces DOWNEY & Co
COATHAM MARSH
Furnaces ROBSON MAYNARD & Co
LAZENBY
RAILWAY
EDCAR
Furnaes LACKENBY
UTH BANK



MAP OF THE TEES SALT DISTRICT.

EYRE AND SPOTTISWOODE.

AMERICAN DRILLING & PUMPING RIG, BRINE WELL &c.

EIGHT OF WHICH ARE NOW IN OPERATION AT THE

SALTWORKS, HAVERTON HILL,

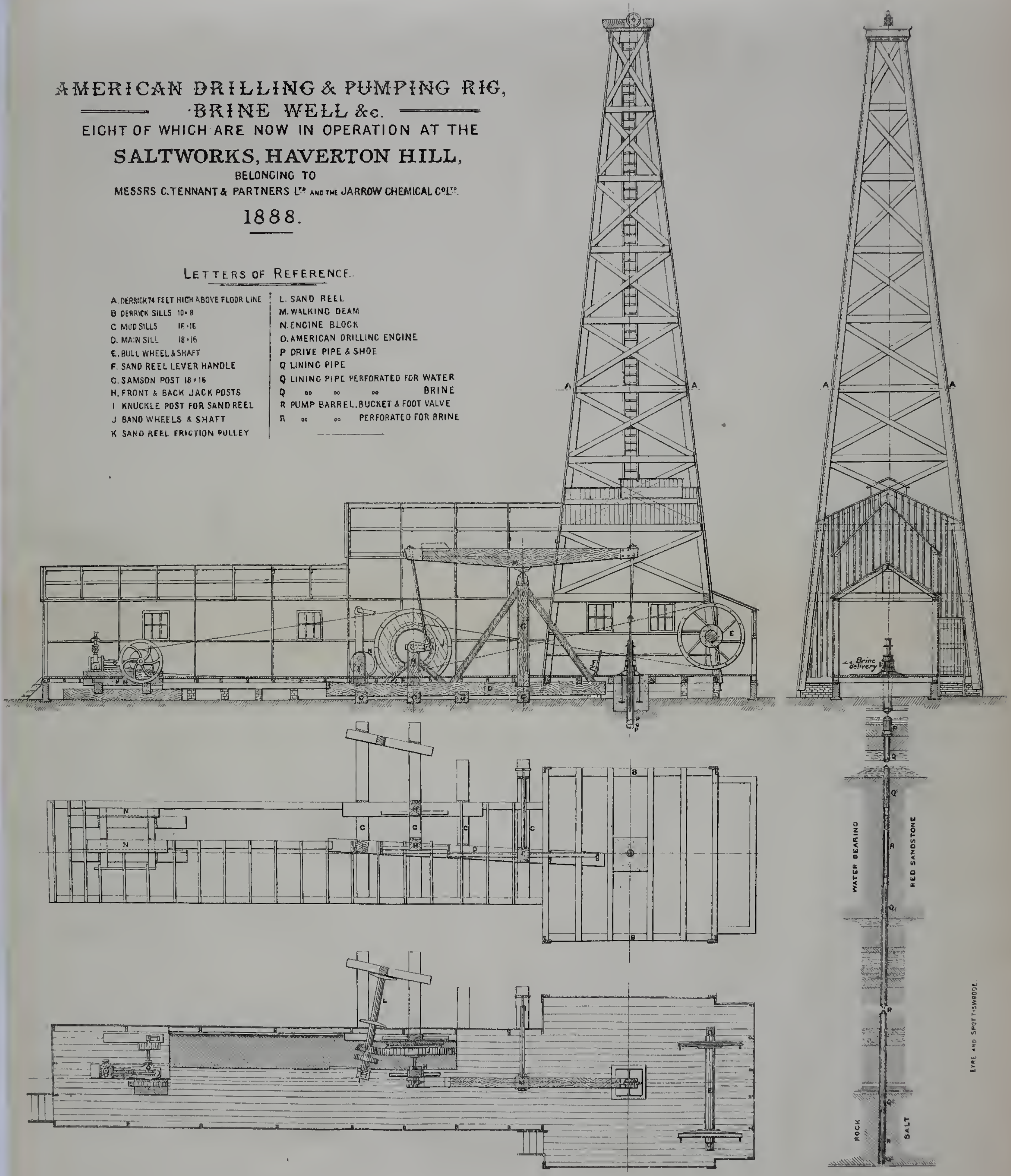
BELONGING TO

MESSRS C. TENNANT & PARTNERS L^{TD} AND THE JARROW CHEMICAL C^OL^{TD}.

1888.

LETTERS OF REFERENCE.

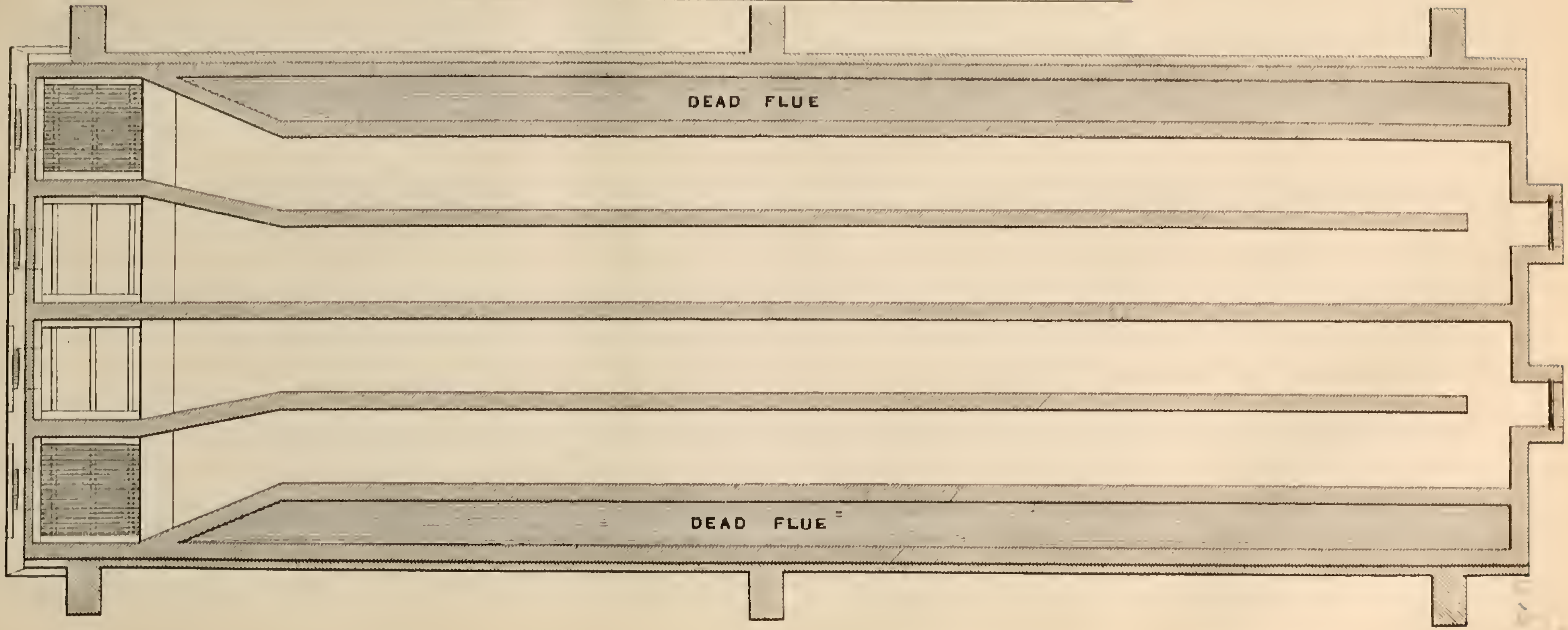
A. DERRICK 74 FEET HIGH ABOVE FLOOR LINE
B DERRICK SILLS 10 × 8
C MUD SILLS 16 × 16
D. MAIN SILL 18 × 16
E. BULL WHEEL & SHAFT
F. SAND REEL LEVER HANDLE
G. SAMSON POST 18 × 16
H. FRONT & BACK JACK POSTS
I KNUCKLE POST FOR SAND REEL
J BAND WHEELS & SHAFT
K SAND REEL FRICTION PULLEY
L. SAND REEL
M. WALKING BEAM
N. ENGINE BLOCK
O. AMERICAN DRILLING ENGINE
P DRIVE PIPE & SHOE
Q LINING PIPE
Q LINING PIPE PERFORATED FOR WATER
Q DO DO DO BRINE
R PUMP BARREL, BUCKET & FOOT VALVE
R DO DO PERFORATED FOR BRINE



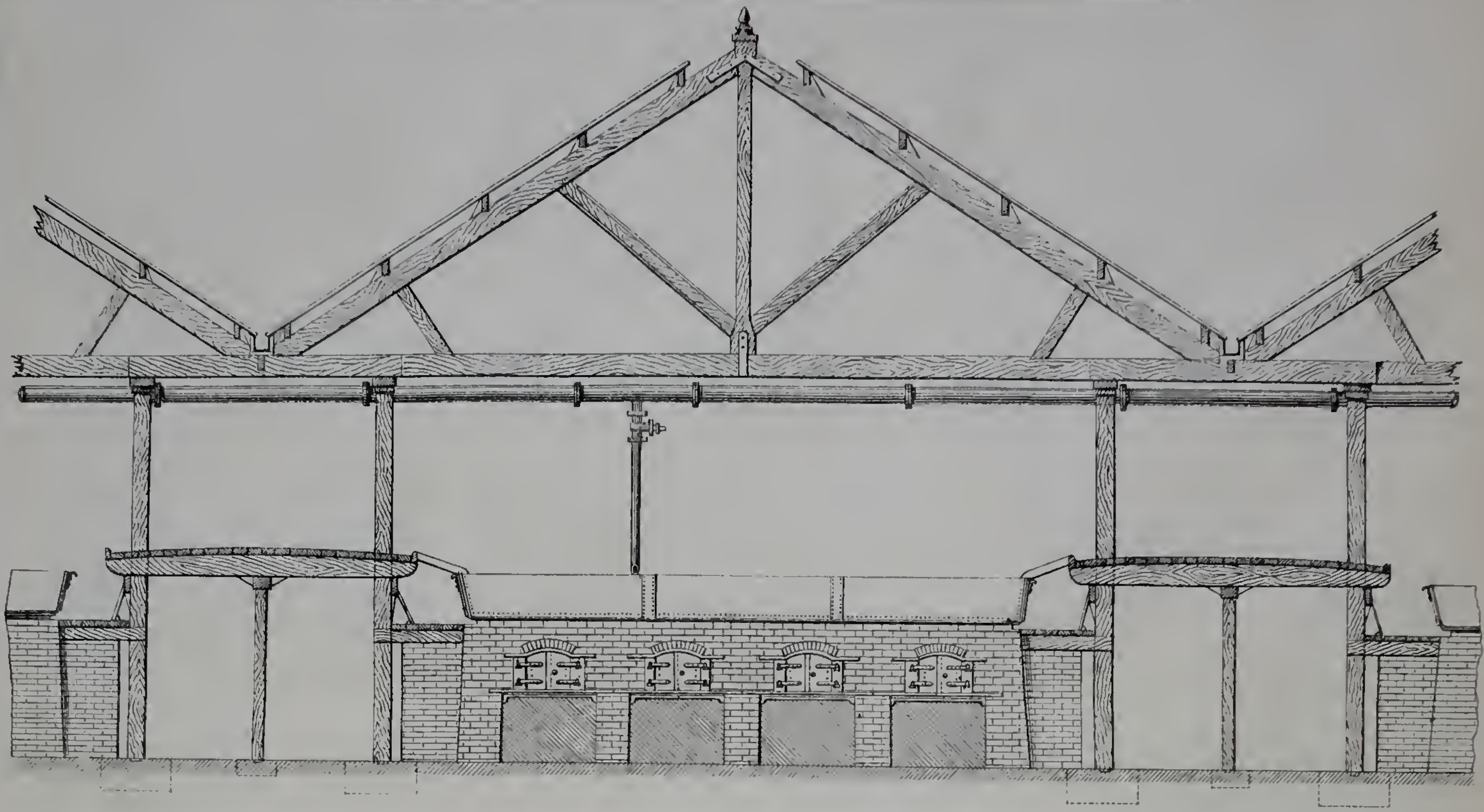
EYRE AND SPOTTISWOODE.

SECTIONAL ELEVATION OF PAN AND HURDLE FOR COMMON SALT.

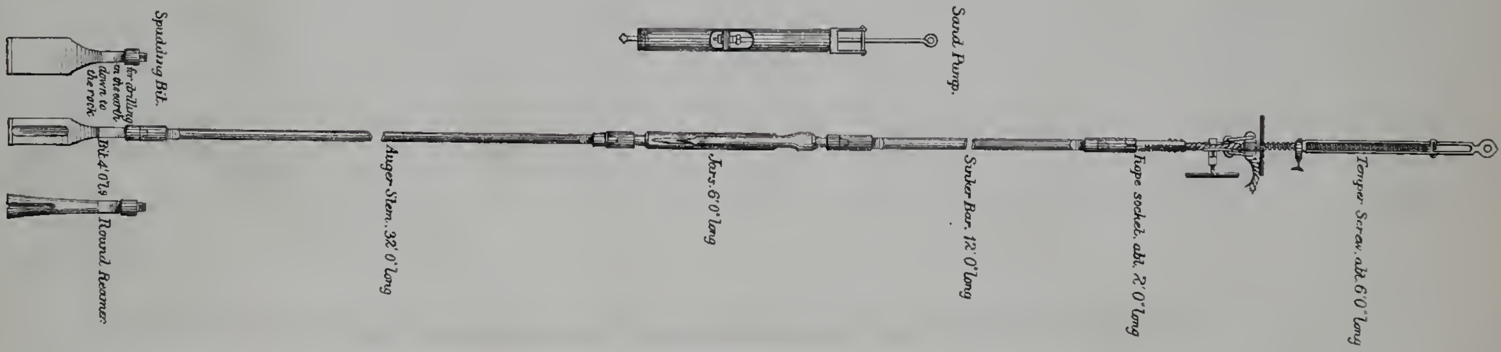
PLAN OF FLUES AND SEAT FOR SALT PAN



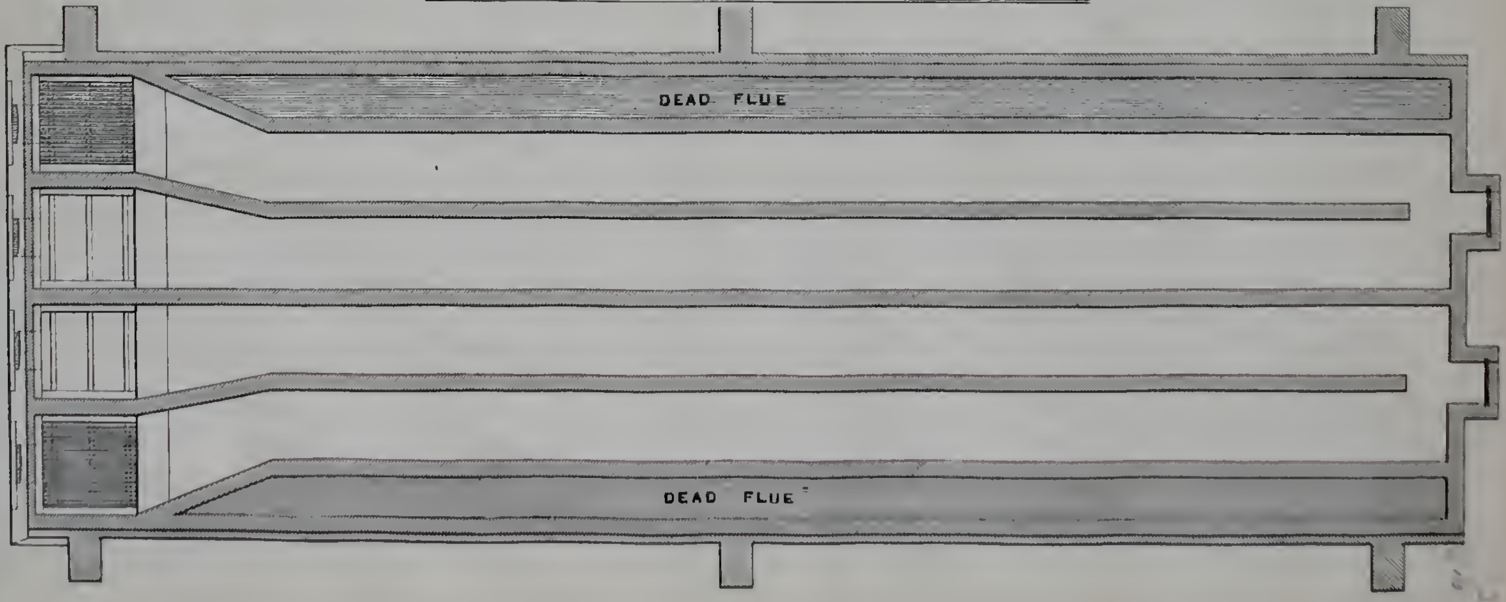
SECTIONAL ELEVATION OF PAN AND HURDLE FOR COMMON SALT.



AMERICAN DRILLING TOOLS &c.



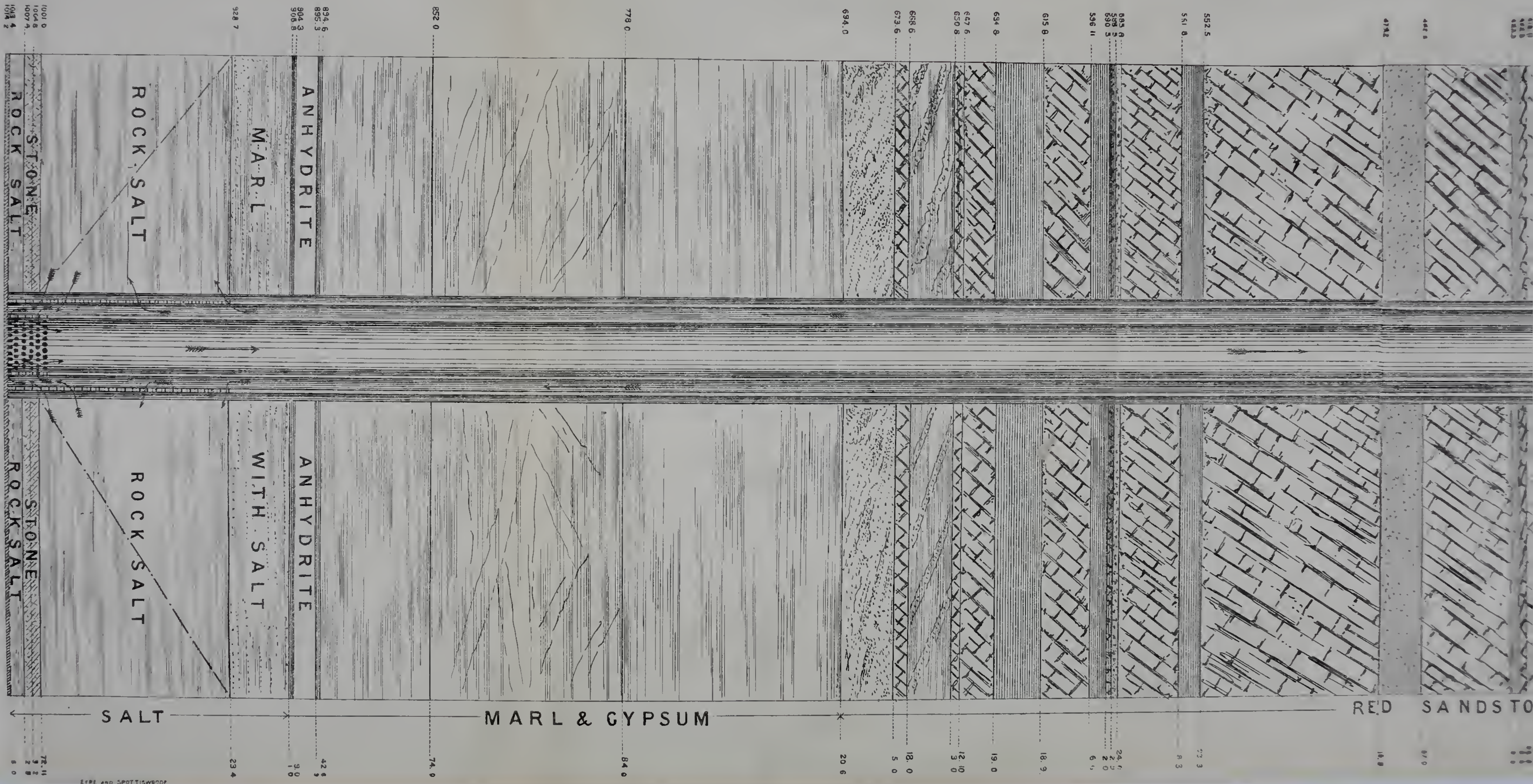
PLAN OF FLUES AND SEAT FOR SALT PAN



EYRE AND SPOTTISWOODE

SECTION of BRINE and WATER WELLS at the SALTW

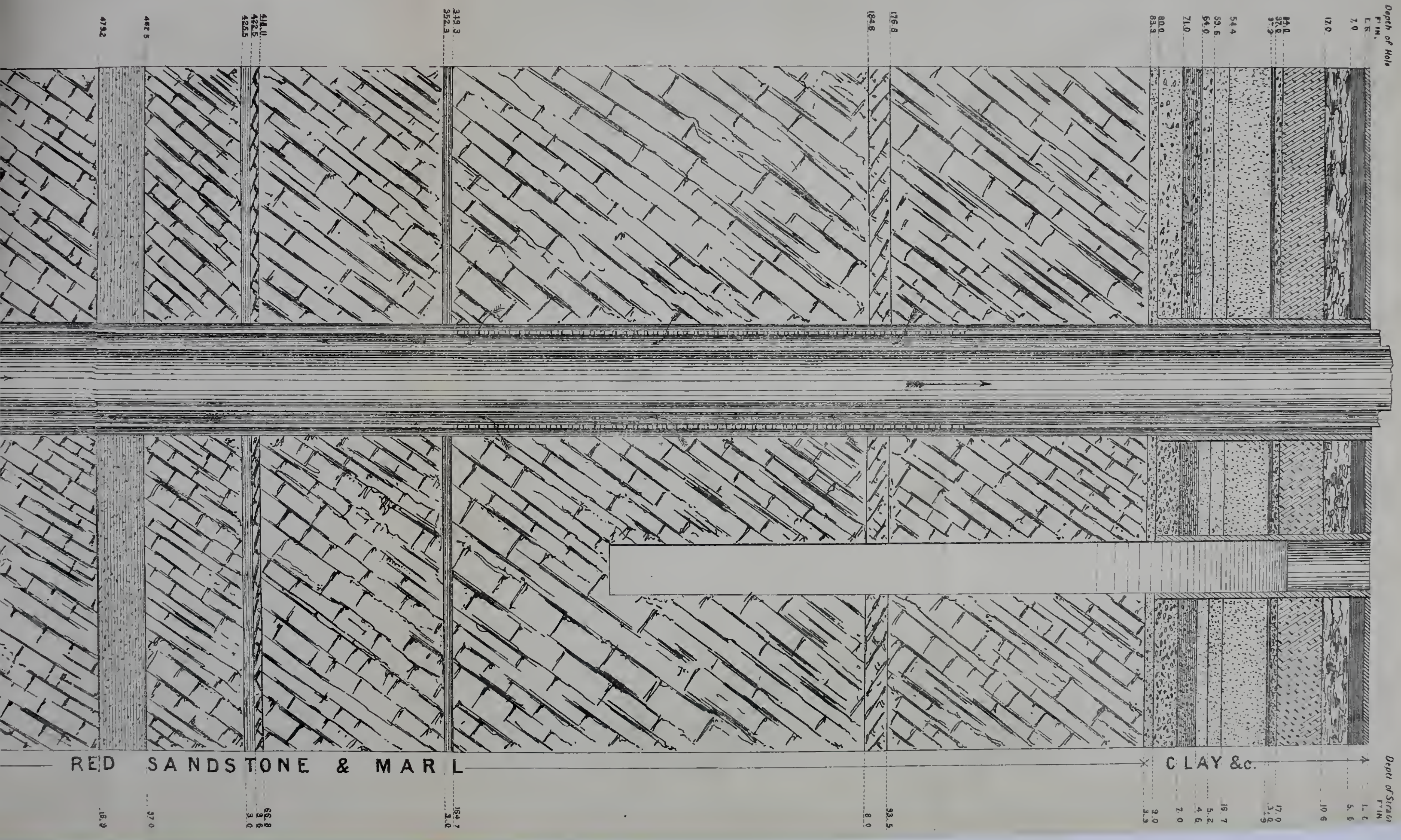
Belonging to Messrs. C. TENNANT and PARTNERS, Limited, and the JARROW CHEM



EYRE AND SPOTTISWOODE

LS at the SALTWORKS, HAVERTON HILL,

S, Limited, and the JARROW CHEMICAL COMPANY, Limited.



DISCUSSION.

Mr. J. C. Stevenson, M.P., in proposing a vote of thanks to Mr. Stuart, said the subject excited great interest in all who were concerned with the welfare of the northern seaports. He remembered when all the salt used on the Tyne came from Cheshire by canal to the Humber, and was brought generally as ballast by foreign coasting vessels from Hull to the Tyne. He referred to the curious fact mentioned by Mr. Stuart, that no improvement in the method of evaporating the brine had been made since the time of the Romans; one reason he thought was that only by a slow evaporation could the scale be got rid of and prevented from mixing with the salt. He remembered being one of a number of alkali makers who visited the east of France when it was first proposed to use the French method for pumping the brine, but the depth of the French wells was only some 400 feet, instead of 1,000 or 1,200 feet, as in the case of the Tees-side deposits.

Mr. Alfred Allhusen seconded the vote of thanks. He would like to mention one thing which he thought Mr. Stuart had not mentioned when speaking of the American tools, namely, the taper screw, which by a single turn joined the different parts together, and really formed a most important feature in the system.

Mr. John Pattinson, in supporting the vote, said he remembered analysing the first specimen of salt from the Middlesbro' deposits. It had always seemed to him a strange thing that so many years should have been allowed to elapse between the discovery of the salt deposits and their utilisation on a commercial scale. It was not wonderful that Messrs. Bolckow and Vaughan, who were iron masters, should not have pursued the thing very eagerly, but that the Tyne alkali makers should not have taken it up before seemed very strange.

Mr. Stuart, in acknowledging the vote of thanks, said that the same wonder had often been in his mind. But in industrial operations real progress was always very slow. He instanced in proof of this the ammonia-soda process, which had taken 50 years to develop.

A resolution was afterwards carried altering the night of future meetings of this Section to Thursday, in consequence of the engagement of the meeting room on other evenings.

On Saturday, the 13th inst., by special invitation of Mr. Stuart, about 30 members of the Newcastle Section visited the salt works of Messrs. Tennant and the Jarrow Chemical Company, Haverton Hill, near Middlesbro', of which Mr. Stuart is the manager, as well as of Messrs. Tennant's chemical works on the Tyne.

The salt works referred to have been recently erected with all the latest American improvements in drilling, equipping, and repairing brine wells, and are capable of producing about 1,200 tons of common salt per week for consumption in the three alkali works belonging to Messrs. Tennant and the Jarrow Chemical Company on the Tyne.

The party, conducted by Mr. Stuart and Mr. James Tennant, made a minute examination of the American brine wells, and the French method of producing artificial brine, in which they were much interested. They then examined the manufacture of salt, which is conducted precisely as in Cheshire, and afterwards an excellent luncheon was served in the works.

Glasgow and Scottish Section.

Chairman: J. J. Coleman.
Vice-Chairman: R. R. Tatlock.
Hon. Vice-Chairmen: E. C. C. Stanford.
Sir J. Neilson Cuthbertson.

Committee:

J. Addie.
G. Beilby.
A. Crum Brown.
J. Christie.
W. S. Curphey.
W. Dittmar.
D. B. Dott.
R. Irvine.
T. P. Miller.
E. J. Mills.
J. M. Milne.
T. L. Patterson.
J. Pattison.
F. J. Rowan.
D. R. Steuart.
A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.
Hon. Local Secretary:
G. G. Henderson, Chemical Laboratory, University of Glasgow.

SESSION 1888-89.

The first Meeting of the Section will take place in the Rooms, 207, Bath Street, Glasgow, on Tuesday, 6th November, at 8 p.m.

Papers to be read by—

Prof. Dittmar. "On the Behaviour of the Hydrates and Carbonates of Potassium, Sodium, Lithium, Rubidium, and Barium at High Temperatures."

Mr. A. French. "A new Process for obtaining Ammonium Chloride from the Nitrogen of Coal, Coke, Cinders, and Organic Matter generally."

Notices of papers and communications for the meetings to be sent to the Local Secretary.

CORRIGENDUM.

This Journal, September Number, page 613, line 9, instead of "Dr. Griess was sixty-four years of age," read "Dr. Griess was born at Kirchhosbach, Eschwege, Hesse-Cassel, on Sept. 6th, 1829, and thus at the time of his death was nearly 59 years of age."

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Emil Passburg's Vacuum Drying Apparatus. Dingl. Polyt. J. **269**, 223—224.

B, the preliminary dryer, is situated above A, the actual drying cylinder, and is connected with C, the charging vessel. A is double-walled. The material to be dried passes from B to A through D, a tube provided with a valve. From A the thoroughly dried material passes into the receiver F through a tube E. The steam enters the drying cylinder through the tube a, traverses the central tube A_1 and the side tubes A_2, and returns through the tube a_1 to the right side of the apparatus, where it passes through b into the cylinder B_1. After traversing the latter, the steam

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*.	½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*.......	1*d*.
„ 1*s*. 6*d*., „ „ 2*s*. 4*d*.......	1½*d*.
„ 2*s*. 4*d*., „ „ 3*s*. 4*d*.......	2*d*.

escapes through the tube b_1 (Fig. 2). k_1 and k_2 are bent tubes which serve to carry off the water of condensation. A and B are connected, by means of the tubes G and H, with an air pump and condenser. Both tubes are provided with valves or sieves *g* and *h*. The heating arrangements are made to revolve by means of the cog-wheels R and R_1, the axes of which pass through stuffing-boxes. The arrangement of the feet J, J_1, the columns K, and the chambers K_1, through which the steam passes into the tubes A_2, is clearly shown in the figure. The spades *h*, which serve to turn and move on the material which is being dried, are attached to the cylinder A_1, as are also the discs *l*, which serve to support the tube A_2. The internal cylinder B_1 consists of two halves bolted together, and provided with bulges b_2, which are arranged spirally, and force on the material, which is stirred up at the same time by the spades *m*. The apparatus makes five revolutions per minute, and the medium size, which is 5 m. long by 1·5 m. diameter, requires one man and 3 H.P. to work it. To keep the materials from being overheated, the temperature is kept at 50° C., and under these conditions 750 litres of water are evaporated per hour.—F. W. T. K.

II.—FUEL, GAS, AND LIGHT.

Precautions necessary in using Water Gas for Industrial Purposes. G. Lunge. Zeits. f. angew. Chem. 1888, 462—465.

This paper embodies the results of the work of a commission of experts appointed by the Swiss Industry Department. Two kinds of water gas are used commercially, one of which is true water gas, and is produced by the action of steam on red-hot coke, while the other (better termed generator gas, and corresponding to Dowson gas) is formed when a mixture of air and steam is employed. While ordinary coal gas has a penetrating and characteristic smell, and contains about 8 per cent. of CO, water gas and generator gas contain about 40 and 22 to 25 per cent. of that constituent respectively, and are odourless. Means for preventing and detecting escape are therefore very necessary.

The commission accordingly recommends—

(1.) The use of some arrangement on the main supply pipe to indicate whether the distributing system be reasonably tight, and to detect the fact of any cock being left open after the main cock is closed (so as to avoid escape when the main cock is again opened). An apparatus known as Muchall's gas governor fulfils these conditions, and also controls the generation of the gas.

(2.) The removal of the products of combustion from the room in which the gas is used. This is to guard against the risk of the CO being imperfectly burnt.

(3.) The addition of a powerfully odorous substance to the gas, in order to make its escape readily perceptible. Mercaptan is efficient for this purpose, the quantity necessary being far too small to increase the poisonous properties of the gas.—B. B.

Gaseous Fuel. Brit. Assoc. Mech. Science Section, Bath, 1888. J. Emerson Dawson.

The author considered himself justified in saying that gas power is now fairly launched in competition with steam power, and he thinks with the late Fleming Jenkin that eventually the former will to a great extent supersede the latter. He also thinks it tolerably sure that even better results than those already recorded will be obtained when an engine is really designed to give the best effect with generator gas. It is well known that in the Otto engines each new charge of gas is diluted with a portion of the products of combustion from the previous charge, and this answers very well for ordinary lighting gas. But as generator gas, such as the author's, has only about one-fourth the explosive power of the other gas, it is a disadvantage to dilute it with products of combustion, and he feels confident that sooner or later makers of engines will find it expedient to design all engines of large power specially for cheap generator gas. The best fuel to use for making the gas is anthracite, as it does not yield tar or other condensable products, and does not cake in the generator. Ordinary gas coke can also be used with certain precautions. On the Continent several firms use this gas for singeing silk yarns and textile fabrics. It is also used by several linen manufacturers in the north of Ireland for stentering, which they formerly did with hot air. The cost of the gas somewhat depends on that of the fuel; but speaking generally, the equivalent of 1,000 cubic feet of ordinary lighting gas costs from 6*d.* to 1*s.*—W. S.

Meeting of the German Society of Gas and Water Experts at Stuttgart from 12th to 14th June 1888. P. Behrend. Dingl. Polyt. J. **269**, 230—234.

Director Fischer made a communication, based on a pamphlet by Dr. N. H. Schilling, on the question of *connecting lightning conductors with gas and water piping.* Schilling comes to the conclusion that "the connexion of lightning conductors with gas and water piping is neither necessary, nor, for practical reasons, advisable in the interests of gas and water works." Statistics show that houses provided with such piping do not incur greater risk from lightning; on the contrary, it probably acts as a protection. In only very few cases have pipes inside houses been struck, and the damage done was very slight. In these cases the damage concentrates itself on those points which lie on the shortest line between the outer wall and the piping. The gas and water-piping is only exposed to danger from lightning, (1) when the lightning passes to it from a neighbouring lightning conductor, and this can generally be traced to defective conduction of the lightning conductor; (2) when the packing of the piping consists of a badly conducting material (*e.g.*, india-rubber or wool), the use of which should therefore be avoided. The piping should not be connected with the conductor, as it is sometimes interrupted when repairs or a new arrangement of pipes is being carried out. Besides, the danger should not be forgotten to which workmen are exposed when repairing these pipes during a thunderstorm. A committee was subsequently appointed to discuss the subject in conjunction with the "Elektro-technische Verein" and the "Verband Deutscher Architekten und Ingenieure."

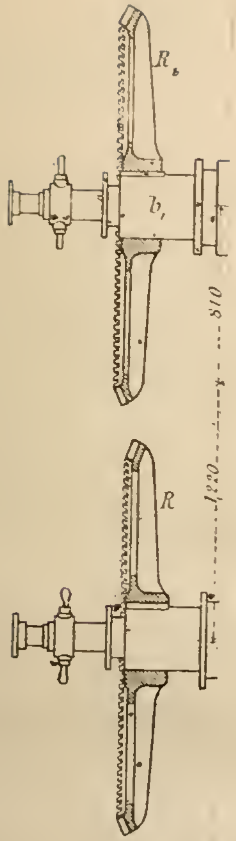
Director Reichart, in communicating the report of the committee on the *use of gas for heating purposes*, showed that the use of gas for cooking and heating purposes has greatly increased during the last few years.

The *Report of the Photometric Committee* points out that the advantages of the amyl-acetate lamp as a light unit have received renewed recognition. The Society intends, however, to communicate with the "Physikalisch-technische Reichsanstalt," with a view to the carrying out of careful experiments on the relative luminosity of this light and other standards of light at present in use, as this point is still uncertain.

Dr. Krüss, who has constructed Grosse's photometer, explained the principle and application of the same. *The importance of chemical investigations in gasworks* was emphasised by Prof. Bunte. Analyses of raw material of products and by-products should be made, and investigations conducted for regulating the working of the establishment. Improvements in and the economic working of gasworks can only go hand-in-hand with such investigations. Bunte demonstrated a method of his own for examining gas for hydrogen sulphide.

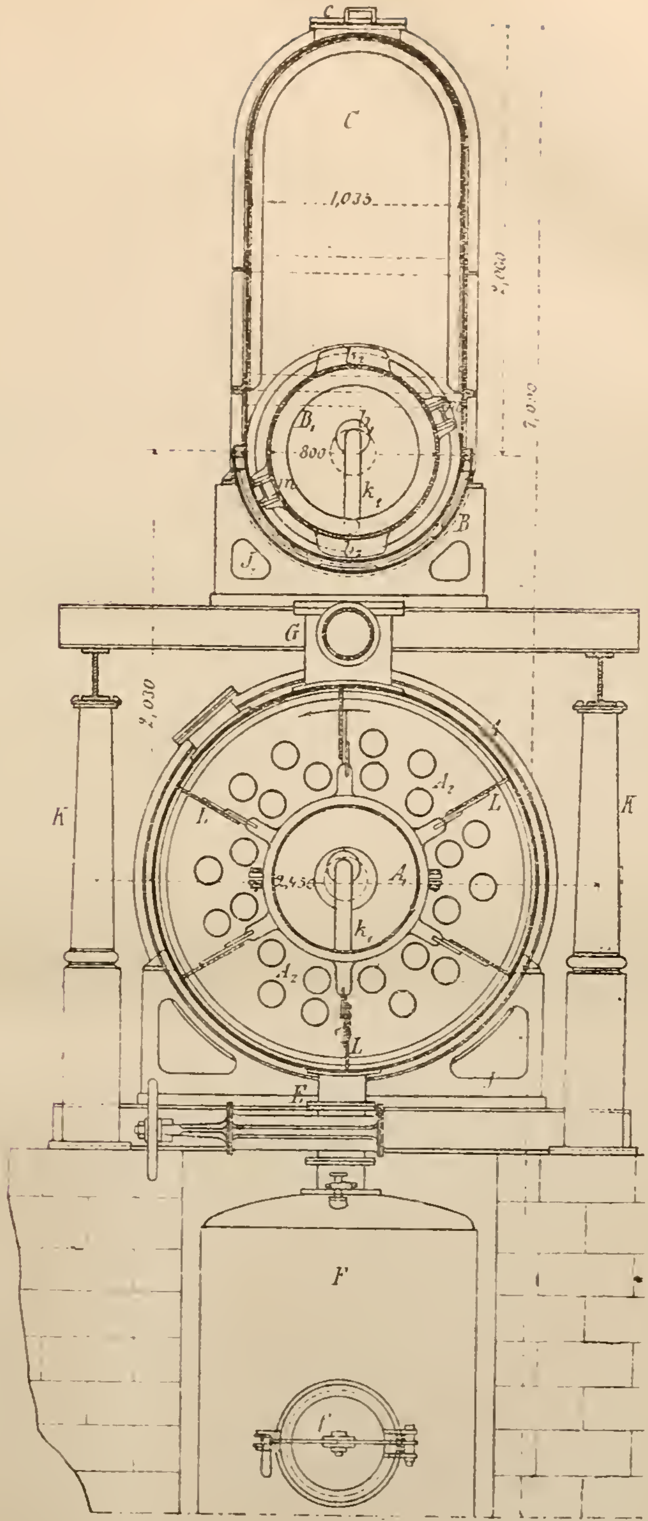
A communication on *Improvements in Lux's Gas Balances* was made by Director Kunath.

This refers to the attachment of a thermometer to the globes and an arrangement which makes it possible to represent graphically the weight of the gas during the working.



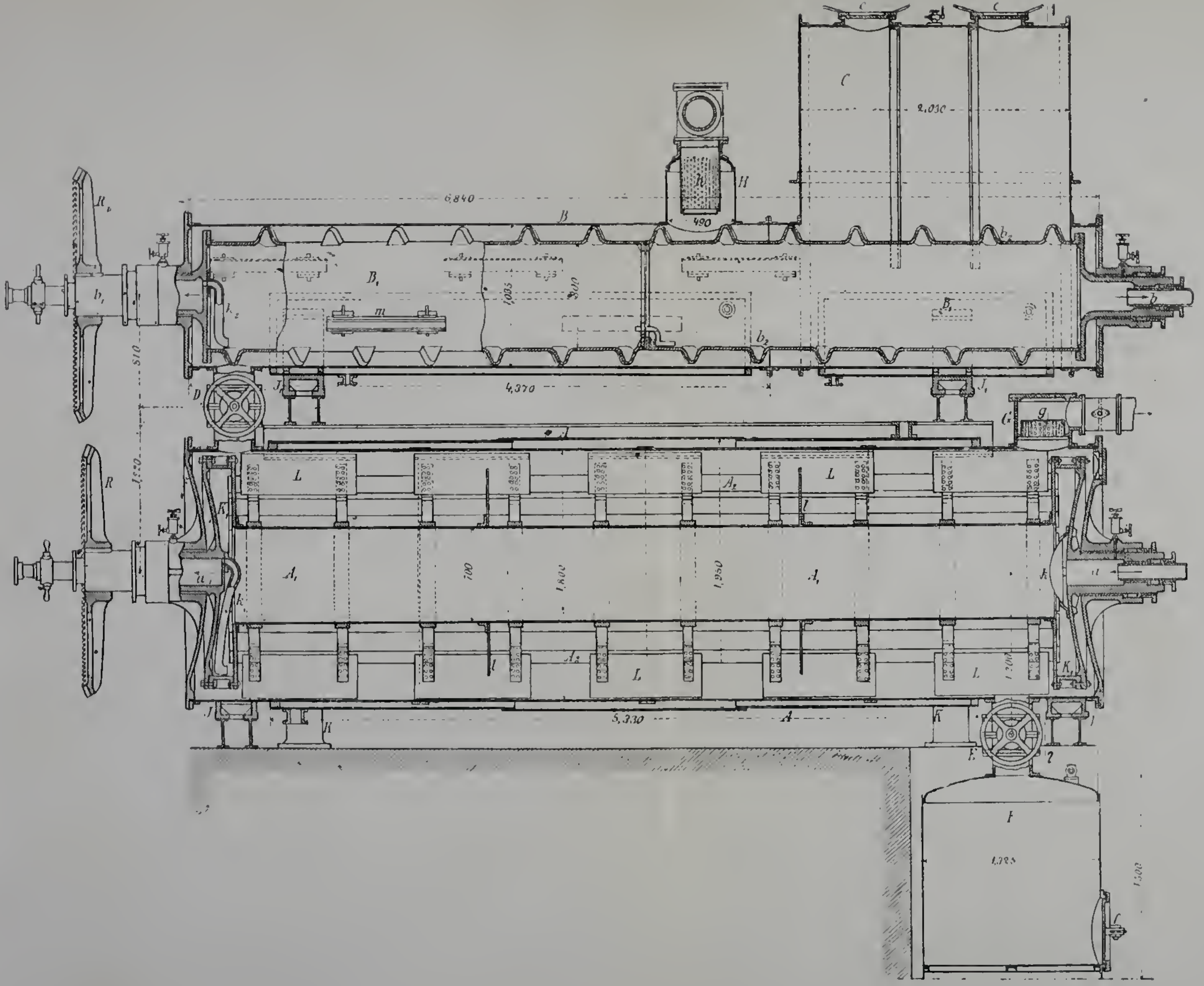
R_b
b_1
810
1,220
R

Fig. 2.



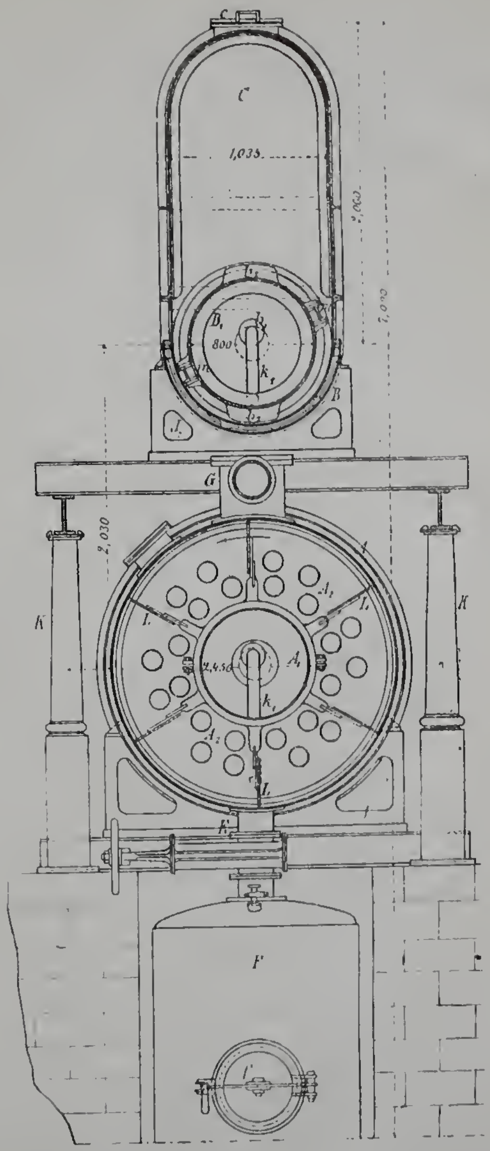
c
C
1,035
2,000
1,000
b_2
B_1
b_1
800
m
k_1
B
J
G
2,030
L
A_2
K
2,450
A_1
k_1
E
F
f

Fig. 1.



c
c
C
2,030
h
H
490
6,840
B
b_2
R_1
b_1
B_1
m
1,035
800
B_1
b_2
b
810
D
J_1
4,370
J_1
G
g
1,220
R
L
L
A_2
L
K_1
a
A_1
700
1,800
1,950
A_1
k
a
l
A_2
L
L
1,200
K_1
J
K
5,330
A
K
E
F
1,325
1,300
f

Fig. 2.



c
C
1,035
2,060
1,090
b_1
B_1
800
k_1
m
B
b_2
J_1
G
2,030
K
K
A_2
L
L
A_1
2,450
k_1
A_2
L
K_1
F
f

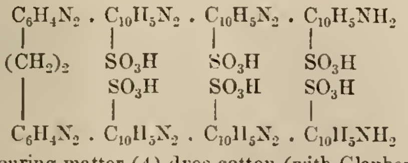
Dr. Hueppe, discussing *well-water supply*, emphasises the importance of the bacteriological examination of water in connexion with the chemical analysis. Both number and kind of bacteria and germs should be observed. The quality of the water, as well as its liability to contamination, and the prevention of this latter evil, require careful attention. The casing of wells should be watertight, and should descend to a sufficient depth (the lowest limit to which the influences exerted by cultivation extend is 4 to 6 m.). Wells should be closed at the top, and provided with sufficient ventilation. Wells in the vicinity of cesspools should be at least 5 m. away from the latter, and the cesspools should be watertight. Draw-wells should be avoided, and only tube-wells (artesian and deep wells) employed. The natural cleansing power of the soil should be taken advantage of, but, as in the case of artificial filters, the wells should be kept free from slime and mud. In the chemical investigation the origin of the constituents is more important than the quantity.

As regards the *employment of leaden water-pipes*, Prof. Bunte states that these are only acted upon by the water when they contain air, *e.g.*, after having stood empty. The presence of salts in the water, more especially of carbonates or bicarbonates, weakens or entirely prevents the action. A compilation of the analyses of the waters in a large number of German towns shows that, with two exceptions, almost all contain the minimum amount of carbonates. Since water supplies are continuous in Germany, lead pipes can be safely employed. In England, where the intermittent water supply is general, the case is different, as the pipes become filled with air and get oxidised.—F. W. T. K.

IV.—COLOURING MATTERS AND DYES.

Azo-colours from Ortho-diamidostilbene. C. A. Bischoff. Ber. 21, 2078—2084.

O-DINITROSTILBENE may be reduced to the amido-compound with tin and hydrochloric acid. It melts at 176°. It forms salts with HCl and H_2SO_4, and a platinum double salt. To convert the amido-compound into the azo colouring-matters, 40 cc. HCl, sp. gr. 1·145, are added to 16·8 grms. substance dissolved in hot water and diluted to 1 litre. 250 cc. are diazotised with the calculated quantity of nitrite. The tetrazo-compound thus formed may be combined with two molecules of the following:—(1) salicylic acid; (2 and 3) sodium naphtholsulphonate (Beyer's and Schäffer's); (4) α-naphthylaminesulphonic acid; (5) sodium naphtholdisulphonate; and (6) with one molecule α-naphthylaminesulphonic acid and 1 molecule resorcinol; (7) sodium naphtholdisulphonate and α-naphthylaminesulphonic acid; (8) sodium naphtholdisulphonate and phenol; and finally (9) the compound (4) obtained from α-naphthylaminesulphonic acid, and may be diazotised again, and this combined with two molecules α-naphthylaminesulphonic acid to form a compound of the following formula:—



$$\begin{array}{ccccccc} C_6H_4N_2 & . & C_{10}H_5N_2 & . & C_{10}H_5N_2 & . & C_{10}H_5NH_2 \\ | & & | & & | & & | \\ (CH_2)_2 & & SO_3H & & SO_3H & & SO_3H \\ | & & SO_3H & & SO_3H & & SO_3H \\ | & & | & & | & & | \\ C_6H_4N_2 & . & C_{10}H_5N_2 & . & C_{10}H_5N_2 & . & C_{10}H_5NH_2 \end{array}$$

The colouring-matter (4) dyes cotton (with Glauber's salt, soda, and soap) red-brown; (5) and (7) red-violet; (6) used as sodium salt, cinnamon-brown; (7) in a salt bath with oxalic acid, light purple; (8) dyed in the same way, purple-red; and (9) colours cotton yellowish-brown. The use of Turkey-red oil does not materially modify the results.—J. B. C.

Aniline-trisulphonic Acid. G. T. Hartshorn and C. L. Jackson. Ber. 21, 2032—2033.

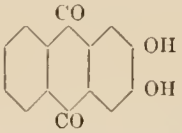
ANILINE-trisulphonic acid is prepared by heating potassium β-aniline *m*-disulphonate with conc. sulphuric acid or aniline with an excess of conc. sulphuric acid, and the calculated quantity of K_2SO_4 in a porcelain basin until the mixture begins to carbonise. The free acid crystallises from water in brilliant prisms of considerable size. The potassium salt has the formula—

$$C_6H_2.NH_2.SO_3H(SO_3K)_2 + 3H_2O.$$

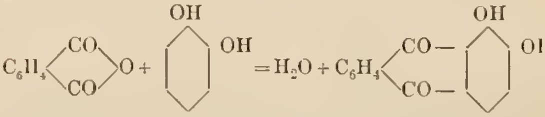
The fact that this salt contains two atoms of potassium may be due to the amido group saturating the free sulphonyl group.—J. B. C.

Hystazarin, a new Dihydroxyanthraquinone. C. Liebermann. Ber. 21, 2501—2502.

OF the ten theoretically possible hydroxyanthraquinones eight are certainly known, viz., alizarin, quinizarin, xanthopurpurin, anthra-, and isoanthraflavinic acid, benzdihydroxyanthraquinone, anthrarufin, chrysazin. Lifschütz described a ninth (Ber. 17, 879). No positive evidence has been brought forward in favour of the tenth, reported by Rochleder (Ber. 3, 292), and called by him isoalizarin. None of the first nine isomers, at all events, correspond to the following:—



By heating pyrocatechol and phthalic anhydride with sulphuric acid, Baeyer and Caro (Ber. 7, 972) obtained alizarin—



and it seemed therefore probable to the author that the isomer in question might be formed at the same time. A repetition of the experiments of Baeyer and Caro showed that in addition to alizarin there was formed an isomer, easily separable from the alizarin by its insolubility in benzene, and, by reason of the method of synthesis, this isomer must have the above constitution given to it.

Its preparation settles the question whether the property of dihydroxyanthraquinone to form lakes with mordants depends on the proximity alone of the hydroxyl groups, or whether, in addition, they must be in the α-β position.

The new isomer does form lakes, but the property is so weak that it is evident the mere proximity of the hydroxyl groups is not in itself sufficient.

The isomer was named hystazarin, from ὕστερον (last), and alizarin.—T. L. B.

Hystazarin. A. Schoeller. Ber. 21, 2503—2505.

FIVE grms. pyrocatechol, 6·8 grms. phthalic anhydride, and 75 grms. concentrated sulphuric acid were heated together to 140°—145° on a sand-bath for about five hours. The mass becomes pink, then red, and finally dark brown. The resulting product is poured into water, and the whole boiled and filtered hot. The dark green precipitate is boiled with water, dissolved in dilute caustic potash solution, and precipitated warm with acid. Extraction with hot alcohol removes the alizarin and hystazarin, and separation of these is effected by means of benzene, in which hystazarin is insoluble.

The alizarin dyed exactly like pure alizarin, whereas the alizarin of Baeyer and Caro contained yellow, due to the hystazarin present.

The author confirmed the identity of his alizarin by converting it into the diacetyl-compound which melted at 178°—180°. Hystazarin, as obtained, was an orange-yellow body, soluble in hot alcohol, ether, glacial acetic acid, and acetone. It crystallises from glacial acetic acid in small needles. It is soluble in alkalis, forming a blue solution; ammonia dissolves it with a violet colour, and sulphuric acid blood-red. Barium hydrate gives a blue barium salt, and lime-water a violet calcium salt. An alcoholic solution gives with ferric chloride a green colouration, and precipitates metallic silver on boiling with silver solution.

Mordanted goods are only slightly dyed by hystazarin, and the shades differ from those of alizarin.

The diacetyl-compound melts at 205°—207°.—T. L. B.

Dichroïnes formed by the action of Aqua Regia and Nitrohydrobromic Acid on Phenols. H. Brunner and P. Chuit. Ber. **21**, 2479—2486.

Resorcinol and Aqua Regia.—Fifteen grms. resorcinol, 60 cc. water, 20 cc. nitric acid (sp. gr. 1·39), and 60 cc. hydrochloric acid (sp. gr. 1·2) were heated together with frequent agitation on a water-bath for half an hour. The liquid turns first red then violet; so soon as oily streaks of violet are apparent, the whole is poured into cold water, filtered and washed. In order conveniently to dry the mass obtained, it is evaporated on the water-bath with alcohol, then taken up with ether, and the ether distilled off. The colour forms a violet lustrous mass, insoluble in chloroform, benzene, and carbon disulphide, but soluble with yellow-brown colour in alcohol and ether, violet in water, blue with brown fluorescence in alkalis. Ammonium sulphide converts it into a leuco body, which on exposure to air turns red.

Analysis gives the formula as $C_{65}H_{48}ClN_2O_{18}$, monochlor-α-pentaresorcinol-dichroïne ether.

The reaction may be represented thus:—

$$11\ C_6H_4(OH)_2 + 3\ NOCl = 3\ HCl + 7\ H_2O + C_{66}H_{49}N_3O_{18}.$$

Nitrosodiresorcinol ether is formed—

$$(HO)C_6H_4.O.C_6H_3(OH)NO,$$

and two molecules of this act on four molecules of resorcinol, to form a body, which with α-resorcinol-dichroïne (Ber. **18**, 375) gives the colour. This shows the body to be a pentaresorcinol ether, whilst the acetyl derivative shows that it contains eight hydroxyl groups.

If in the preparation, concentrated *aqua regia* is used, a body is obtained, which dissolves in alkalis with a red colour and cinnabar-red fluorescence.

Resorcinol and Nitrohydrobromic Acid.—Fifteen grms. resorcinol were dissolved in 70 cc. water, and 60 cc. hydrobromic acid (sp. gr. 1·49), and 20 cc. nitric acid (sp. gr. 1·39) added. The whole was warmed on a water-bath with frequent agitation until a brown precipitate formed, and was then poured into cold water. The product obtained was monobrom-α-tetraresorcinol-dichroïne ether,

$$C_{48}H_{35}BrN_2O_{13},$$

the formation corresponding to that of the previous dichroïne. On washing with water and alcohol, then drying, extracting with benzene (which dissolves out a brown substance), dissolving in ether and evaporating off the latter, the pure substance is obtained as a brownish-violet mass with metallic lustre. It is readily soluble in alcohol and acetone with brown colouration, less soluble in ether, and almost insoluble in chloroform and benzene. It dissolves in hot water and in alkalis, with blue colouration and brown fluorescence. It dissolves also with a blue colouration in hydrochloric, sulphuric, and acetic acids.

Orcinol and Aqua Regia.—By heating on a water-bath 10 grms. orcinol, 10 cc. nitric acid, and 30 cc. hydrochloric acid of the same concentration as before, till rapid action sets in, and then pouring into water, monochlor-α-orcinol-dichroïne, $C_{21}H_{20}ClNO_6$, is obtained. This colour was first obtained by Reymann (Ber. **13**, 809), who considered it to be a chlorine derivative of Liebermann's orcinol colour, $C_{21}H_{18}N_2O_6$, to which the present author, however, gives the formula $C_{21}H_{21}NO_6$, with the designation α-orcinol-dichroïne (this Journal, 1888, 315).

The purification is performed by washing with water, dissolving in caustic soda or ammonia, and reprecipitating with hydrochloric acid. It forms a brown lustrous mass, soluble in alkalis and concentrated sulphuric acid with reddish-violet colour; the alcoholic solutions in alkalis show a brown fluorescence.

Orcinol and Nitrohydrobromic Acid.—Four grms. finely powdered orcinol were dissolved in hot water, and 10 cc. nitric acid (sp. gr. 1·39), and 30 cc. hydrobromic acid (sp. gr. 1·49) added, and the whole heated on a water-bath. As soon as evolution of bubbles of gas takes place, it is poured into water. After washing, the mass is dissolved in soda, evaporated to dryness, and the residue extracted with absolute alcohol.

The alcoholic solution is evaporated to dryness, taken up with water and the colour precipitated by hydrochloric acid. Of this, part only is soluble in ether, giving, after evaporation of the solvent, a red mass, soluble in alkalis with blood-red colour and fiery-red fluorescence. Analysis gives the formula $C_{48}H_{27}(CH_3)_8BrN_2O_{13}$, the monobrom-derivative of α-tetra-orcinol-dichroïne ether. The part insoluble in ether was not examined.

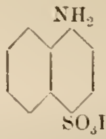
The residue insoluble in absolute alcohol was dissolved in water and precipitated with hydrochloric acid. This precipitate was partly soluble in alcohol; the soluble part being the monobrom-α-orcinol-dichroïne, $C_{21}H_{20}BrNO_6$, a brown powder soluble in alkalis with reddish-violet colour and brown fluorescence, and the insoluble part an oxychroïne, soluble in alkalis without fluorescence.

By the action of *aqua regia* and nitrohydrobromic acid on α- and β-naphthol, dichroïnes were not obtained. Thymol gave colours soluble with green colour in alkalis. Diphenylamine and phenol give with *aqua regia* at ordinary temperatures colouring-matters, but nitrohydrobromic acid does not give dichroïnes.—T. L. B.

A new α-Naphthylamine Mono-sulphonic Acid. R. Hirsch Ber. **21**, 2370—2373.

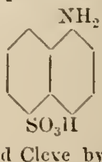
Some two years ago Witt (Ber. **19**, 55 and 578) established the individuality of the two following mono-sulphonic acids of α-napthylamine:—

(1.) *Naphthionic Acid*—



obtained by Piria by reduction of nitro-naphthalene with ammonium sulphide, by Schmidt and Schaal by the action of fuming sulphuric acid on α-naphthylamine, and by Witt by heating naphthylamine with five parts of sulphuric acid till the mixture was soluble in alkalis.

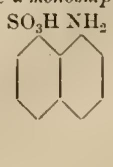
(2.) *Naphthalidine-sulphonic Acid*—



obtained by Laurent and Cleve by reduction of the nitronaphthalene-sulphonic acid, which forms the chief product when nitronaphthalene is acted on by sulphuric acid; obtained by Witt by the action of cold fuming sulphuric acid on the hydrochloride of α-naphthylamine.

The nitronaphthalene-sulphonic acid, whose reduction product is naphthalidine-sulphonic acid, may also be obtained by nitrating α-naphthalene-sulphonic acid, but in this case an isomeric nitronaphthalene-sulphonic acid is formed. Its discovery is due to Mensching. On reduction—

(3.) *α-naphthylamine-α-monosulphonic Acid*—



is formed (Schultz, Ber. **20**, 3161). By nitration of naphthalene-β-sulphonic acid Cleve has obtained several nitronaphthalene-sulphonic acids, which may be separated by conversion into the barium salts, which have different solubilities. Thus Cleve has obtained :—

(4.) *α-naphthylamine-β-monosulphonic Acid.*

(5.) *α-naphthylamine-δ-monosulphonic Acid.*

(6.) *α-naphthylamine-γ-monosulphonic Acid.*

The author has obtained the remaining isomer.

(7.) *α-naphthylamine-δ-monosulphonic acid* by the action of fairly concentrated sulphuric acid on naphthionic acid and naphthalidine sulphonic acid.

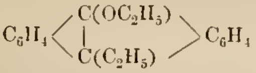
α-naphthylamine is heated for 8—9 hours to 125°—130° with five parts of concentrated (not fuming) sulphuric acid, and the whole poured into water. Conversion into the calcium salt is performed without waiting for the crystallisation of the acid. The filtered solution is evaporated until its sp. gr. is 1·12, and the hydrochloric acid necessary for conversion then added. In 36 hours the new acid is almost completely crystallised out. (If only so much hydrochloric acid is added as corresponds to the amount of naphthionic acid present, this latter separates out and may be removed.) The new acid may be separated from more easily soluble acids by carefully boiling with small quantities of water insufficient for the solution of the acid itself. After this, recrystallisation from water is a sufficient purification.

The α-naphthylamine-δ-monosulphonic acid crystallises in rhombic tablets, is soluble in 150 parts of boiling and 450 parts cold water, is less soluble in alcohol, and insoluble in ether and benzene.

The diazo-compound is prepared from a 1 per cent. solution of the sodium salt, and crystallises in three hours in amber-yellow quadratic tablets, which explode at 60°. The diazo-compound boiled with dilute nitric acid yields, in contradistinction to naphthionic acid, no sulphuric acid; a dinitronaphthol sulphonic acid is formed, of which the potassium salt is easily soluble, the barium salt difficultly soluble.—T. L. B.

Derivatives of Anthranol. F. Goldmann. Ber. **21**, 2505—2508.

In addition to the bodies, anthranol ether and diethylanthron, previously obtained, the product ethylanthranoethyl ether has been prepared. It possesses the constitutional formula—



$$C_6H_4\left\langle \begin{array}{c} C(OC_2H_5) \\ | \\ C(C_2H_5) \end{array} \right\rangle C_6H_4$$

and crystallises from dilute alcohol in fine needles, melting at about 77°. Its dilute solutions in benzene, ligroïn, and ether possess a blue fluorescence. The picric acid salt forms reddish-brown needles.

A reaction for the detection of anthranol, and one which distinctly shows its character as a phenol, is given by the author. Diazobenzene sulphonic acid suspended in water is added to a dilute alkaline solution of anthranol, when the whole becomes immediately deep blue. The pure colour may be obtained by converting into the lead salt, which is insoluble in water, and subsequently decomposing this by sulphuretted hydrogen. The colour forms a reddish-brown amorphous mass. It is easily soluble in water, forming an orange-coloured solution; alkalis dissolve it with a beautiful blue colour. From a weak acetic acid bath it dyes silk and wool orange. Other diazo-compounds give similarly, with anthranol, colouring-matters varying in shade from yellow to red.—T. L. B.

Fastness of Colouring-Matters fixed on Textile Fabrics. I. Joffre. Bull. Soc. Chim. **49**, 860.

The fastness of colouring-matters fixed on textile fabrics is not merely dependent upon the character of the dye, but also upon the amount of colour contained in the fibre. In making trials as to the comparative fugitiveness of dyes it is necessary to expose the various patterns to the sun for the same length of time. It is also shown that coloured goods are more readily affected by light in a moist atmosphere, a circumstance which explains the known fact that dyed fabrics lose their colour more quickly near the sea than inland.—D. B.

Oxidation of β-Naphthol to Orthocinnamiccarboxylic Acid. E. Ehrlich and R. Benedikt. Monatsh. Chem. **9**, 527—532.

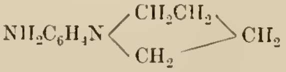
β-Naphthol yields orthocinnamiccarboxylic acid when oxidised with alkaline potassium permanganate. The process is best carried out as follows:—A solution of 50 grms. potassium permanganate in one litre of water is added, at first drop by drop and then in a fine stream, to a solution of 30 grms. β-naphthol and 30 grms. potash in one litre of water, the whole being well shaken. If the potassium permanganate is added sufficiently slowly no rise of temperature occurs, and the formation of resinous products is minimised. After standing for a short time the solution is filtered, dilute sulphuric acid is added to the filtrate as long as a violet or reddish flocculent precipitate is formed, and the precipitate, which consists of a colouring-matter and unchanged naphthol, is separated by filtration. Dilute sulphuric acid is added in excess, the solution extracted three or four times with ether, the latter evaporated until a white powder begins to separate, and the whole poured into a dish. The unchanged naphthol is dissolved out with anhydrous benzene and the residue washed with cold benzene. The yield is 6·5 per cent. of the naphthol employed. The pure compound melts at 183°—184°, is readily soluble in alcohol, ether, and boiling water, but almost insoluble in benzene and chloroform. When heated with sodium acetate and acetic anhydride it is readily converted into the anhydride of benzhydrylacetic-carboxylic acid (compare Gabriel and Michael, Ber. **10**, 2200).

The colouring-matter referred to above can be separated from the naphthol by extracting the dried precipitate with boiling benzene. It remains as a dark violet powder and constitutes about 10 per cent. of the naphthol employed. It is readily soluble in alcohol and glacial acetic acid, and dissolves in potash forming a bluish-green solution.

—F. S. K.

On the formation of Dyes from p Amidophenylpiperidine. E. Lellmann and W. Geller. Ber. **21**, 2287.

Para-amidophenylpiperidine



$$NH_2C_6H_4N\left\langle \begin{array}{c} CH_2CH_2 \\ CH_2 \end{array} \right\rangle CH_2$$

can be compared with amidodimethylaniline, $NH_2C_6H_4N(CH_3)_2$, and it reacts in a great many instances like this compound.

When oxidised with a primary, secondary, or tertiary aromatic amine, indamines are obtained varying from blue to green.

If meta-diamines are oxidised with it, bodies result, which can be precipitated by zinc chloride as a brown powder and which dye cotton blue.

They belong to the toluylene blue groups, and are easily decomposed by boiling their acid solutions; the metatoluylene product yields a red, the metaphenylene product a more violet dyestuff. Both are precipitated by zinc chloride.

Para amidophenylpiperidine and phenol yield, on oxidation with the theoretical quantity of potassium ferricyanide, a blue indophenol; naphthols produce more violet shades.

From the indamines before mentioned safranines can be obtained in the ordinary way. One molecule of amidophenylpiperidine oxidised with two molecules of aniline hydrochloride yields, after boiling, standing 24 hours, and neutralisation with chalk, a safranine dyeing bluish-red.

If a solution of the hydrochloric acid salt of this base, containing an excess of hydrochloric acid, is treated with sulphuretted hydrogen and ferric chloride, a blue solution is obtained, dyeing a little greener than methylene blue.
—A. L.

Thio-Derivatives of some Secondary and Tertiary Aromatic Amines. E. Holzmann. Ber. 21, 2056—2071.

The author has shown that chloride of sulphur acts upon dimethylaniline with the formation of a well-characterised monothiodimethylaniline, $S(C_6H_4N(CH_3)_2)_2$. The sulphur in this base is readily eliminated by nitrate of silver, and passes into monoxydimethylaniline, $(C_6H_4N(CH_3)_2)_2O$, which crystallises in colourless needles (m.p. 119°). It forms a platinum chloride and picric acid double salt. Diethylaniline and chloride of sulphur give monothiodiethylaniline, $S(C_6H_4N(C_2H_5)_2)_2$, which crystallises in yellow needles. It forms similar double salts to the dimethylaniline derivative, and reacts with silver nitrate to form oxydiethylaniline. Diphenylamine reacts with sulphur chloride to form dithiodiphenylamine, $S_2(C_6H_4)_2NH$, which crystallises in needles. Sulphur tetrachloride and diphenylamine yield the same thiodiphenylamine that Bernthsen obtained from diphenylamine and sulphur. By the action of sulphur tetrachloride dissolved in petroleum ether upon methyldiphenylamine, a yellow crystalline methylthiodiphenylamine is obtained. The compound obtained by Bernthsen from thiodiphenylamine, methyliodide and methylalcohol, does not agree in properties with this compound, and is probably an isomeric body. Methyldiphenylamine and sulphur do not yield a thio-derivative, but diphenylamine.—J. B. C.

Diazo-amido-Compounds. H. Goldschmidt and E. Molinari. Ber. 21, 2557—2579.

Goldschmidt and Holm published (Ber. 21, 1016) a method for determining the constitution of the mixed diazo-amido compounds. It consisted in converting the diazo-amido body into a diazo-urea by treatment with phenyl cyanate, and subsequently decomposing by boiling with an acid. There is obtained a di-substituted urea, to one nitrogen atom of which the phenyl group from the phenyl cyanate is attached, and to the other the radicle, which in the original diazo-amido body was connected with the imide residue. Thus from diazobenzenebenzylamine was obtained the diazo-urea—

$$C_6H_5NH.CO.N(N_2.C_6H_5)(CH_2.C_6H_5),$$

which gave benzylphenyl-urea—

$$C_6H_5NH.CO.NH(CH_2.C_6H_5).$$

The formation of the last-named product determines the formula of the diazo-urea, and shows the initial substance, the condensation product of diazobenzenechloride, to be really diazobenzenebenzylamine.

The same method proved insufficient in the case of amido bodies containing only purely aromatic radicles.

Diazoamidobenzenetoluene, obtained from diazobenzenechloride and *p*-toluidine, was boiled with phenyl cyanate with reversed condenser, but the constitution of the diazo-urea could not be definitely settled, as on boiling with acid the solid decomposition product proved to be a mixture of *p*-tolylphenyl-urea and diphenyl-urea. It would thus seem that two isomeric diazo-ureas were formed. During the boiling with acids, however, the odour of phenyl cyanate was noticed. Formation of phenyl acetate and heating of this with reversed condenser in presence of water would necessarily give rise to diphenyl-urea.

To make this point more clear the present authors have examined diazo-ureas formed from symmetrical diazo-amido bodies. Then they prepared diazo-ureas obtained from phenyl cyanate and mixed diazo-amido bodies, and by decomposition determined their constitution.

Of the symmetrical diazo-amido compounds diazo-amidobenzene with phenyl cyanate and with *p*-tolylcyanate, and *p*-diazoamidotoluene with the same were examined.

Diazoamidobenzenetoluene, as typical of the mixed compounds, was taken, and this when warmed in ethereal solution with phenyl cyanate gave a homogeneous product, yielding on decomposition *p*-tolylphenyl-urea. Thus of the two possible constitutions for this diazo-urea—

$$C_6H_5NH.CO.N(N_2.C_6H_5)(C_7H_7), \text{ or}$$
$$C_6H_5NH.CO.N(N_2.C_7H_7)(C_6H_5),$$

the first is the correct one, and at the same time it is shown that the two previously supposed isomers do not really exist.

The authors conclude that the diazo-amido bodies are perfectly homogeneous bodies, and cannot consist of two isomers, seeing that they have been found to give but one diazo-urea.—T. L. B.

PATENTS.

Improvements in the Manufacture of Alpha-naphtholdisulpho Acid and in the Production of Colouring-Matters therefrom. H. H. Lake, Southampton Buildings. From Wirth and Co., for A. Leonhardt and Co., Mühlheim-on-the-Main, Germany. Eng. Pat. 11,318, August 18, 1887. 6*d*.

The present invention has for its object the preparation of a pure disulphonic acid of α-naphthol, *i.e.*, one not contaminated with the mono- or trisulphonic acids as is usually the case when prepared by the methods formerly employed. For this purpose one part of α-naphthol is heated with 2—3 parts of ordinary hydrous sulphuric acid of commerce (65°—66° B.) to 125°—130° C. for about two hours. The disulphonic acid thus produced is soluble in strong sulphuric acid; it is not changed by boiling with dilute sulphuric acid, and its salts are readily soluble and hardly crystallisable. It yields azo-, nitroso-, and nitro-derivatives. The following examples illustrate the preparation of colouring-matters from the acid:—(1.) An acid solution of the acid or its salts is treated with sodium nitrite as long as nitrous acid is absorbed. The nitroso acid is then nitrated by means of nitric acid at 50° C., and converted into a potassium salt. (2.) The sodium salt of the acid is acted upon by the necessary quantity of diazoxylene-chloride and the product precipitated by acid and common salt. The colouring-matter is orange. Similarly diazotised naphthionic acid, amidoazobenzene, and amidoazotoluene give reds; diazotised benzidine, diamidostilbene, and its disulphonic acids give violet colouring-matters.—R. M.

A new Class of Diamido-Compounds and Azo-Colours produced therefrom and the Process of producing the same. G. Pitt, Sutton, Surrey. From A. Weinberg, Frankfort-on-the-Main, Germany. Eng. Pat. 14,464, October 24, 1887. 6*d*.

The new bases described in this specification are prepared in the following manner:—Diazobenzene and its homologues can be combined with phenol-parasulphonic acid to form azo-derivatives in which the azo-group enters the ortho-position with respect to the hydroxyl-group. The salts of these azo-compounds are then alkylated in the usual way. The two following examples illustrate this part of the process:—(1.) Benzeneazo-paraphenolsulphonate of sodium is boiled in alcoholic solution with the necessary quantity of sodium hydroxide and ethyl bromide or benzyl chloride so as to form the ethyl or benzyl ether. (2.) Orthotoluenazo-paraphenolsulphonate of sodium is mixed with the necessary quantity of sodium hydroxide and sodium-methyl sulphate and heated to 110°.

The alkyl-ethers formed in accordance with the foregoing methods are purified and then reduced, when they give rise to sulphonic acids of alkyloxydiphenyl bases. Thus benzeneazophenetoïlsulphonate of sodium on reduction by tin and hydrochloric acid gives ethoxybenzidinemonosulphonic acid—

$$NH_2.C_6H_4.C_6H_2(OC_2H_5)(HSO_3)(NH_2).$$

A similar benzyl derivative is obtained by reducing the corresponding benzeneazobenzyl-compound. The sulphonic acids of the diamines formed by the foregoing process can be hydrolysed by heating them with water to a high temperature (170°) under pressure—

$$NH_2.C_6H_4.C_6H_2(OR')(NH_2)(HSO_3) + H_2O =$$

$$NH_2.C_6H_4.C_6H_3(OR')(NH_2) + H_2SO_4.$$

The following examples illustrate the production of azo-colours from the new diamines :—(*a.*) Yellow dyestuffs: (1.) Ethoxybenzidine is diazotised and combined with two molecules of sodium salicylate. (2.) Methoxybenzidine is diazotised and combined with one molecule of salicylic acid and one molecule of phenol. (*b.*) Red dyestuffs: (1.) Diamidomethoxyphenyltolyl is diazotised and combined with two molecules of β-naphthylaminemonosulphonic acid F. (2.) Diazotised ethoxybenzidine is combined with one molecule of naphthionic acid and one molecule of α-naphthylamine. (*c.*) Orange-red dyestuffs: (1.) Diamidoethoxyphenyltolyl is diazotised and combined with one molecule of naphthionic acid and one molecule of phenol. (*d.*) Blue dyestuffs: (1.) The diamine of the last example is diazotised and combined with two molecules of α-naphthol. (2.) The same tetrazo-compound is combined with one molecule of β-naphtholdisulphonic acid (R. salt) and one molecule of α-naphtholmonosulphonic acid. (*e.*) Violet dyestuffs: (1.) Ethoxybenzidine is diazotised and combined with one molecule of amidobenzenesulphonic acid and one molecule of β-naphthol-β-sulphonic acid. (2.) The same tetrazo-compound is combined with one molecule of naphthionic acid and one molecule of α-naphthol-α-monosulphonic acid. —R. M.

Production of Yellow, Red, and Violet Colouring-Matters from Tetrazodiphenyl and Tetrazoditolyl. C. D. Abel, Southampton Buildings, Chancery Lane. From G. C. Zimmer, Mannheim, Germany. Eng. Pat. 15,154, November 7, 1887. 6*d*.

These colouring-matters are produced by combining the tetrazo-salts of benzidine or tolidine with the sulphonic acids of mono-ethylaniline or diphenylamine. The following colouring-matters are described as examples illustrating the mode of working :—(1.) One molecule of diazotised benzidine + two molecules of mono-ethylaniline-sulphonic acid. (2.) One mol. of diazotised benzidine + two mols. of diphenylamine-sulphonic acid. (3.) One mol. of diazotised benzidine + one mol. of diphenylamine-sulphonic acid + one mol. ethylaniline-sulphonic acid. (4.) One mol. of diazotised benzidine + one mol. diphenylamine-sulphonic acid + one mol. phenol. (5.) One mol. diazotised benzidine + one mol. diphenylamine-sulphonic acid + one mol. cresol. All these are dyestuffs of various shades of yellow. (6.) One mol. tetrazodiphenyl + one mol. diphenylamine-sulphonic acid + one mol. resorcinol yield a compound which dyes cotton an orange-red. (7.) One mol. tetrazodiphenyl + one mol. diphenylamine-sulphonic acid + one mol. salicylic acid; orange-yellow. (8.) One mol. tetrazodiphenyl + one mol. ethylaniline-sulphonic acid + one mol. naphthionic acid; yellowish red. (9.) The same as preceding with diphenylamine instead of ethylaniline-sulphonic acid; redder than preceding. (10.) Same as last with diazotised tolidine instead of benzidine; bluish red. (11.) One mol. tetrazoditolyl + one mol. diphenylamine-sulphonic acid + one mol. β-naphtholsulphonic acid, Schäffer; violet red. (12.) Same as last, with tolidine, diphenylamine-sulphonic acid and α-naphthol-α-sulphonic acid. (13.) One mol. tetrazo-diphenyl + one mol. diphenylamine-sulphonic acid + one mol. β-naphtholdi-sulphonic acid; reddish violet.—R. M.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

PATENT.

Process for Separating Chlorine from Gas Mixtures. C. Heinzerling, Zurich. Eng. Pat. 13,647, October 8, 1887. 4*d*.

Gas mixtures containing chlorine are passed through cooled water or cooled aqueous solutions, whereby the chlorine is retained in the form of a crystalline substance, having the composition $Cl_2 + 10 H_2O$, and containing about 27·7 per cent. of chlorine. From this hydrate the chlorine can be liberated by heating or by mixing the hydrate with warm water. The first process is suitable, when the chlorine is to be used for the production of bleaching powder, and so forth, whereas the second process is employed for producing an aqueous solution of chlorine gas for use in primary chlorine gas batteries.—S. H.

VII.—ACIDS, ALKALIS, AND SALTS.

PATENTS.

Processes for Obtaining Nitrates, Chromates, Manganates, Permanganates, and Arseniates. C. Huggenberg, Chemnitz, Germany. Eng. Pat. 13,695, October 10, 1887. 6*d*.

Manganic peroxide, chromic oxide, or arsenious oxide is fused with a base and sufficient alkaline nitrate to produce alkaline nitrite and a manganate, chromate, or arseniate as the case may be. The base employed is preferably one which yields an insoluble compound, so that the nitrite and undecomposed nitrate may be removed by lixiviation. These two last are separated by crystallisation. Supposing barium manganate to have been produced in the above manner, it may be utilised for the production of alkaline permanganate by boiling with a solution of alkaline carbonate, and at the same time passing a current of carbonic acid through the mixture. Alkaline permanganate is formed, and there is deposited manganic peroxide mixed with barium carbonate.—A. R. D.

Improvements in the Manufacture of Sulphate of Soda, and in Apparatus therefor. D. Herman, St. Helens. Eng. Pat. 13,983, October 15, 1887. 8*d*.

The object of this invention is the production of sodium sulphate free from iron. Commercial salt-cake is dissolved in water, the iron oxidised by bleaching powder and precipitated by an alkali, and the clear filtrate concentrated in pans, agitated by mechanical agitators. Under these circumstances small anhydrous crystals of sodium sulphate are deposited, which are fished out, and after drying by hydro-extractors, are especially suitable for the manufacture of glass, owing to their finely granular condition. The accompanying drawings represent the apparatus employed. Figs. 1 and 2 are vertical sections at right angles to each other, and Fig. 3 is a plan, part being in section. 1 is a metal boiling-down pan; 3 are air spaces and openings to prevent the pan from becoming too highly heated, and to allow of access for cleaning; 4 is the furnace, and 5 a flue over the surface of the liquor in the pan. Inside the pan there is an endless chain 7, carried on pulleys 8, and provided with dredging boards 9. The driving pulley 8^a is carried on oscillating bearings. 10 is a shoot and 11 a hydro-extractor. The crystals as salted out in the pan are quickly removed by the dredgers, and continuously delivered down the shoot into the hydro-extractor. Whenever it is wished to remove the dried crystals from the extractor, the pulley 8^a is raised to the position shown by the dotted lines, and the extractor is arrested. The raising of the pulley at

Fig. 1.

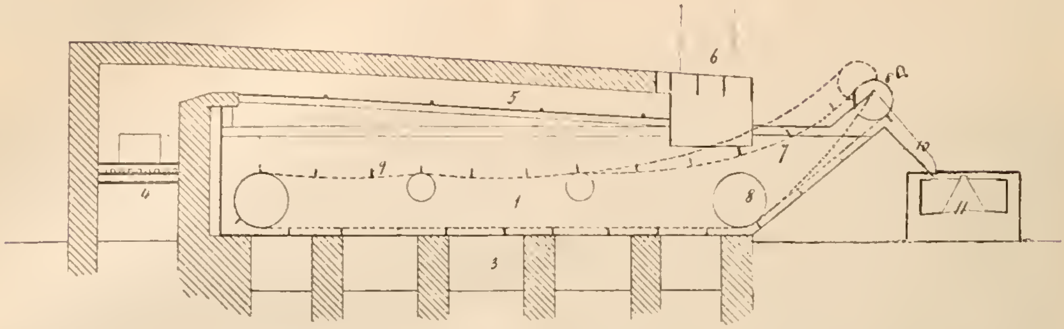


Fig. 2.

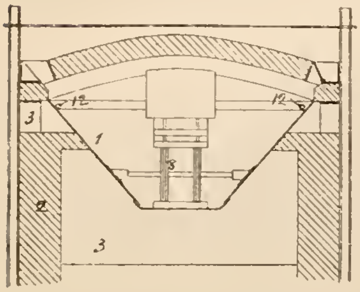


Fig. 5.

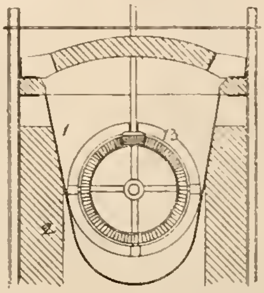


Fig. 6.

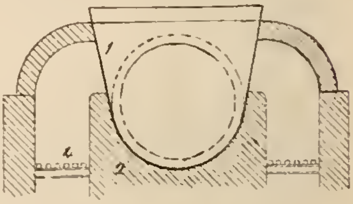


Fig. 3.

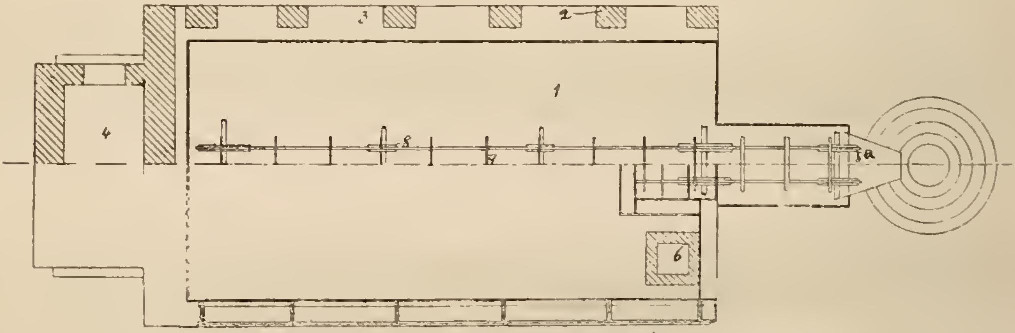
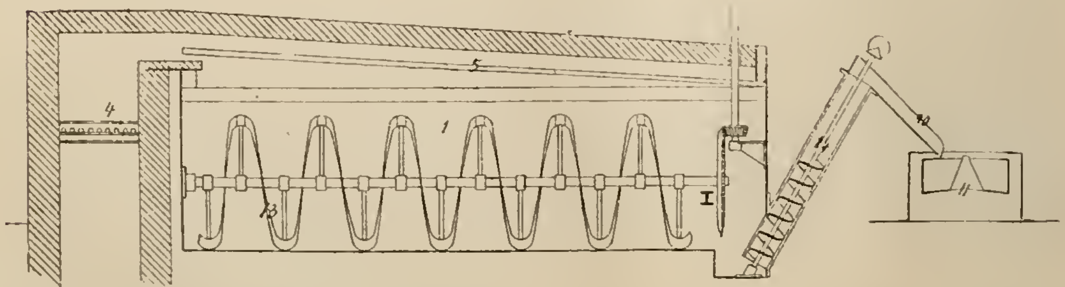


Fig. 4.



once arrests the delivery of the crystals into the shoot. Figs. 4 and 5 show a modified construction of the apparatus. Here an endless worm 13 is used to cause the precipitated crystals to travel from one end of the pan to the other, and a worm elevator 14 is employed to remove the crystals from the pan into the hydro-extractor. Fig. 6 is a transverse section of a pan, in which the products of combustion do not come into contact with the liquor to be concentrated. Thus discolouration of the crystals is avoided. The fineness of the crystals is regulated by the rapidity of concentration and the amount of agitation.—S. H.

Improvements in the Manufacture of Ammonia and Hydrochloric Acid, and in the Apparatus employed therein. F. Bale, Droitwich. Eng. Pat. 14,000, October 15, 1887. 6*d.*

Similar to Eng. Pat. 14,001, 1887 (this Journal, 1888, 629).—S. H.

Improvements in the Manufacture of Hydrate of Baryta and of Strontia. The Tyne Alkali Co., Ltd., Newcastle-on-Tyne, and T. Gibb, South Shields. Eng. Pat. 14,345, October 21, 1887. 4*d.*

Barium or strontium sulphide is mixed with powdered hydrated iron peroxide (bog-iron ore). The mixture is treated with hot water, whereby barium or strontium hydrate is formed. The hot solution is then run into crystallising vessels, where crystals of barium or strontium hydrate are deposited.—S. H.

Improvements in the Treatment of Solutions containing Barium or Strontium Compounds, and the Obtainment of Products therefrom. The Tyne Alkali Co., Ltd., Newcastle-on-Tyne, and T. Gibb, South Shields. Eng. Pat. 14,345A, October 21, 1887. 6*d.*

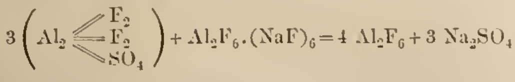
Solutions containing barium or strontium sulphide are subjected to the action of air or air and steam, whereby a precipitate of barium or strontiom hyposulphite is formed. This method of proceeding may be generally applied to the separation of barium or strontium polysulphides from their hydrate. After separating the precipitate of hyposulphite, barium or strontium hydrate is obtained by concentration and subsequent crystallisation. The precipitate of the hyposulphite may be utilised instead of the sulphate for the production of crude sulphide, or it may be decomposed with an alkaline salt in solution, producing thereby an alkaline hyposulphite and the corresponding salt of barium or strontium, or it may be decomposed by an acid, whereby a salt of barium or strontium is obtained along with sulphur and sulphur dioxide.—S. H.

Improvements relating to the Production of Fluoride of Aluminium. L. Grabau, Hanover, Germany. Eng. Pat. 14,356, October 21, 1887. 6*d.*

A solution of aluminium sulphate is heated with natural or artificial cryolite in quantity according to the equation—

$$Al_2(SO_4)_3 + Al_2F_6.(NaF)_6 = 2\ Al_2F_6 + 3\ Na_2SO_4$$

The clear solution is evaporated to dryness and the residue heated. On lixiviation the sodium sulphate is washed out and aluminium fluoride left behind. Instead of aluminium sulphate, may be used a solution of "aluminium fluorine sulphate," $Al_2F_4SO_4$, obtained by heating a solution of aluminium sulphate with powdered fluorspar to 90° C. In this case the equation becomes—



$$3\left(Al_2\begin{matrix}F_2\\F_2\\SO_4\end{matrix}\right) + Al_2F_6.(NaF)_6 = 4\ Al_2F_6 + 3\ Na_2SO_4$$

As the by-product obtained in the ordinary method of extracting aluminium from aluminium fluoride by means of an alkali metal has a composition closely approaching that of cryolite, it is evident that the present improvements effect a great economy in this manufacture.—A. R. D.

Improvements in Apparatuses for the Production of Phosphorus Trichloride. C. Fahlberg, Selbke-Westerhüsen, Prussia. Eng. Pat. 14,906, November 2, 1887. 8*d.*

The manufacture of phosphorus trichloride, by causing gaseous chlorine to act upon phosphorus, has hitherto been carried on in vessels of glass or earthenware because of the corrosive action of chlorine upon metals. Moreover, to diminish the violence of the action, it has been found necessary to use the more expensive red or amorphous phosphorus. The patentee has discovered that so long as an excess of phosphorus is maintained, any metals present are unacted upon. He is accordingly able to carry on the process in metal retorts, and to use ordinary yellow phosphorus. The retort is steam-jacketed and provided with the requisite openings for the admission of chlorine and the exit of the phosphorus trichloride A vessel above contains phosphorus kept melted under water by means of a steam coil. A regulating valve controls the flow of phosphorus from this vessel to the retort according to the indications yielded by sight glasses suitably disposed.
—A. R. D.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Plaster of Paris. H. Le Chatelier. Ann. des Mines, 1887, 346—365.

The authors experiments with gypsum and plaster of Paris lead him to conclude that the dehydration of gypsum by heat takes place in two stages, the first at about 120°—130°, resulting in the production of a compound $2\ CaSO_4, H_2O$ (identical with plaster of Paris); the second at about 160°—170°, which completes the dehydration of the gypsum. These decompositions proceed independent of pressure, but are quicker or slower according as the temperature is higher or lower. The compound, $2\ CaSO_4 + H_2O$, may be obtained in very long and very thin rectangular prisms by heating a saturated solution of calcium sulphate to 130°—150° in a sealed tube. It takes up water rapidly below 130°; therefore the tube is opened while hot, and the moist contents thrown into absolute alcohol, pressed and dried at 100°. The incrustation formed in boilers fed with sea-water is an impure form of this compound, and, in fact, behaves like half-burnt gypsum; its temperature of dehydration is 160°—170°, and when finely powdered and mixed with water it sets like plaster, but of course only incompletely owing to the impurities mixed with it. In the manufacture of plaster of Paris the burning of the gypsum does not go beyond the first stage, hence plaster of Paris must also be regarded as the compound $2\ CaSO_4 + H_2O$. When mixed with water this salt takes up the necessary water immediately, forming the normal salt, gypsum, which dissolves and soon forms a supersaturated solution, causing sudden crystallisation, resulting in the production of spherulites of gypsum. The water set free by the crystallisation is available to attack a fresh quantity of plaster. These phenomena of hydration, supersaturation, and crystallisation, go on simultaneously in different parts of the mass, and continue until all the plaster is converted into gypsum. These changes can be followed under the microscope. The author is of opinion that it is by reason of these changes that the plaster hardens. The peculiar form of crystallisation, very long fine prisms grouped in spherical aggregations round a central point, allowing of a maximum adhesive surface to each crystalline particle besides favouring extensive intermingling and interlacing, thus presenting the very conditions for the production of a solid mass. Experimental evidence with fused sodium sulphate is adduced, by which it is shown that the setting of a substance by mixing with water may take place at a certain distance from the mass of the substance, and the idea of supersaturation and crystallisation is supported. The setting of all stone cements, whether they set by mere hydration or by the decomposition of some compound by means of water, may, according to the author, be attributed to a similar series of phenomena. It is, moreover, shown that the more soluble a subtance is in water the quicker is the progress of the hardening. Thus plaster sets quicker and is more soluble than calcium aluminate, and the latter sets quicker than the less soluble calcium silicate. Hence, mixing plaster with substances increasing the solubility of calcium sulphate in water, causes it to set quicker when mixed with water, and *vice versâ*.—D. A. L.

Barium Cements. H. Le Chatelier. Ann. des Mines, 1887, 365—373.

The author has studied these substances from a point of theoretical rather than practical interest. Barium silicate, $BaSiO_3$, prepared by fusing together the proper proportions of barium oxide and silica, forms a crystalline mass which in section under the microscope exhibits an entanglement of long prismatic crystals well defined with slight double refraction and easy cleavage. The silicate, Ba_2SiO_4, prepared in a similar manner, agglomerates without fusing, forming a porous mass, which, under the microscope, shows only a confused crystallisation. The author could only obtain one hydrated barium silicate, $BaSiO_3, 6\,H_2O$; this was prepared by mixing solutions of barium hydroxide and sodium silicate, or colloid silica; it forms, at first, a bulky, voluminous, and seemingly amorphous mass of the salt, which is, however, in an unstable form, and by a process of re-solution and re-crystallisation, gradually changes to the stable condition, and, at the end of 24 hours, has assumed the form of tabular crystals. This silicate is identical with the crystals frequently formed in glass bottles containing baryta-water, the silica in such cases being derived from the glass. This silicate is decomposed by water.

The silicates, $BaSiO_3$, Ba_2SiO_4, and a mixture of silica and barium hydrate, harden when finely pulverised and quenched with water. But the setting in all three cases is due to the formation, solution, crystallisation, &c. of the same hydrated silicate, $BaSiO_3, 6\,H_2O$, in the first case by direct hydration, in the second by decomposition of the more basic silicate and the elimination of baryta, whilst in the third case the change is produced by direct combination, as illustrated by the equations—

$$Ba_2SiO_4 + 15\,H_2O = BaSiO_3, 6\,H_2O + BaO, 9\,H_2O;$$

$$SiO_2 + BaO, 9\,H_2O = BaSiO_3, 6\,H_2O + 3\,H_2O.$$

—D. A. L.

Atmospheric Mortars. H. Le Chatelier. Ann. des Mines, 1887, 373—374.

Atmospheric mortars are those mixtures of sand and slaked lime which harden in the air, as compared with hydraulic cements, which harden under water. Mixtures of the former harden by drying in the first instance and afterwards by carbonation or absorption of carbonic anhydride from the air; the carbonation is, however, only superficial, and takes place slowly. The sand in these mixtures plays the same *rôle* as it does in bricks; it forms a framework which prevents the mortar from cracking during drying. When wetted, the dry mortars crumble and lose consistency; the carbonation renders them more capable of resisting rain.—D. A. L.

PATENTS.

Improvements in the Manufacture of Cement. J. Hargreaves, Widnes. Eng. Pat. 13,180, September 29, 1887. 4*d*.

Coal mine or other clay is mixed in the wet state with carbonate of lime, prepared by passing carbonic acid gas through alkali waste. The mixture is made into bricks or blocks and burnt.—E. G. C.

Improvements in Lime Kilns. E. Solvay, Brussels. Eng. Pat. 13,322, October 1, 1887. 8*d*.

The accompanying drawings show the construction of the lime kiln, the novel features of which are, that it is worked by a blast of air, and is fitted with an arrangement for mechanically removing the charge. The bottom of the kiln is perfectly closed, and the air necessary for combustion is forced in through the pipe T, which opens into a chamber at the bottom. The walls of the kiln are made vertical at their lower part so as to present no obstruction to the regular fall of the material. The discharging mechanism

Fig. 1.

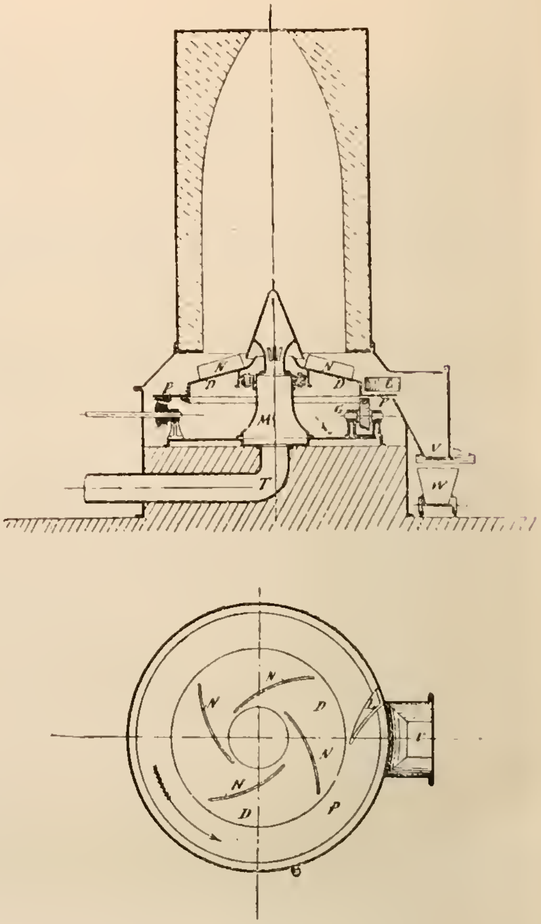
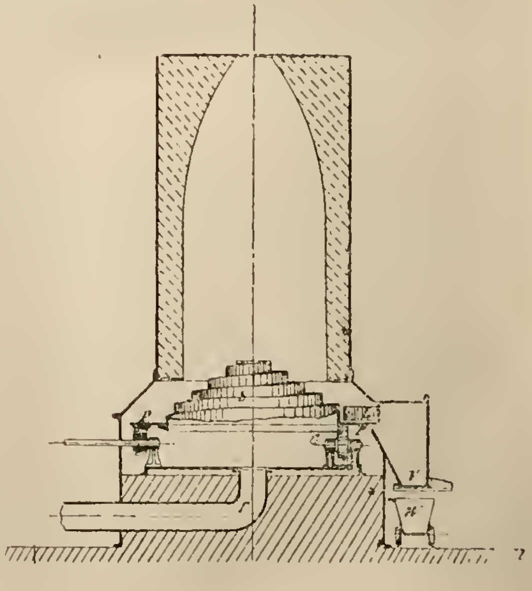
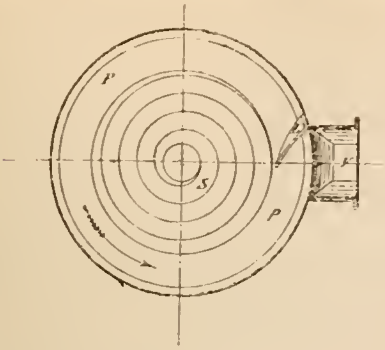


Fig. 2.





consists of a central part M and an annular part D. The central part rests on the ground and is of a conical shape. It is placed in the axis of the kiln, and the air-pipe T is embedded in it. Beneath the conical part is placed an annular part or disc I, mounted on rollers G, upon which bears the charge of the kiln. The disc, which is either slightly inclined or horizontal, is provided with ribs N, running obliquely from the circumference towards the centre. By the rotation of the disc and the action of the ribs, the lime is evenly thrown over its whole periphery. An annular projection P, cast to the disc and rotating with it, forms a lower step to the plate, and the lime finally falls upon this projection. The central cone need not be stationary, but it may be made to rotate. In this case the cone and disc are replaced by a single spiral part S (Fig. 2), forming a continuous incline. The lime carried away by the circular motion is stopped by a vertical fixed blade L, arranged obliquely to the radius of the disc. The lime then falls into a recess, where, by means of a sliding door V, it can be emptied into waggons. The limestone is charged in at the top of the kiln by means of an elevator with buckets. The kiln is thus entirely mechanical and continuous in its work.—S. H.

Improvements relating to the Treatment of Blast-Furnace Slag for the Manufacture therefrom of Hydraulic or similar Cement. T. C. Hutchinson, Middlesbro'-on-Tees. Eng. Pat. 13,534, October 6, 1887. 6*d.*

This invention has reference to the disintegration of blast-furnace slag by immersion in water, the operation being so effected that the slag floats to the surface of the water, and can be removed therefrom before the initial heat is expended.—E. G. C.

The Manufacture of a Light Elastic Fire-resisting Material applicable as a Substitute for Cork. E. Langen, Hanover, Prussia. Eng. Pat. 9000, June 19, 1888. 6*d.*

The pith of maize or other similar plants is powdered and intimately mixed with some adhesive material such as potato starch. The mass is rendered elastic by the addition of linseed oil or tar and fireproof by the addition of water glass, tungstate of soda, &c. The mixture is finally dried. —E. E. B.

Improvements in and connected with the Manufacture of Cements. G. J. Snelus, Workington; T. Gibb, Jarrow; J. C. Swan, Newcastle-on-Tyne; H. Smith, Newcastle-on-Tyne; and N. Whamond, Jarrow. Eng. Pat. 10,312, July 16, 1888. 4*d.*

Granulated blast furnace slag is partially dried by passing it on a continuous band between rollers, and then calcined. The calcined slag is ground together with a frit, composed essentially of lime and alumina, made by burning a mixture of aluminous ore and lime, or rich aluminous clay and lime. —E. G. C.

X.—METALLURGY, MINING, Etc.

Report of Committee of the Franklin Institute on A. E. Outerbridge's Method of Carbonising Fabrics and of obtaining Castings therefrom in Metal. Journ. Franklin Institute [3], **94**, 389.

This invention consists essentially in the preparation of organic textile fabrics, such as cloth and lace, and the natural organic structures of ferns, grasses, and the leaves of plants so that they can be exposed to very high heats without causing a disturbance of their form by destructive distillation.

The material which has been subjected to this process becomes capable of resisting the action of the heat from molten cast iron, and may be used as a part of the surface or facing of a mould for the purpose of producing an intaglio impression of the material in cast iron or other metal, and which casting can be employed, in the manner of a die, for the purpose of reproducing the design or figure upon leather, wood, or metal.

The material to be used as a pattern or mould is first dusted with finely-powdered carbon, and then packed in finely-ground carbon within a refractory case made of cast iron, graphite, clay, or other suitable material. This case is fitted with a lid sufficiently close to prevent such free access of air as would allow of combustion, but which is loose enough to permit the escape of the vapours and gases which are given off in the subsequent heating. The case and contents are then placed in an oven and subjected to a temperature of about 300° F. for several hours, until the escape of volatile matters from the case has ceased. The case is then removed from the oven, placed in a suitable furnace, and the temperature gradually raised to and kept at a glowing heat for about two hours, after which it is removed from the fire and cooled. When the contents are taken out of the box they are shaken in order to remove the carbon with which they were dusted and packed. They are then tested by heating to a white heat in a blow-pipe flame, and if combustion ceases upon their removal from the flame, the operation of carbonisation has been properly conducted and they are suitable for use. The change in the properties of the carbonaceous residue from fabrics, by which it resists the action of highly heated metal, similarly with graphite or graphitic carbon, permits the use of woven or natural fabrics as moulds for the cheap reproduction in metal of designs which could not otherwise be made except at enormous expense for engraving. The method of using the prepared fabric is very simple. When it is desired to pour the metal over it, the ends of the material are fastened down, either by the edges of the flask or by pinning, and the gates arranged so that the metal shall flow over and not fall upon it. When the side of the block of metal is to receive the impression, the fabric is secured at the lower edge, and it is floated against the side by the inflowing metal. The application in the arts of this invention is at present limited to the cheap production of elaborate designs for the ornamentation of castings, or for the production of dies for embossing leather, paper, or metallic surfaces, and also for the easy parting or dividing of metal in casting; but new fields of application will undoubtedly be opened when the method is brought into more general use.

The committee recommend that an award for meritorious invention be given to the inventor.—G. H. B.

PATENTS.

Treating the Residual Spent Iron Liquors resulting from the Manufacture of Copper from Burnt Cupreous Sulphur Ores to obtain a certain Oxide of Iron therefrom, and Apparatus to be used therefor. H. Bird, Devonport. Eng. Pat. 12,458, September 14, 1887. 8*d.*

Spent iron liquor from copper extraction is precipitated with milk of lime, filtered, and washed. The hydrated oxide of iron so produced is dried, mixed with sawdust, tan-waste, or other like material, and is oxidised into

peroxide, by exposure to air upon a floor protected from the weather. By this means "gas oxide" is produced. The sulphate of lime present can be avoided by first treating the iron liquor with calcium chloride, afterwards subjecting the ferrous chloride solution to the treatment above described.
—A. W.

Improvements in obtaining Gold and Silver from Ores and other Compounds. J. S. MacArthur, Pollokshields, N.B., R. W. and W. Forrest, both of Glasgow. Eng. Pat. 14,174, October 19, 1887. 6*d.*

This patent relates to the use of a dilute solution of cyanogen or any cyanide to dissolve gold and silver from their ores. The metals are afterwards precipitated by zinc or other means and the cyanogen regenerated.—A. W.

Improvements in the Wet Method of extracting Gold from Crushed Ores or other finely-divided Auriferous Material. J. H. Pollok, Glasgow. Eng. Pat. 17,495, December 20, 1887. 11*d.*

The claim in this specification is the application of the production of pressure by hydraulic means to processes where the extraction of gold by chlorine is carried on under pressure. The finely-crushed and, if necessary, roasted ore is introduced with chloride of lime and sulphuric acid into a cylinder, which is then closed, and water forced in until the pressure has reached 100 lbs. per square inch. The whole is revolved for some time, the pressure relieved, and the charge withdrawn and treated in the usual manner. Drawings of apparatus recommended are given, a convenient size for the cylinder being 42 cubic feet capacity. In this, one ton of ore can be operated upon, and 25 cubic feet of water will have been pumped in to produce the above pressure.
—A. W.

Improvements relating to the Extraction of Metals from Refractory, Complex, and other Ores. H. R. Lewis, London, and C. B. Phillips, Chester. Eng. Pat. 421, January 10, 1888. 11*d.*

The special feature of this invention is the use of the ordinary iron blast furnace for the extraction of gold and silver from their ores simultaneously with the production of pig-iron, ferro-manganese, chrome or tungsten iron. The object is to have present in the charge a sufficient quantity of lead, a due proportion of iron to manganese, a suitable flux and the right amount of fuel, so that after working through the furnace there shall be produced an auriferous and argentiferous lead, ferro-manganese, and a fusible slag. The proportions are of necessity regulated entirely by the composition of the individual materials used. Several instances of charges are given in the specification.

Manganiferous iron ores, or mixtures of manganese and iron ores, are used, and galena is added if necessary.

In refractory ores containing sulphur, arsenic, zinc, or antimony in small quantity, it is found that these substances burn off at the upper portion of the furnace. If much of these elements are present, however, the ore must be roasted in the ordinary way or calcined with salt, previous to making up the charge. Any kind of ore of however refractory a nature can be treated by this process, and it is even claimed as suitable for Anglesea "bluestone" and auriferous tellurides.

Any kind of blast furnace can be used provided suitable arrangements are made in the crucible part for tapping the separate layers of material, but drawings are given of two forms which are recommended. The bottom layer of lead, the ferro-manganese, and the slag are each run off separately by tap holes at different elevations. To prevent loss by percolation of the lead through the bricks, it is recommended to make the crucible of one piece or block of Stourbridge or ganister clay, and to encase it in iron.—A. W.

An Improved Process of Extracting pure Zinc from Zinciferous Ores. C. F. Croselmire, New Jersey, U.S.A. Eng. Pat. 4286, March 20, 1888. 6*d.*

The ore is finely pulverised, roasted in a reverberatory furnace with either a blast or jet of steam, to convert the blende into sulphate, and extracted with a known quantity of dilute sulphuric acid—one equivalent of acid for each equivalent of zinc found in the ore. All the zinc enters solution, together with some iron and manganese. The two latter are precipitated by blowing air through the solution, which when clear is drawn off and the zinc electrolytically deposited, or precipitated and smelted by the usual methods. A pure variety of zinc is said to be obtained by this process. If silver is present it is found in the residue after extraction, free from zinc, and can be readily smelted.—A. W.

New Process for Extracting Zinc from Pyrites containing Blende, the Waste of the Same, and from any other Ores containing Sulphide of Zinc. J. Perino, Charlottenburg, Germany. Eng. Pat. 10,657, July 23, 1888. 4*d.*

Blende or any residue containing the same is intimately mixed with nitrate of iron, about five parts of the latter for every one part of zinc present, and heated in clay retorts, gradually, to a temperature of 150° or 200° C. A pure solution of sulphate of zinc is then obtained by lixiviating the mass with water. The nitrous fumes produced are absorbed in water, which is then used for redissolving the oxide of iron. If any oxide of zinc is formed it remains in the residue after lixiviation, and is dissolved by the nitric acid. The nitrate of iron thus becomes more and more impregnated with nitrate of zinc. This is remedied by occasionally adding oxide of zinc to precipitate the iron, afterwards igniting the nitrate of zinc to oxide, and again utilising the nitrous fumes. The metal is obtained by any known method.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in Electrical Batteries. R. P. Milburn, Newcastle-on-Tyne. Eng. Pat. 10,611, August 2, 1887. 6*d.*

This invention consists in the use, as exciting liquids, of a mixture of bichromate of potash, sulphuric acid and water, with the zinc and nitric acid or nitric acid and bichromate of potash with the carbon. The battery may be of any known construction, or the carbon itself may be made to form the outer shell if glazed or otherwise rendered impervious on the outside; or the outer shell may be of metal.—E. T.

Improvements in Secondary Batteries or Electrical Accumulators. N. de Benardos, St. Petersburg, Russia. Eng. Pat. 14,024, October 15, 1887. 8*d.*

The plates consist of a framework of lead divided by a number of vertical strips of thin lead into narrow rectangular spaces, of the depth of the plate. These are filled by strips of thin lead corrugated so as to zigzag from top to bottom, each bend of the zigzag touching one or other of the boundary straight strips. The spaces in the corrugations may either be left vacant or be filled with spongy lead or litharge. Vertical lugs from the top corners of the frames have horizontal projections which rest on the sides of the cell and thus support the plates, which are, moreover, separated from each other by india-rubber plugs at the corners of the frames.—E. T.

Improvements in Apparatus to be used in the Deposition or Treatment of Metals by the Electrolytic Process. W. Terrill, Swansea. Eng. Pat. 14,954, November 2, 1887. 6*d.*

It is usual to allow the liquid from one bath to flow over a projecting lip into the next; leakage, and, therefore, waste, of current takes place in consequence. The inventor, to remedy this, connects the two tanks by a siphon of moderately small bore and sufficient length to offer a considerable electrical resistance, and at the same time allow the liquid to flow at a sufficient rate; such, for example, as a siphon 2 ft. high and ⅜-in. bore.—E. T.

Improvements in Voltaic or Galvanic Batteries. T. Coad, London. Eng. Pat. 713, January 17, 1888. 8*d.*

This invention relates to improved means of coupling one cell to another. In a case of cells the partition between each two is perforated near the top for a platinum peg, against the ends of which the carbon of one cell and the zinc of the next are pressed by wedges of suitable material driven in between the zinc and carbon electrodes of each cell. Instead of by wedges, the electrodes of adjacent cells may be held against the partition by clamps of springy material. For double fluid batteries the porous pot is closed at the top and the carbon enclosed within. It has a projection which passes out of a hole in the side, and makes contact with the above-mentioned contact peg. Parts of the porous pot not immediately opposite the zinc are treated by glazing or otherwise to destroy their porous properties at those places.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Determination of the Density of Paraffin. L. Weinstein. Chem. Zeit. **12**, 875 and 894.

Many methods exist for the determination of the density of fats, and although the matter is very simple, discrepancies in the test are very frequent, owing to the fact that much confusion has crept into the mode of stating specific gravities. In many instances it is quite uncertain whether the recorded densities refer to the actual density, or the apparent density, or the actual specific gravity of a substance. It is therefore recommended to adhere strictly to the true definition of the term density, which the author expresses in the following manner:—The density of a substance for a certain temperature is the quotient of the weight of the substance and its volume at the same temperature.

The density of fats may be taken by means of the hydrometer, the pycnometer, or Mohr's hydrostatic balance. In all cases it is necessary to make the requisite corrections for temperature and expansion of glass. Hydrometers are usually adjusted for a temperature of 15°, and as the density of fats is taken at 100° the following calculation is necessary:—t' is the temperature at which the hydrometer is adjusted, t'' the temperature at which the density of the fat is taken, s the reading of the hydrometer, D'' the density for the temperature t'', G the weight of the hydrometer, V' the volume of the immersed part at the temperature of t', V'' the volume of the immersed part at the temperature of t'', β the coefficient of expansion of glass.

$$V'' = V'\,[1 + 3\,\beta\,(t'' - t')]$$

$$D'' = \frac{G}{V''}$$

$$D'' = \frac{G}{V'}\left[1 + 3\,\beta\,(t'' - t')\right].\,s = \frac{G}{V'}$$

$$D'' = s\,\frac{1}{1 + 3\,\beta\,(t'' - t')} \text{ for } t' = 15^\circ;\ t'' = 100^\circ$$

and $3\,\beta = 0{\cdot}0000276$ for glass. The calculation will therefore be—

$s = 0{\cdot}7500$ $D'' = 0{\cdot}7483$
$s = 0{\cdot}7600$ $D'' = 0{\cdot}7583$
$s = 0{\cdot}7700$ $D'' = 0{\cdot}7682$
$s = 0{\cdot}7800$ $D'' = 0{\cdot}7782$
$s = 0{\cdot}7900$ $D'' = 0{\cdot}7882$
$s = 0{\cdot}8000$ $D'' = 0{\cdot}7982$
$s = 0{\cdot}8100$ $D'' = 0{\cdot}8081$
$s = 0{\cdot}8200$ $D'' = 0{\cdot}8181$
$s = 0{\cdot}8300$ $D'' = 0{\cdot}8281$
$s = 0{\cdot}8400$ $D'' = 0{\cdot}8381$
$s = 0{\cdot}8500$ $D'' = 0{\cdot}8480$

A sample of paraffin melting at 50° gave at 100° $s = 0{\cdot}753$ equal to $D = 0{\cdot}751$. By allowing a large amount of paraffin to cool gradually in a stout glass beaker, and taking precautionary measures to ensure uniformity of temperature, the author was able to note the increase of density, and consequently the coefficient of expansion of paraffin.

Temperature.	*s*, read off.	D, calculated as above.
° C. 100	0·753	0·7512
95	0·756	0·7543
90	0·759	0·7574
85	0·762	0·7605
80	0·765	0·7636
75	0·768	0·7667
70	0·772	0·7708
65	0·775	0·7739
60	0·778	0·7700
55	0·782	0·7811

For the interval between 100° and 55° the increase is 0·030, hence for 1° the increase would be 0·00067.

The apparatus (Fig. 1) employed consists of an Erlenmeyer flask, an upright tube from an extraction apparatus, and a tube closed at the bottom which contains the paraffin. The reading is taken as soon as the temperature of the liquid is constant. Greater accuracy is afforded by the use

Fig. 1

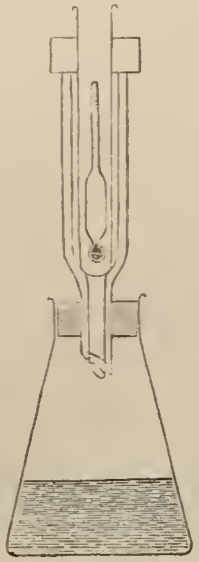
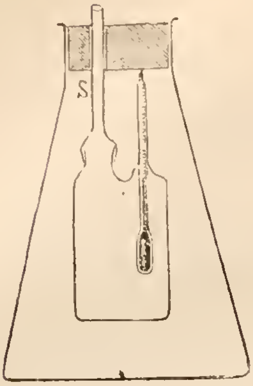


Fig. 2.



of the pycnometer (Fig. 2). Having determined the cubical contents of the apparatus at 100°, the fat is introduced and the upright tube S attached, the apparatus is then heated in an Erlenmeyer flask. The excess of oil which rises in the tube S is removed. When the temperature has reached 100° the apparatus is taken out of the bath and weighed. It is, of course, necessary to make the usual corrections for barometric pressure.

The following table gives the results of some paraffin determinations by both methods :—

Source.	Melting Point.	Sp. Gr. at 100°.
Paraffin from lignite	42°	0·7452 (P), 0·745 (H).
American paraffin from petroleum residues	46	0·7497 (P).
Do. do.	50	0·7513 (P), 0·751 (H).
Paraffin from lignite	54	0·7527 (P).
Do.	58	0·7536 (P), 0·753 (H).
Scotch paraffin	50	0·754 (H).
Do.	54	0·753 (H).
German paraffin, Pit Messel......	58	0·753 (H).

It will be seen that, with the exception of Scotch paraffin, the density increases with the melting point.—D. B.

Drying Oils. A. Bauer and K. Hazura. Monatsh. Chem. 9, 459—468.

Mulder investigated the cause of the drying of oils, and in his "Chemistry of Drying Oils" states that when lead linoleate, in thin layers, is exposed to the air, the lead salt of oxylinoleic acid is formed in a short time, and, further, that a hydrate of this acid, which he named white oxylinoleic acid, is formed by the oxidation of thin layers of linoleic acid. This white oxylinoleic acid, says Mulder, is converted into red oxylinoleic acid by the action of heat, alkalis, or acids, but is retransformed into white oxylinoleic acid by exposure to direct sunlight.

It follows, from the author's experiments on the oxidation of the liquid fatty acid of linseed oil (compare this Journal, 1888, 506), that Mulder's oxylinoleic acids must be mixtures, and it is probable that they are not the final products of oxidation, but contain fatty acids in a more or less advanced stage of oxidation mixed with unchanged acids.

When lead linoleate is exposed to the air in thin layers for about three weeks, it is only partially oxidised, and when air is passed through the acid obtained from hemp oil placed in a Pettenkofer tube, oxidation is not complete even after 41 days. Another portion of this acid was exposed to the air for seven months in layers about 2 mm. in thickness; it became very viscous, but was not completely oxidised. These partially oxidised samples of acid were then exposed to the air for eight months, but even then oxidation was not complete. The lead and the barium salt are also only partially oxidised after an exposure of seven months' duration. A stream of air was passed for 12 days through linoleic acid; at the end of this time it had become viscous, but oxidation was incomplete. The acid from hemp oil, which had been exposed for 15 months, and the linoleic acid from the last-named experiment, were exposed to the air at about 40° in thin layers. After three months they were still sticky, but lost this property after continued heating at 80° for some weeks, and were then insoluble in ether. They were, however, readily soluble in alkalis, yielding a solution from which sulphuric acid precipitated a yellow substance readily soluble in ether.

Drying oils all behave similarly when exposed to the air, but the rapidity of oxidation depends upon the proportion of linoleic to linolenic acid in the individual oils. The more linolenic acid present, the more quickly oxidation takes place. The salts are oxidised in an exactly similar manner. The only acids which take part in all the processes known as the drying of oils are linoleic acid, linolenic acid, and isolinolenic acid; oleic acid yields no solid oxidation products when exposed to the air.

It has been already shown (loc. cit.) that the unsaturated fatty acids present in drying oils yield certain saturated hydroxy acids when oxidised with alkaline potassium permanganate; it was, therefore, deemed unnecessary to isolate the various products which are formed when the oils are exposed to the air.

The authors are of the opinion that Mulder's red oxylinoleic acid is not formed from the white acid by any molecular change, but that a small quantity of the white acid is decomposed by the action of alkalis at high temperatures, and that these decomposition-products are the cause of the red colour.

Drying of Oils.—From the above experiment it can be assumed that linseed oil, hemp oil, poppy-seed oil, and nut oil all behave similarly on exposure to the air, because they contain glycerides of the same fatty acids. This assumption is supported by Mulder, who states (loc. cit.) that a white solid substance is the final oxidation-product of hemp oil, poppy-seed oil, and nut oil, as well as of linseed oil. The results obtained in the experiments with linseed oil can, therefore, be applied to the other three oils. According to Mulder, when thin layers of linseed oil are exposed to the air, the glycerol is oxidised first and then the linoleic acid, which takes up oxygen and is converted into the anhydride of a hydroxylinoleic acid. This anhydride—linoxyn—is a neutral substance, and insoluble in ether. As oxidation proceeds, the oleic acid is attacked, and then, but not until then, the palmitic and myristic acid. As long as the three last-named acids are present in the oxidation product, the dry linseed oil is elastic, but as soon as these acids are oxidised, the surface crumbles and the paint is spoilt. Now, if Mulder's explanations of the drying of oils is correct, linseed oil which has only reached the first stages of oxidation must contain free acids. This conclusion was proved to be true; a sample of linseed oil four years old, which was only covered by a thin insoluble skin but was otherwise completely soluble in ether, gave the iodine value 116·2, and the acid value 8·9. A similar sample, which had been kept in a badly-closed flask for five years, gave the iodine value 115 and the acid value 12·1.

Linoxyn is a glyceride of hydroxylinoleic acid, and not an anhydride. Mulder's statement that first all the glycerol in the linseed oil is oxidised, and that oxidation commences with the glyceride of linoleic acid is, therefore, incorrect. The acid values found in the above samples of old linseed oil prove that the oxidation certainly begins with the glycerol, but probably only with that of the oleïn, palmitin, and myristin, and ultimately proceeds to the linoleïn, which is converted into the glyceride of hydroxylinoleic acid (linoxyn). This substance the authors name hydroxylinoleïn.—F. S. K.

Drying Oleic Acids. K. Hazura and A. Grüssner. Monatsh. Chem. **9**, 475—484. (Compare also this Journal, 1888, 506.)

200 grms. of castor oil are saponified with alcoholic potash (50 grms. KHO, 500 cc. 50 per cent. alcohol), the soap dissolved in four litres of water, the solution neutralised with acetic acid and precipitated with lead acetate. The air-dried lead salt is extracted with ether, sulphuric acid is added to the extract, the whole filtered, and the filtrate washed with water. When the ether has evaporated, the liquid acid of castor oil is obtained.

This acid was oxidised with alkaline potassium permanganate, the oxidation product (A + B) precipitated from the filtered solution with dilute sulphuric acid, and dried on porous plates. The filtrate from (A + B) contains azelaïc acid. 60 grms. of (A + B) were extracted with 2½ litres of ether (B_1), and then with a further quantity of 1½ litres (B_2). The residue (A) weighed 18 grms., and after recrystallisation from alcohol melted at 140°—142°. The extract (B_1) yielded a yellowish product, which was recrystallised from alcohol, converted into the barium salt, and the latter extracted with water. The insoluble portion was decomposed with hydrochloric acid, and the precipitate recrystallised from alcohol; this precipitate contained an acid melting at 110°—111°, and a small quantity of an acid melting at 140°—142°. The soluble portion yielded an acid melting at 110°—111°. The extract (B_2) gave a pure acid, m.p. 110°—111°.

The product melting at 140°—142° is *trihydroxystearic acid*, $C_{18}H_{36}O_5$. It crystallises in microscopic needles, and is insoluble in cold water, sparingly soluble in hot water, ether, and cold alcohol. When treated with nascent hydrogen iodide it yields stearic acid. The potassium salt is very readily soluble in water, and crystallises in anhydrous needles. The sodium salt crystallises in microscopic needles containing ½ H_2O, and is rather sparingly soluble in water. The remaining salts are either sparingly soluble or quite insoluble. The acetyl derivative is a colourless syrup, insoluble in water but soluble in alcohol and ether.

The product melting at 110°—111° is isomeric with the acid just described, and is named by the authors *isotrihydroxystearic acid*. It crystallises from water in microscopic needles, is readily soluble in ether and alcohol, insoluble in cold, and only sparingly soluble in hot water. It yields stearic acid when reduced with hydrogen iodide. The acetyl derivative has the same physical properties as the corresponding derivative of trihydroxystearic acid. The potassium salt is readily soluble in water. The sodium salt crystallises in prisms with 1 H_2O, and is very readily soluble in water. The remaining salts are sparingly soluble or insoluble.

It follows from these experiments that the liquid fatty acid of castor oil is a mixture of two isomeric acids, $C_{18}H_{34}O_3$, of which one yields trihydroxystearic acid (1 part), and the other isotrihydroxystearic acid (2 parts). The authors name the former *ricinoleic acid*, and the latter *ricinisoleic acid*. These acids are present in the proportion of 1 : 2. Oleïn is not contained in castor oil.—F. S. K.

Oxidation of Unsaturated Fatty Acids with Potassium Permanganate. K. Hazura. Monatsh. Chem. **9**, 469—474.

To further prove the correctness of the author's law relating to the oxidation of unsaturated fatty acids by potassium permanganate in alkaline solution (compare this Journal, 1888, 506), several acids have been experimented upon in this direction.

Erucic acid, $C_{22}H_{42}O_2$ (m.p. 33°—34°), yields dihydroxybehenic acid, $C_{22}H_{42}O_2(OH_2)$, melting at 132°—133°. Brassidinic acid yields an isomeric dihydroxybehenic acid. Undecylenic acid ($C_{11}H_{20}O_2$, m.p. 24°—25°) gives dihydroxydecylic acid, $C_{11}H_{20}O_2(OH)_2$, melting at 84°—86°.

Stearoxylic acid, $C_{18}H_{32}O_2.O_2$, melting at 86°, is obtained when stearoleic acid ($C_{18}H_{32}O_2$) is oxidised with alkaline potassium permanganate.

It appears, therefore, that an unsaturated fatty acid yields a hydroxy-acid when oxidised with potassium permanganate only when it contains one or more double linkings which are not adjacent to any other double linking. Unsaturated fatty acids which contain a triple linking probably yield on oxidation hydroxy-acids which are at once decomposed into ketone acids. An unsaturated fatty acid containing two or more adjacent double linkings would give an acid which would be both a ketone acid and a hydroxy-acid. Unsaturated fatty acids are oxidised to hydroxy-acids by potassium permanganate only in presence of free alkali. A better yield of hydroxy-acid is obtained when the potassium permanganate is only allowed to act for a short time:—30 grms. of the acid from poppy-seed oil are oxidised as already described in the case of the acid from linseed oil (loc. cit.), but 10 minutes after the addition of the potassium permanganate a stream of sulphurous anhydride is passed until the solution becomes acid and the manganese oxide is dissolved. The sparingly soluble dihydroxystearic and sativic acid are filtered off, dried in the air and washed with ether. The ether dissolved about 5 grms. of unoxidised acid, and the residue weighed about 20 grms., whereas by the old method only 8 grms. are obtained.—F. S. K.

On Drying Oils. A. Bauer and K. Hazura. Zeits. f. angew. Chem. 1888, 455—458.

(For previous papers see Zeits. f. angew. Chem. 1888, 315; Monatsh. Chem. **7**, 637; **8**, 147; **8**, 156; **8**, 260; **9**, 180; **9**, 198; this Journal, 1888, 506.)

I.—*Mulder's Oxylinoleic Acid.*

Mulder asserts (Chem. der Austrocknenden Oele) that the fatty acids of linseed oil and their lead salts yield respectively oxylinoleic acid, $C_{16}H_{26}O_5.OH_2$, and lead oxylinoleate, when exposed in thin layers to the air, and that the former is converted into a red substance of the formula $C_{16}H_{26}O_5$ by heat, alkalis, and acids, returning to its original state on exposure to direct sunlight.

The authors contend that, as the liquid fatty acids of linseed oil consist of 80 per cent. of linolenic and isolinolenic acids ($C_{18}H_{30}O_2$), together with nearly 20 per cent. of linoleic acid ($C_{18}H_{32}O_2$) and small quantities of oleic acid ($C_{18}H_{34}O_2$), the oxidation-products would also contain 18 atoms of carbon, and not 16. They are of opinion that Mulder's oxylinoleic acid was not a homogeneous, perfectly oxidised body, but contained more or less unchanged fatty acids; and, further, that its formation is effected not only by the mere addition of oxygen, but also by the introduction of it to form (OH) groups.

The first proposition rests on experiments made with hemp seed as well as linseed oil, in which, after exposing the fatty acids (or their lead or barium salts) of these oils to prolonged contact with air at ordinary temperatures, either by means of a stream forced through them or by spreading them in thin layers on glass, the iodine number was taken and found to be never less than 27·6, showing that a considerable proportion of unsaturated substances was present. The second is upheld by the fact that acetyl groups can be inserted in the oxidised fatty acids, and also by a consideration of Mulder's own figures.

For assuming that the fatty acids of linseed oil consist mainly of linolenic acid, $C_{18}H_{20}O_2$, as it is known that this can only combine additively with 6 atoms of bromine, the most highly oxidised additive product would be $C_{18}H_{30}O_5$, containing 66·26 per cent. of carbon, while Mulder found that his oxylinoleic acid contained 61 per cent. of carbon, a percentage agreeing better with the formula $C_{18}H_{30}O_7$ than with that which he assigns to it, viz., $C_{16}H_{26}O_5$ 2 OH_2. If, then, this be the formula for oxylinoleic acid, it must have two of its oxygen atoms attached in some manner other than additively.

Mulder's red oxylinoleic acid is considered by the authors to be merely the white oxylinoleic acid coloured by decomposition products formed by the action on it of heat and alkalis.

The following are the conclusions arrived at :—

(1.) The more linolenic acid an oil contains the more quickly it dries.

(2.) The products of oxidation are not merely additive compounds, but contain part of their oxygen as (OH) groups.

(3.) The oxidation of the salts of the fatty acids is similar to that of the acids themselves.

(4.) By very prolonged exposure to the air at ordinary temperatures, or by shorter exposure at about 80° C., the fatty acids are fully oxidised with the formation of a resinous sticky solid, insoluble in ether, but reconverted into acids soluble in ether on heating with alkali.

(5.) All the drying properties of oils depend upon the presence of linoleic, linolenic, and isolinolenic acids, as oleic acid forms no solid products.

(6.) Having regard to the knowledge to be gained of the constitution of the unsaturated fatty acids of drying oils by their perfect oxidation in alkaline solution by permanganate, it appears superfluous to try to isolate the various bodies produced by their imperfect oxidation by exposure to air.

II.—*On the Drying of Oils.*

Mulder's view is that when linseed oil dries, the glycerol is first attacked, liberating the drying fatty acids, which are then transformed into the anhydride of an oxy-acid (a neutral body insoluble in ether, which he calls linoxyn), and lastly oleic, palmitic, and myristic acids are oxidised in the order named. As long as these three last are present, the dried oil is elastic, but on their destruction it becomes brittle, losing, as it were, its agglutinant.

The authors consider that only the glycerol of the non-drying glycerides is oxidised, as is shown by the very small quantities of carbonic, formic, and acetic acids formed by passing pure air through pumice soaked in linseed oil. With regard to the liberation of fatty acids, they found for two samples of linseed oil which were only in the first stage of oxidation, as shown by their being still soluble in ether, the acid numbers 8·9 and 12·1. With respect to linoxyn, they found that linseed oil exposed in thin layers yielded a body like linoxyn, insoluble in ether, but, unlike that, consisting of the glyceride of oxylinoleic acid: this they named hydroxylinolein.—B. B.

PATENTS.

Improvements in Soaps and Soap Substitutes. Alexander Macqueen Tunbridge Wells. Eng. Pat. 9161, June 23, 1888. 4*d.*

Finely ground wheat is boiled with water, and incorporated with (curd) soap ; kerosine oil is also occasionally added.—W. L. C.

Improvements in, or in the Manufacture of, Soaps and Soap Compounds. S. C. Fenton, J. Fitton, and J. Fenton, Dewsbury. Eng. Pat. 9768, July 5, 1888. 4*d.*

Fuller's earth, either alone or with various other mineral substances, is incorporated with any of the commoner varieties of soap during its manufacture.—W. L. C.

Improvements in and Relating to Illuminating and Lubricating Oils. C. H. Currie, Liverpool. Eng. Pat. 11,545, August 10, 1888. 6*d.*

A heavy mineral oil, with a flashing point of about 300° Fahr. (Abel test) is mixed with a light oil whose flashing point is about 60 to 80° Fahr. To this is added about 5 per cent. by weight of cocoa-nut oil or palm-kernel oil ; the whole is agitated with about 1 per cent. of caustic soda, washed with water, and purified by subsidence. Higher flashing point, whiter light, and increased illuminating power, are claimed for oil thus treated.—W. L. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Shellac. R. Benedikt and F. Ulzer. Monatsh Chem. **9,** 579—585.

Wax from seedlac.—2 kilos. of seedlac were boiled with a solution of 1 kilo. of sodium carbonate in 40 litres of water until the wax separated at the surface, and, after cooling, the wax was clarified by boiling with water and melting. The yield was 0·5 to 1·0 per cent. The wax (1 part) was then boiled for 24 hours with an alcoholic solution of potash (6 parts), the liquid poured into water and the alcohol completely evaporated. Calcium chloride was then added, the precipitated calcium salts of fatty acids and wax alcohols separated, and repeatedly extracted with boiling alcohol. The cold extract deposited a crystalline substance which was separated, dried on porous plates, and boiled with acetic anhydride. The product was poured into water and the cake obtained extracted with alcohol ; it was thus separated into a more soluble portion, which consisted of ceryl acetate, and a less soluble portion consisting of myricyl acetate.

The precipitate of calcium salts referred to above was washed with alcohol and decomposed with hydrochloric acid. The quantity of fatty acids obtained was extremely small and probably consisted chiefly of stearic, palmitic, and oleic acid, but contained no resinous acid.

Seedlac wax has the saponification value 57·6, the acetyl derivative the saponification value 115 ; the acetyl value is, therefore, 57·4. As the acetyl derivative of ceryl alcohol has the saponification value 128·1, and that of myricyl alcohol is 116·9, it follows that seedlac wax probably contains about 50 per cent. of free alcohols.

Resinous wax from commercial shellac wax.—The sample employed was obtained from the commercial soda solutions of shellac, but whether it is a different wax to that obtained from seedlac, or whether it was contaminated with wax from colophony, the authors cannot say. To separate the resinous wax as completely as possible from the other substances, the finely-divided shellac wax was mixed with petroleum ether, shaken repeatedly, and, after standing a day, the petroleum distilled off. The residue was distilled with steam until the wax floated on the surface of the condensed water quite homogeneous and free from bubbles. It was then dissolved in absolute alcohol to free it from fatty wax, the solution filtered, concentrated, allowed to cool, and any fresh deposit of fatty wax separated. The filtrate was diluted with water and boiled to expel the alcohol ; the wax is then obtained in the form of a soft, yellow, transparent solid, melting at 56°. The yield was 40 per cent. of the raw wax. The acid value of this product was found to be 9, whereas that of the raw wax was 43·7. To eliminate as far as possible the free acid it was dissolved in alcohol, exactly neutralised with potash, and the solution shaken with light petroleum. The product then gave the acid value 2—4, the saponification value 126·4, the acetyl saponification value 131·8, the acetyl value 5·4, and the iodine value 32·8, showing that it consists chiefly of a wax, but contains traces of free wax alcohols and free acids. It was saponified with alcoholic potash and the solution extracted with petroleum ether. Ceryl and myricyl alcohol were isolated from the extract. The residue was precipitated with dilute sulphuric acid and distilled with steam to remove the alcohol and petroleum. The precipitated acid was heavier than water, hard and brittle when cold with a conchoidal fracture. It was melted carefully until the frothing was at an end and showed then all the properties of colophony.

The resinous acids contained 8·5 per cent. of fatty acids and took up 88 per cent. of iodine when treated with Hübl's solution ; this fact shows that they are not identical with the acids obtained from shellac itself.

The acid value was found to be 146, the same as that of colophony ; moreover these acids showed all the properties of raw abietic acid with which they are without doubt identical.

The rest of the shellac wax consisted of free ceryl and myricyl alcohol, a wax, and a substance which is insoluble in boiling alcohol.—F. S. K.

PATENTS.

A New or Improved Combination of Substances for the Manufacture of Varnish, Paint, Enamel, and other similar Articles. A. G. Wass, Peckham. Eng. Pat. 13,885, October 13, 1887. 6*d*.

The acid tar and tarry residue obtained in refining mineral oils are boiled until the mass when cold is brittle or friable. It is then dissolved in turpentine, and if not already sufficiently acid, nitric or sulphuric or some other suitable acid must be added. The compound is subsequently thinned down with benzoline, naphtha, or other solvent for mineral pitch, and body may be imparted to it by the addition of white lead.—E. E. B.

An Anticorrosive Composition for the Protection of the Inside of Iron and Steel Vessels, Bridges, Piers, and other Structures which may be exposed to the Action of the Atmosphere or Water. W. C. A. Holzapfel, Newcastle-upon-Tyne. Eng. Pat. 683, January 16, 1888. 4*d*.

Quick drying varnish is intimately mixed for about half an hour with shale or other spirits, and then a mixture of soapstone and Venetian red or other colouring-matter is added and the whole stirred for six to eight hours.

—E. E. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Improvements in Compounds for Chemical Tanning, and in the Process of Tanning without the Use of Tan-Bark or Tannic Acid. E. Gerson, Sydney, N.S.W. Eng. Pat. 8369, June 7, 1888. 4*d*.

In carrying out this invention the hides are unhaired and prepared for tanning by the ordinary methods. The hides are then immersed for about three days in a solution prepared as follows:—200 lbs. sodium chloride, 400 lbs. common alum, and 600 lbs. potassium bichromate are dissolved in hot water. The solution is cooled, and 100 lbs. acetic acid are added, and the whole is diluted in about 7,000 lbs. cold water. This quantity is sufficient for the treatment, at one operation, of about 100 bullock hides. "Bismarck" brown may be partially substituted for the bichromate. The hides are next well washed, and then immersed in a bath consisting of 300 lbs. bran, 300 lbs. grain malt, and 6,000 lbs. water during one to one and a half days. The leather can then be curried and dressed in the ordinary manner.—B. H.

An Improved Process of Preparing Hides and Skins for Tanning. J. Myers, Clonmel, Tipperary. Eng. Pat. 9902, July 7, 1888. 4*d*.

Instead of treating the hides with lime to remove the hair, as in the ordinary process, the inventor soaks them in water into which a current of carbonic acid gas is forced. The hair is stated to be loosened, and the hides can then be unhaired and fleshed, and otherwise prepared for tanning.

—B. H.

An Improved Process of Preparing Hides and Skins for Aluming or Dyeing. J. Myers, Clonmel, Tipperary. Eng. Pat. 10,138, July 12, 1888. 4*d*.

The hides and skins are immersed in water and any suitable quantity of "carbolic acid gas" is forced into the water. The hair or wool is thus loosened without the necessity of liming, and the articles may be taken out of the solution and unhaired, fleshed, and otherwise prepared for the aluming or dyeing process.—T. L. B.

XV.—AGRICULTURE, MANURES, Etc.

Thomas-Slag as a Manure for Oats. A. Emmerling. Landw. Wochenbl. f. Elsass-Lothringen, **38**, 164—166.

Experiments were conducted in 1887 on four different plots of a loamy soil in the province of Schleswig-Holstein. The season was deficient in rain, the heading out period being too dry.

The results show that a mixed manure of ground Thomas-slag and Chili saltpetre used in spring on loamy land is profitable. The application of 8 centners of Thomas-slag and 3 centners of Chili saltpetre per hectare gave a net profit of 14*s*. per hectare as a mean of the four experiments; in two of them there was a loss of 7*s*. and 26*s*. per hectare, the gain being in the other two. These results apply to the grain only, the value of the increase of straw and the residual value of the manure would almost cover the cases of loss. When 12 centners of Thomas-slag and the already quoted proportion of Chili saltpetre were used per hectare, the increased value of the grain as balanced against the cost of the manure shows a considerable loss in the mean of the four experiments, but here again the value of the increase of straw and the manurial residue nearly covers the loss; the proportion 8:3 is, however, the best.

A comparison of the effect of 5 centners of superphosphate (16 per cent.) and 3 centners of Chili saltpetre with the above results show that in a dry season Thomas-slag pays better than superphosphate on loamy soils, being less dependent on rain for its effect.—A. G. B.

"Ammonium Phosphate" as a Manure for Sugar Beet. A. Meyer-Everloh. Hannoverische land-u-forstw. Zeit. 1888, 118—119.

(The "ammonium phosphate" is a double salt of acid ammonium sulphate with two of ammonium phosphate, the latter made by the action of free phosphoric acid upon ammonium sulphate.)

The experimental field was drained and in good condition, the soil heavy and somewhat clayey. In the spring of 1887 100 centners per morgen of sifted lime were directly applied to the land, in which beetroot was grown. The manure was, per acre, 6·2 centners ammonium superphosphate (5 per cent. N and 12 per cent. phosphoric acid) or 2·9 centners of ammonium phosphate (10·5 per cent. N and 26 per cent. phosphoric acid). The whole field also received 17 lb. of nitrogen as potassium nitrate. (1 morgen = 0·62 acres.)

The beetroots were put in on April 29th, the previous cropping being wheat after beans. The roots developed well and were very fine at harvest time; they were gathered between 19th September and 5th October.

The beet, gathered between 19th and 27th September, amounted to 179 centners per morgen, those from the experimental plots (gathered on the 29th September) were 173 centners per acre, and the rest, gathered from 29th September to 7th October, were 206 centners per morgen (showing a growth of 4·68 cwts. per acre per day from September 27th).

Analysis of the roots gave :—

—	Not Sugar.	Sugar in Juice.	Sugar in Root.	Valuable Matter.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Experimental roots	3·2	16·5	14·5	12·15
Mean of the others......	..	14·9	13·1	10·80

—A. G. B.

Artificial Manures on Sugar Beet. Zeits. d. landw. Vereins f. Rheinpreussen, 1888, 5—38.

The land had been manured with night soil for two years; it was ploughed 9 inches deep, and one plot was also trench-ploughed 6 inches deep. The following are the manures and crops per acre:—

——	Roots.	Cost of Manure.		
	Lbs.	£	s.	d.
Unmanured	10,813·7		—	
7·8 centners Thomas-slag	38,100·4	0	6	0
3·9 " Chili saltpetre	40,949·6	1	10	0
7·8 " Thomas-slag 3·9 " Chili saltpetre	46,744·9	1	17	0
7·8 " Thomas-slag 3·9 " Chili saltpetre 6·2 " Kainit	56,617·4 55,930·0	2 2	5 5	0 0
Do. on trench-ploughed plot	61,693·0	2	5	0
15·6 centners Thomas-slag 3·9 " Chili saltpetre 6·2 " Kainit	56,802·1	2	11	0
6·2 " superphosphate 3·9 " Chili saltpetre 6·2 " Kainit	51,400·0	2	19	0
9·3 " dissolved guano 6·2 " Kainit	51,051·1	3	0	0

Thus 15·6 centners of Thomas-slag are not more beneficial than 7·8 centners, and the latter quantity is at least as good as 6·2 centners of superphosphate, and when mixed with Chili saltpetre, better than 9·3 centners of dissolved guano. It is evident that potash, phosphoric acid, and nitrogen produce a very good effect on the soil, and that trench-ploughing increases the yield.—A. G. B.

Manuring Tobacco. Nessler. Bied. Centr. 17, 568.

Uniform and unchecked growth of all the plants are of the highest importance for the quantity and quality of the tobacco crop. Every irregularity caused by drought, or insufficient or badly distributed nourishment, is prejudicial. Too liberal a manuring diminishes the quality of the tobacco, and manures should be applied early to ensure thorough distribution. Tobacco grown on land which has grown the same crop the year before, is better than that grown on land deeply manured and ploughed. By applying farmyard manure or potassium salts in autumn or winter, the tobacco is better than when the manures are applied shortly before sowing; and when the manures have been applied in the spring, sowing should be delayed as long as possible. In autumn a suitable soil may receive per hectare 6 centners of purified "kalimagnesia" (containing not more than 3 per cent. of Cl.), and 2 centners of superphosphate, and in spring 3—4 centners of Chili saltpetre. If the soil is in good condition and has not been autumn manured, 3—4 centners of "kalimagnesia," 1·5 centners of superphosphate, and 3—4 centners of Chili saltpetre may be applied in spring. A solution of 2 lbs. of this mixture in 22 gallons of water may be used in the beginning of summer for watering the plants. Employment of night soil, and watering the plants in summer with night soil drainage and urine, are especially hurtful to the quality of the tobacco.—A. G. B.

Phosphorite from the Capo di Leuca. I. Giglioli. Stazioni Sperimentali Agrarie Italiane, 14, 21—26.

In this paper analytical results are given of the phosphorite obtained from the Capo di Santa Maria di Lenca in the Ferra di Otranto. The phosphorite, which has only recently been found in this district of Italy, occurs in nodules of irregular form as a kind of breccia, encased in chalk. The following results were obtained:—

	Per Cent.
Calcium phosphate	39·22
Calcium carbonate	39·84
Calcium sulphate	1·81
Ferric oxide	4·02
Silica and insoluble silicates	3·88
Alumina and substances not determined	12·98
Water	1·25

—V. H. V.

The Emulsive Power of various Substances for Subdivision of Carbon Disulphide, and the Relative Value of Insecticides. A. Targioni-Tozzetti and Antonio Berlese. Stazioni Sperimentali Agrarie Italiane, 1426–39.

As an insecticide, carbon disulphide presents two disadvantages, its insolubility in water and its volatility. To avoid the double difficulty it has been proposed either to form emulsions of this liquid as of petroleum, or, on the other hand, to mix them with some solid inert material. In the case of petroleum Riley has proposed an emulsion of 10 parts of soap with 20 parts of water.

In this paper an account is given of experiments made to determine the relative values of various insecticides such as phenol, either by itself or with petroleum or carbon disulphide admixed with soap, carbon disulphide with oil or gum. Some experiments were made with the above insecticides by themselves, as also with benzene, ethyl sulphide, essence of mirbane and gas-water. Various methods were tried, such as immersing insects directly in insecticides, either pure or in a state of emulsion, placing them in a bell-jar over the liquids, or over blotting paper soaked with the solutions, or in a current of air which passed over and vaporised the insecticides. The process of fumigation and soaking the earth with solutions or emulsions were also tried. Various species of insects, either in the perfect or larval state, spiders, and terrestial crustaceæ, were subjected to the experiments. The times required to produce a fatal effect under the various conditions for the different species of insects are set forth in a series of tables. It appears that carbon disulphide under every condition is the most efficacious, and petroleum or phenol the next best, while gas-water produces the least result. As regards experiments on the volatility of carbon disulphide, it is shown that the quantity evaporated by the same current of air is at first very great, but so rapidly does this process take place that it is necessary to mix it with oil, fat, or gum to retard the evaporation. It is still efficacious as an insecticide when three centigrammes are evaporated into two litres of air.

—V. H. V.

PATENT.

A Process and Apparatus for Conversion of Phosphates into Thermophosphates or Phosphates Treated with Heat. L. R. Bazin, Paris, France. Eng. Pat. 15,237, November 8, 1887. 8*d.*

Mineral phosphates are heated in retorts to a temperature of from 1,300° to 1,500° C. This so changes their constitution that they become capable of being readily assimilated by plants, and the ordinary treatment with acid is rendered unnecessary. The heating is preferably conducted by means of a regenerative gas furnace, and in order that the hot gases may play amongst the material itself besides heating the exteriors of the retorts, these latter are pierced with a longitudinal slot in the bottom and suitable apertures in the top. The material is prevented from falling through the slot by a low wall on either side.—A. R. D.

XVI.—SUGAR, STARCH, GUM, Etc.

Do Cereal Grains contain Sugar? A. v. Asbóth. Neue Zeits. f. Rübenzucker Ind. 20, 74—76.

The author's investigation shows that neither glucose nor saccharose exists in cereal grains. Previous workers have fallen into the error of inverting an aqueous or alcoholic solution of the grain with acid. This is inadmissible, as the author has shown that dextrin and dextrin-like substances are dissolved in the water or alcohol, and these are converted into sugar by acids.

Even treatment with water, as adopted by Schlösing, converts dextrin, and probably some starch, into sugar, possibly through the formation of some substance similar to diastase.—A. G. B.

Cane Sugar Disease in Java. Zuckerind. 13, 665.

The pernicious "Seréh" disease is said to be on the increase, and as its nature is still unknown, and the question regarding the infectious character of the disease disputed, there remains much obscurity about the remedies to be adopted. It is, however, certain that diseased cane shoots always yield sick plants, but it has been found that shoots from healthy districts frequently show "Seréh" in the second generation. Although a high premium has been offered by the Government for the best research on the character, origin, and extermination of this disease, all investigations have hitherto been without success.—D. B.

Carbohydrates. M. Hönig and L. Jesser. Monatsh. Chem. 9, 562—578.

In the investigations of Winter (this Journal, 1888, 445), and Herzfeld (loc. cit.), the levulose experimented on was deliquescent, and consequently impure, so that the results cannot be relied upon. The authors have made determinations of the rotatory power, with the following results:—

Percentage. p.	Temperature. t.	Specific Rotatory Power. α_D
4·7541	12·0	− 94·352
9·0870	12·9	− 95·295
9·0870	15·4	− 93·526
9·0870	20·2	− 90·118
9·0870	30·4	− 83·468
9·0870	39·9	− 77·157
17·1421	15·4	− 95·867
17·1421	20·2	− 92·524
17·1421	35·2	− 82·572
20·2446	12·0	− 98·775
23·4979	9·0	−101·487
23·4979	14·4	− 97·544
23·4979	20·6	− 93·562
23·4979	33·5	− 84·294
23·4979	44·6	− 76·877
39·3379	16·6	−100·645

The levulose employed, prepared by the method already described (loc. cit.), was purified by recrystallisation from absolute alcohol, and completely freed from the latter by keeping in a partial vacuum over sulphuric acid. This preparation was free from ash, not in the least degree hygroscopic, and, on analysis, yielded concordant results agreeing for the formula $C_6H_{12}O_6$. An examination of the results given in the table shows that for the same degree of concentration (p) the increase and decrease in the specific rotatory power is proportional to the temperature, so that the relation can be expressed by the equation $\alpha_D^t = a + b\,t$. The values of a and b, calculated from the two series of observations in which $p = 9·0870$ and 23·4979 respectively, show that between these limits of concentration the rotation increases 0°·67142 for every 1° C. From this relation the rotatory power of the above solutions containing various quantities of water (q) can be calculated, and the values at 20° are given in the following table:—

q	$\alpha_D^{20°}$
95·2459	− 89·400
90·9150	− 90·496
82·8579	− 92·659
79·7554	− 93·404
76·5026	− 94·039
60·6626	− 98·362

These numbers show that the relation between the specific rotatory power and the percentage of water is expressed by the equation—

$$\alpha_D = A + B\,q \text{ and at } 20°$$

$$\alpha_D^{20°} = -\ 113·9635 + 0·25831\ q.$$

The specific rotatory power of pure anhydrous levulose at 20° is, therefore, − 113·96, and the numbers calculated from this value agree very closely with those obtained in the experiments.

The specific rotatory power at 20° of solutions of various concentrations is calculated to be as follows:—

Percentage.	$\alpha_D^{20°}$	
	Hönig and Jesser.	Herzfeld.
5	− 89·424	..
10	− 90·716	− 69·67
20	− 93·299	− 70·59
30	− 95·882	− 71·02
40	− 98·465	− 71·97

The authors are of the opinion that Herzfeld's (loc. cit.) results are incorrect, owing to the substance employed by the latter having been contaminated with dextro-rotatory inulin derivatives.

Reducing Power of Levulose.—Experiments in which solutions of 250 mgrms. of levulose were boiled for two, five, and 10 minutes with Fehling's solution, show that two minutes' boiling is ample for the oxidation of the levulose. Determinations of the reducing power by Allihn's method gave the following results:—

Levulose in 25 cc.	Metallic Copper.
Mgrms.	Mgrms.
250·0	428·0
194·8	338·0
158·9	276·0
122·6	224·6
76·5	137·2
61·3	108·0
21·7	35·3
9·7	13·3

Calculated from these values the quantity of copper y, obtained with a quantity of levulose x, is—

$$y = -5{\cdot}372 + 1{\cdot}91856\,x - 0{\cdot}0007605\,x^2.$$

This equation was employed to calculate the values given in the following table :—

Levulose. Mgrms.	Copper. Mgrms.	Levulose. Mgrms.	Copper. Mgrms.	Levulose. Mgrms.	Copper. Mgrms.
10	13·73	95	170·03	180	315·33
15	23·23	100	178·88	185	323·53
24	32·69	105	187·69	190	331·67
25	42·12	110	196·47	195	339·81
30	51·50	115	205·25	200	347·91
35	60·85	120	213·90	205	355·97
40	70·15	125	222·56	210	363·99
45	79·42	130	231·19	215	371·98
50	88·65	135	239·77	220	379·92
55	97·85	140	248·32	225	387·83
60	107·10	145	256·84	230	395·70
65	116·12	150	265·32	235	403·53
70	125·20	155	273·76	240	411·32
75	134·24	100	282·16	245	419·03
80	143·24	165	290·48	250	426·73
85	152·22	170	298·85		
90	161·14	175	307·09		

which shows that the reducing power of levulose is not identical with that of grape sugar, and in this respect the results agree with those obtained by Lehmann.

The reducing power of levulose for any given concentration is less than that of dextrose, whereas Lehmann found that in solutions containing up to 33·5 mgrms. in 25 cc. levulose had a greater reducing power. The values obtained with solutions containing up to 80 mgrms. are less than, those found with solutions more concentrated still greater than, those obtained by Lehmann; this discordance is probably due to the impurity of Lehmann's samples and to the fact that he continued the boiling for a long time. The sp. gr. of levulose was found to be 1·6691 at 17·5°. The sp. gr. of aqueous solutions, calculated from the values which were obtained in the determinations of the rotatory power, are given in the following table :—

Percentage.	Specific Gravity.	Percentage.	Specific Gravity.
6	1·02150	16	1·06503
7	1·02575	17	1·06950
8	1·03012	18	1·07380
9	1·03447	19	1·07825
10	1·03870	20	1·08253
11	1·04303	21	1·08700
12	1·04747	22	1·09137
13	1·05175	23	1·09588
14	1·05620	24	1·10030
15	1·06053	25	1·10488

The author's experiments show that inverted sugar consists of equal parts of anhydrous levulose and dextrose.
—F. S. K.

PATENT.

Improvement in the Evaporation and Concentration of Sugar Cane Juice and other Liquids, and Apparatus therefor. G. Fletcher, Litchurch. Eng. Pat. 14,164, October 18, 1887. 11*d.*

This invention relates to the evaporation and concentration of sugar cane juice and other liquids by the aid of steam, air, or fire, in either open or closed vessels under vacuum or pressure or ordinary atmospheric conditions; it relates more particularly, however, to the working of vacuum pans and effets. The object of the invention is to accelerate the circulation of the liquids treated in the evaporators or concentrators, and thus enable evaporation to take place under the most favourable conditions. To accomplish this a triple effet vessel furnished with a heating drum, in which are fixed a large central circulating tube, surrounded by a number of smaller heating tubes, is employed.

At the lower extremity of the circulating tube is a screw propeller attached to a vertical revolving spindle, which is worked by a horizontal shaft. The rotation of this horizontal shaft causes the propeller to work in such a manner as to cause the liquor in the circulating tube to descend. In this way a constant current of the liquor is passing down through the circulating tube and up through the heating tubes, whereby a constant and complete circulation of the contents of the vessel is maintained.
—J. H.

XVII.—BREWING, WINES, SPIRITS, Etc.

Respiration of Yeast at different Temperatures. Gréhant and Quinquaud. Compt. Rend. **106**, 609—611.

The following results were obtained from 5 grms. of yeast in distilled water :—

Temp.	Duration of the Experiment.	Oxygen.			Expired. CO_2.	Ratio of CO_2 to O.
		Given.	Found afterwards.	Absorbed.		
°	h. m.	cc.	cc.	cc.	cc.	
0	1 0	8·16	5·76	2·40	2·1	0·87
0·7	1 6	9·46	4·20	5·26	3·4	0·64
13·8	0 30	8·30	5·86	2·44	2·6	1·06
17·0	0 30	9·46	6·43	3·03	3·2	1·05
19·5	0 30	7·96	5·10	2·80	3·9	1·40
21·0	0 30	8·30	4·46	3·84	6·0	1·50
26·0	0 30	8·30	5·20	3·10	5·8	1·90
27·6	0 30	6·20	2·06	4·14	9·6	2·30
30·3	0 50	7·96	4·03	3·93	9·4	2·40
36·0	0 30	9·20	5·23	3·97	9·6	2·40
40·0	0 15	9·26	5·80	3·46	11·2	3·20
46·3	0 30	9·20	4·26	4·94	22·3	4·50

The ratio CO_2 : O varies with the temperature. It shows that the yeast cells are not like the *boletus* and the chlorophyll-free organs, in which, according to the experiments of Bonnier and Mangin, this ratio is constant for the same individual, whatever the temperature.—A. G. B.

Recent Progress in the Manufacture of Spirit. Dingl. Polyt. J. **269**, 272—280 and 324—336.

C. Schulze and Th. Seliwanoff (Landwirth. Versuchsst. **34**, 403) have obtained cane sugar from potatoes.

Seliwanoff (*ibid.* **34**, 414) has examined bianched potato buds, and found the nitrogenous bodies contained in them to consist almost wholly of asparagin (2·95 per cent.). They also contained 8·4 per cent. of glucose and

3·45 per cent. of a non-reducing sugar, which the author regards as cane sugar.

Schoeckh (Zeits. f. Spiritusind. **11**, 3) treats of the working up of frozen potatoes. Steam is turned on. When the waste liquor has run off the blow-off tap is opened, and the potatoes are steamed in this manner for one hour. For a further period of three-quarters of an hour they are steamed with the tap nearly closed, and then steamed for another quarter of an hour at four atmospheres' pressure. The results were very satisfactory.

In a paper on the "*Buying and Selling of Molasses for Distilling Purposes*" (Oesterr. Ung. Brennereizeit. **12**, 2) it is pointed out that the usual method of estimating molasses by taking the specific gravity and polarimetric reading is wrong, because molasses often contain large quantities of raffinose. It is proposed to polarise before and after inversion, as this will give, if not absolute, at least comparative results.

The Pneumatic System of Malting is highly recommended by Schrohe (Zeits. f. Spiritusind. **11**, 72). The author, after referring to Galland's and Saladin's systems, points out that with the ordinary system of malting it is almost impossible to get good results in very hot or cold climates, or even at different seasons in the same locality. It is, for instance, difficult to produce good malt in summer in Germany. The two systems mentioned above allow of uniform results being obtained throughout the year. Further advantages are that it is easier to make a good air-dried malt; that less space is required (Saladin's system only necessitates one-fifth of the usual space), and a saving of manual labour. The system is chiefly to be recommended for the pressed-yeast industry.

The Activity of Malts made from different Grains has been tested by Th. Morawski and M. Glaser (Zeits. f. Spiritusind. **11**, 81). The authors experimented with barley, wheat, rye, oats, and maize. Germination was effected between moist filter-papers at 19°—20° C. In two cases maize was germinated at 30° C. The malts were then examined by Kjeldahl and Lintner's methods.

From the results of their experiments the authors conclude—

(1.) That carefully prepared rye and wheat malts are but slightly inferior to barley-malt as regards saccharifying power.

(2.) That oat-malt is considerably inferior to the three malts above-mentioned.

(3.) That maize-malt is even lower in the scale; but when germinated at 30° C. and slowly washed it very nearly equals oat-malt in saccharifying power.

A. Hesse (Zeits. f. Spiritusind. **11**, 42, 49, 56, and 65) describes his experience of movable attemperators. The results obtained were very satisfactory. There was a saving of vat space to the extent of 8—10 cm. 165 kilos. more potatoes could be used per vat, corresponding to an increased efficiency of 0·71 per cent. Further advantages are the possibility of using stronger worts (28 per cent.), and attenuating down to 1·7—1·8 per cent. In addition, less alcohol is lost by evaporation.

To prevent Boiling Fermentation. J. E. Brauer (*ibid.* **11**, 81) recommends the addition of rye and oat grist in equal proportions to the fermenting wort; further, he recommends the exclusive use of oat malt in the main mash; pitching at 31° C. and cooling to 14° C. A strong, healthy yeast is obtained by the use of these different materials, so that sufficient alcohol is formed before the boiling commences.

The Action of Malt Flour and other Bodies on Attenuation is further treated of by Thausing (Allgem. Zeit. Bierbr. and Malzfab. 1887, 51). He finds that :—

(1.) The addition of malt-flour to the yeast increases the degree of attenuation.

(2.) Previous boiling retards, but does not completely stop the action of the malt-flour.

(3.) Barley-flour has a similar effect to malt-flour.

(4.) Rice-flour is without action.

The author is of opinion that the cause of the weaker or stronger fermentation is to be looked for in the yeast itself. The abstractor (Wochenschr. Brau.) combats this statement, since the addition of a neutral body—barley-flour—has a favourable action.

Different Yeasts found in Distilleries.—Dellbrück makes some interesting communications concerning P. Lintner's work on this subject (Zeits. f. Spiritusind. Suppl. 23).

Previous researches on yeast had for their object the determination of the conditions of temperature, &c. most favourable to its growth. It was assumed that only one species of yeast existed. Hansen's researches have, however, shown this to be erroneous. Beers, prepared with different pure yeast cultures, exhibit differences in taste, smell, &c. The author finds that most distillers' yeasts increase by budding, and that scarcely two different samples are alike in character. Different species, sown in the same wort, behave very differently as regards speed and completeness of fermentation. Nothing would be gained by using pure yeast cultures in pressed yeast manufactories unless great care be taken to prevent contamination from the air. The author concludes by pointing out that the yeast-room ought to be the most important part of a distillery.

A Method of freeing Raw Spirit, or Wort containing Spirit, from Fusel Oil and other Impurities (Ger. Pat. 41,678, January 22, 1887). Grote and Pinetta, Guatemala.

The method consists in adding an ignited mixture of potassium or sodium nitrate and magnesium carbonate to the liquid before distillation. From 45—60 grms. per 100 litres may be used. It is said to retard the distillation of the fusel oil.

The Preparation of potable Spirit direct from the fermented Mash was discussed by Hayduck at the general meeting of spirit manufacturers (Zeits. Spiritusind. **11**, Suppl. 25).

This question is of importance in Germany, because potato distilleries are at present compelled to purify their spirit before it is consumed. Scheibner's method (Dingl. Polyt. J. **268**, 272) is cheap and easily applied. Additions of various substances, such as charcoal, metallic oxides, fat, hydrocarbons, have been tried. The latter are not of much value. Ilge's apparatus (Dingl. Polyt. J. **268**, 27) is very efficient.

Proposed experiments on the *Value of Distiller's Wash for Cattle feeding*, reported by Prof. Maercker before the general meeting of spirit manufacturers (Zeits. f. Spiritusind. **11**, Suppl. 70).

The diminution in the number of distilleries causes a corresponding diminution in the quantity of wash available for cattle feeding, so that other substances must be sought to replace it. The author points out that owing to the improved methods employed in distilleries, the wash has not the same nutritive value as ten years ago. Formerly it contained, on the average, 5·69 per cent. of carbohydrates, and 1·04 per cent. nitrogenous bodies; now it contains only 2·3 per cent. and 0·8 per cent. respectively of these constituents. Only 70—85 per cent. of these nitrogenous bodies are digestible. As the quantity of wash diminishes it becomes important to know which animals thrive best on it, and to what extent it should be mixed with other foods. These questions can only be settled by practical men. The author mentions the preparation of artificial distillers' wash by mashing potatoes with just sufficient malt to render the mixture fluid and then adding some highly nitrogenous food. To prevent fermentation it must not be allowed to cool below 50° C. Its cost is about 6½*d.* per 100 litres. The pulpy residue from potato starch factories is very poor in nitrogenous substances, and is only available in combination with foods rich in those bodies. The author states that at Halle, in Saxony, extensive trials are being made with wash as a cattle food. Professor Orth recommends that the milk obtained from these cattle be examined from a hygienic standpoint.

The Use of Distillers' Wash in Pressed-yeast Factories. G. Francke (Zeits. f. Spiritusind. **11**, 11).

It is an almost universal practice to add wash to the wort in the fermenting vessel, but it is not so common to add it at the commencement of the mashing process. The wash used for this purpose must be pure, and its acidity must not neutralise more than 1·0—1·2 cc. normal soda per 20 cc. 100 litres per 100 kilos. of potatoes are sufficient. About 1 per cent. more yeast and alcohol is obtained by this method. The author points out that the freedom of the liquid from volatile fatty acids is a point of importance. If, however, the fermentation was normal, and the wash settled bright, and is pale in colour, it may be used with perfect safety.

Stutzer (Zeits. f. Spiritusind. **11**, 37 and 40) discusses the question whether the various methods for drying distillers' wash will meet with success in Germany. The author is of opinion that even Klaming's method (Dingl. Polyt. J. **261**, 256), which he considers to be the best, is too costly to allow of its being generally adopted. The only method likely to be successful is one in which the liquid is evaporated down to a syrup only. Morgen does not agree with the author's opinion that the dried residue is not commercially valuable on account of its unattractive appearance, but states it to be a very nutritious food, in some respects superior to others. He further states that the thickening process is only available when the paste is to be used at once, because all foods containing more than 12 per cent. of water will not keep for any length of time.—H. T. P.

Report on Italian Wines. P. Freda. Stazioni Sperimentali Agrarie Italiane, **14**, 57—76.

After several unsuccessful attempts the author, with the aid of the Director-General of Agriculture and the *Circolo enofilo Italiano*, obtained samples of wines from communes situated in various provinces. The producers sent replies to inquiries as to the varieties of grape used, either separately or mixed, and their approximate proportion, the duration of the fermentation, the quantity of each kind produced in the commune, and the total quantity sent into the market. A brief account is also given of the causes, favourable or otherwise, which affect the quality and quantity of the wines in each district. In addition, a sample of a litre was sent to the author's laboratory in order to determine (i.) the percentage proportion of alcohol; (ii.) the total acidity in grams per litre expressed in terms of tartaric and of sulphuric acid; (iii.) the dry extract in grams per litre; and (iv.) in the case of red wines the degree of colouration referred to a solution of rosaniline hydrochloride containing ·05 grm. in a litre of 10 per cent. alcohol.

In a series of tables the remarks of the growers and the analytical results are given for 407 samples of wine from 167 different communes. From the tables it is seen that the proportion of alcohol varies from 10 to 13 per cent. for the most part; in the samples from the province of Cagliari the proportion is as high as 17—19 per cent. The total acidity in terms of sulphuric acid varies from 3 to 5, in terms of tartaric acid from 5—8, and the intensity of colouration from about 2 to 5. The dry extract shows very considerable variations; the least value given is 17, the highest 195 grms. per litre. From two schedules it appears that the fermentation is carried on for times varying from 2½ to 60 days, according to the quality of the wine. In the present communication the analytical results are merely set forth; at a future date the author proposes to give his deductions, when a sufficient number of definite data have been obtained.—V. H. V.

PATENTS.

An Improved Process for the Manufacture of Yeast. A. H. Huntley, Newcastle-upon-Tyne. Eng. Pat. 13,840, October 12, 1887. 8*d.*

This invention has for its object the manufacture of a superior yeast without the use of chemicals, and for this purpose several kinds of cereals and vegetables are used, such as wheat, maize, rye, barley, oats, bran, malt, turnips, carrots, beetroot, &c.

The different materials are ground or crushed and steeped in water for several hours at temperatures varying from 135° Fahr. to 205° Fahr., according to the nature of the material. They are next transferred to the "steam vat," and maintained at a temperature of about 131° Fahr. for six to eight hours; the mash is next run into the "brewing vat," where it remains about half an hour to clear, when the liquor can be run off through the perforated bottom into the "yeast vat." Here the "mother yeast" is added, and fermentation takes place; the resulting yeast is separated by well-known methods, washed, pressed, and exposed to a temperature of 90° Fahr. for 12 hours so as to drive off any residual moisture, or it may be dried to a greater degree so as to be crushed into a fine powder.—J. H.

An Improved Process and Apparatus for Refining Sugar. C. Steffen, Vienna, and C. J. Lanyen, Grevenbroich, Germany. Eng. Pat. 9775, July 5, 1888. 8*d.*

The object of the present process is to purify sugar loaves with liquor under pressure in partially or entirely systematic manner, and to rapidly remove and regain the pure liquor contained in the sugar loaf.

The process consists in the rapid treatment of loaf sugar, characterised by the combination of the systematic or partially systematic or simple washing of loaf sugar, within the loaf forms under pressure, with the centrifuging ("machining") of the washed or purified mass of sugar in appropriate centrifugal machines for driving off and regaining the pure washing liquor passing off from the purified sugar loaves and driving off the pure washing liquor out of the apparatus, and the loaf forms, when the process is finished, by means of compressed air.—J. H.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

Saccharine. Dujardin Beaumetz. Monit. Scient. **2**, August 1888.

The author admits the medicinal value of this drug in certain cases, but protests against its use in articles of food. It retards the action of the gastric juice upon albuminoid substances as well as saccharification of starch by ptyalin. The experiments of Dr. Worms prove that in some persons the prolonged ingestion of saccharine in small doses is followed by pains in the stomach and disturbed digestion. These symptoms ceased when the saccharine was discontinued and reappeared on its resumption. Saccharine has already found its way into use as a means of sophistication.

The Academy of Medicine (Paris) has formally concluded that saccharine must not be regarded as a food, but merely as an article of medicine.—W. S.

(*B*)—SANITARY CHEMISTRY.

Toxic Action of Water Gas and Generator Gas. O. Wyss. Zeits. f. angew. Chem. 1888, 465—468.

Experiments made on frogs, mice, guinea-pigs, rabbits, and cats, showed that the toxic action of water gas and generator gas was due solely to CO, the quantities of SH_2, CO_2, and CH_4 present in them being far too small to have any appreciable effect.

0·1 per cent. of water gas or 0·3 per cent. of generator gas is sufficient to render the air of a room injurious, while 1 per cent. and 1·5 per cent. respectively, make it fatal to warm-blooded animals.

A room of 43 cbm. would be rendered lethal if an ordinary gas-tap delivering water gas were left open in it for an hour.

The danger attending the use of water gas and generator gas is increased both by their being odourless and by their property of speedily destroying consciousness, which is almost the first symptom of their presence. Great caution is therefore necessary in their use, particularly in the disposal of the products of combustion, on account of the likelihood of their containing unburnt CO.—B. B.

Corrosion of Zinc Pipes. Dingl. Polyt. J. **269**, 280.

Max Müller (Zeits. f. angew. Chem. 1888, **1**, 24), draws attention to a remarkable corrosion of zinc pipes. Of the many zinc pipes which carry the rain-water off the roof of the Royal castle at Brunswick, only those which drain the copper-covered dome corrode very rapidly.

The original piping made of zinc plate was corroded to the thickness of paper; the surface consisted of copper oxide, while the under layer was chiefly composed of zinc oxide. The analysis of both layers, carefully freed from zinc and powdered together, indicated the following composition:—

	Per Cent.
Insoluble in HCl	1·55
CuO	20·81
$Fe_2O_3+Al_2O_3$	12·91
CO_2	5·75
SO_3	2·52
ZnO	50·97
CaO	3·41
Moisture and organic matter (residue)	2·05

The author made a number of analyses of rain and snow water collected in the neighbourhood of Brunswick, and he has come to the conclusion that the corrosion is due primarily to the action of the ammonia contained in the water. The ammonia dissolves the oxide and basic carbonate of copper on the roof; the copper is then reprecipitated by the zinc of the water-pipes and the subsequent corrosion of the zinc is then entirely due to galvanic action.

—H. T. P.

XIX.—PAPER, PASTEBOARD, Etc.

Change which Paper undergoes when Stored. Papier Zeit. **13**, 893.

It is shown that the firmness of paper sized with resin increases by storage owing to the fact that the resin in the paper undergoes an operation of hardening by exposure to the air. The tensile strength of paper prepared with the addition of "sulphite-cellulose" is diminished by storage, whilst paper made from rags does not suffer in this respect.

—D. B.

PATENT.

Improvements relating to Apparatus for Treating Vegetable Substances for the Production of Paper Stock. H. H. Lake, London. From J. A. Manning, W. M. Peekham, and A. Chambers, Troy, New York, U.S.A. Eng. Pat. 8059, June 1, 1888. 8*d.*

The apparatus consists of a digester with an auxiliary reservoir placed over it. The two vessels are connected by means of pipes, and when the contents of the lower tank have reached the boiling point, part is pumped into the upper vessel, whence it flows back into the lower one again, entering it at the bottom, just between the steam injectors. By this means the liquor is kept in constant circulation and becomes evenly cooked. Drawings accompany the specification showing the arrangement of the pipes.

—E. E. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Catalpin: a bitter principle. E. Claassen. Amer. Chem. J. **10**, 328—330.

Catalpin is obtained from the bark and fruit of *Catalpa, bignonioides Wal.*, by extraction with alcohol, evaporation, solution in water, precipitation with lead acetate, and extraction of the syrup obtained by mixing the filtrate with barium carbonate, and evaporating with ether and alcohol (3:1).

To induce crystallisation this solution was evaporated, the residue dissolved in water, filtered, and concentrated. As no crystals formed, animal charcoal was added to extract the principle, allowed to stand 24 hours, filtered off, washed, and extracted with boiling alcohol. The extract was evaporated, dissolved in water, filtered, and concentrated: crystals then appeared, white and acicular or silky and slender (often curved) when pure, disposed radially in tufts. Catalpin is a glucoside; it is soluble in water hot and cold; easily soluble in alcohol, difficultly in ether; soluble in benzene and amyl alcohol, nearly insoluble in chloroform. It does not reduce alkaline copper solution unless previously boiled with dilute sulphuric acid. Tannin gives no precipitate, even after the addition of dilute sulphuric acid, but after boiling it becomes turbid on cooling.

It has no action on ammoniacal silver nitrate, ferric chloride, lead acetate, phosphomolybdic acid, phosphomolybdic acid and ammonia, potassium mercuric iodide, or iodine in potassium iodide. It is precipitated by basic lead acetate; it slowly reduces gold chloride; conc. hydrochloric acid and strong caustic potash dissolve it without change of colour. The solution in conc. nitric acid is first colourless, then yellow, and on heating reddish yellow. Conc. sulphuric acid dissolves it with a violet colour; this is changed by a little nitric acid first to light brownish red then to reddish brown.—B. B.

Piperidine Colouring-Matters. B. Lachowicz. Monatsh. Chem. **9**, 505—509.

All the quinones (benzo- tolu- naphtha- phenanthraquinone), which the author experimented on, react with piperidine, yielding colouring-matters which are readily changed by acids and alkalis. When an alcoholic solution of quinone is mixed with an excess of piperidine, the reaction commences immediately, and is complete in about an hour. The colouring-matter, $C_6H_2O_2(NC_5H_{10})_2$, separates in thick, reddish, violet prisms with blue reflex. It melts at 178°, is insoluble in water, and only sparingly soluble in cold organic solvents, but readily in cold concentrated hydrochloric acid. Neutral or alkaline solutions are blood-red, acid solutions, carmine. Warming with acids destroys the colour. The formation of this substance is expressed by the equation—

$$3\,C_6H_4O_2 + 2\,C_5H_{11}N =$$
$$C_6H_2O_2(NC_5H_{10})_2 + 2\,C_6H_4(OH)_2$$

Hydroquinone can be advantageously employed in the above reaction in the place of quinone, as, although the reaction takes place much more slowly, the formation of any by-product is avoided.

Other secondary amines (diethyl- dipropyl- diamylamine) are slowly oxidised by hydroquinone, and resinous products are formed.

When piperidine (2 mols.) is added to an alcoholic solution of toluquinone, the mixture becomes purple-red, but no crystalline compound can be isolated; if an excess of piperidine is added the colour changes to brown, and light brown needles, melting at 105°, separate after some time. The real dye remains in solution and separates in an amorphous condition.

Phenanthraquinone and piperidine yield a red colouring-matter and a brown amorphous substance when heated together for a long time, but the products cannot be completely separated.—F. S. K.

Removal of Iodate from Iodide of Potassium by means of Zinc Amalgam. H. N. Morse and W. M. Burton. Amer. Chem. J. **10**, 321—322.

Zinc amalgam, rich in zinc, is prepared by shaking zinc dust with mercury in presence of tartaric acid and washing with water.

The solution of potassium iodide is boiled with it, when any iodate present is reduced, zinc hydroxide being formed.

The filtered solution is found to be quite free from zinc and mercury.

Experiments with the pure iodate showed that quantities of 1 and 2 grms. in 50 cc. of water were completely reduced in 45 and 75 minutes respectively.

Bromate and chlorate of potassium are also reduced by the same reagent, but with successively increased difficulty. —B. B.

Decomposition of Calcium Carbonate by Heat. H. Le Chatelier. Ann. des Mines, 1887, 374—375.

The author's experiments show that, when calcium carbonate is heated rapidly, decomposition sets in at temperatures varying from 890° with precipitated carbonate to 930° with marble, or, if magnesium carbonate be also present, at 720°. More accurate experiments show, however, that at the same temperature, the limit of the tension of decomposition is the same for all forms of the carbonate, but the limit is reached sooner by the precipitated carbonate than by chalk or marble. Below 500° the decomposition is too slow to admit of accurate experimental observation; at 500 it only amounts to $\frac{1}{10000}$ of the mass per hour, and it is only at 812° that the tension of the decomposition is equal to the atmospheric pressure.

In the manufacture of lime the temperature employed is presumably about 850°.—D. A. L.

PATENT.

Improvement in the Manufacture of Salol. Ger. Pat. 43,713, July 22, 1887. M. v. Nencki and F. v. Heyden, Nachf.

In the manufacture of salol from salicylic acid and phenol, or sodium salicylate and phenol, or sodium salicylate and sodium phenolate by means of phosphorus oxychloride or pentachloride, the trichloride may be used instead of the latter products, or sulphur oxychloride may be used, also acid sulphates of the alkalis.

In the case of phosphorus trichloride, for instance, 1 mol. is allowed to run into a melt of 1 mol. salicylic acid and 1 mol. phenol. If SO_2Cl_2 is employed, it is advisable to take sodium salicylate and phenol or sodium phenate.

By heating a mixture of salicylic acid and phenol with the acid sulphates, the sulphates act as dehydrating agents, and salol is formed.

Other dehydrating salts give ketones.

By using, instead of salicylic acid, α-hydroxynaphthoic acid, *o*- or *p*-nitrosalicylic acid, resorcinol-carboxylic acid, and, instead of phenol, other similar bodies, resorcinol, pyrogallol, thymol, nitrophenol, α- and β-naphthol, analogous reactions occur.—T. L. B.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Orthochromatic Emulsion Collodion. J. M. Eder. Phot. Arch. **29**, 177.

The author describes the following mode of preparing collodion sensitive to colour:—15 grms. of crystallised nitrate of silver are dissolved in 12 cc. of water and the solution treated with 90 cc. of 95 per cent. alcohol. This is then mixed with 150 cc. of 4 per cent. plain collodion. In another vessel 15 grms. of cadmium bromide are dissolved in 75 cc. of a warm alcoholic solution of eosin (1 in 800), and the solution mixed with 150 cc. of 4 per cent. plain collodion. From 5 to 10 cc. of this are then added gradually to the collodion sensitised with silver, the addition being made in the dark and with constant agitation. The collodion is then tested with potassium bichromate for free nitrate of silver. The latter should always be present, although only in small quantity. The exposure to light may be effected without the application of yellow glass. The picture is developed in the usual manner.—D. B.

Use of Chrome Alum in the Emulsion. Phot. Arch. **29**, 154.

The addition of chrome alum is said to prevent the curling of the photographic surface, although it affects its sensitiveness. According to Burton this is due to the presence of free sulphuric acid in commercial chrome alum, and when this is removed the photographic properties return. He therefore recommends the recrystallisation of the product, or, preferably, treatment of a 5 per cent. solution with a sufficient amount of ammonia to produce a small permanent precipitate.—D. B.

Emulsion Collodion highly sensitive to Colour. E. Albert. Phot. Zeit. **12**, 166.

The author has prepared emulsion collodion, which is as sensitive as gelatin and does not require the use of yellow glass. He proposes to dissolve the silver salt of eosin in ammonia and neutralise the alkali with picric acid. By this treatment the tendency to fog is not merely prevented, but the ammonium picrate thus formed acts as colouring-matter, which absorbs the ultra-violet rays.

The author also shows that a solution of aesculin, although colourless, changes the ultra-violet into fluorescent rays, and that potassium bichromate absorbs the violet completely, even when applied in a very dilute solution. —D. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

New Explosives. Chem. Indust. **11**, 350—352.

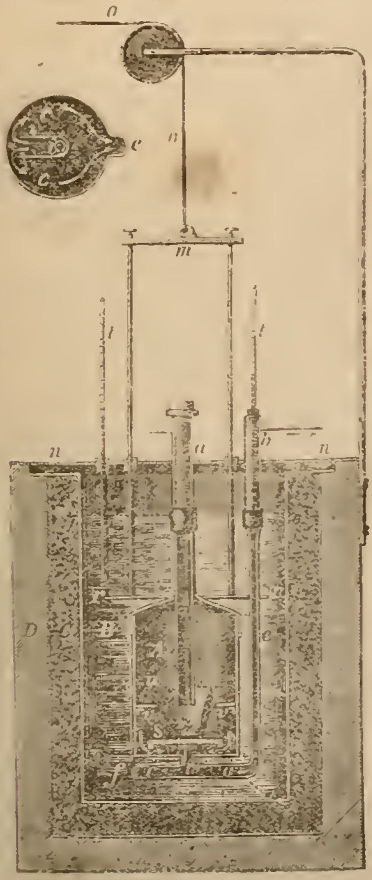
Romite. — This explosive, the invention of a Swede (Sjöberg), is prepared, according to one method, by treating 10 parts of ammonium nitrate and 7 parts of potassium chlorate with a solution of 1 part naphthalene in 2 parts of rectified paraffin oil. Among the advantages claimed for romite is included safety in manufacture, transport, and use, but the writer of this article calls attention to the widely-known fact that chlorate compounds constitute unsafe and unstable explosives, and refers to the spontaneous ignition of some romite, whilst being conveyed from Sweden to Germany, for experimental purposes, under the superintendence of the inventor himself.

Carbo-Dynamite. — The invention of W. D. Borland. (*See* this Journal 1888, 588.)—E. G. C.

XXIII.—ANALYTICAL CHEMISTRY.

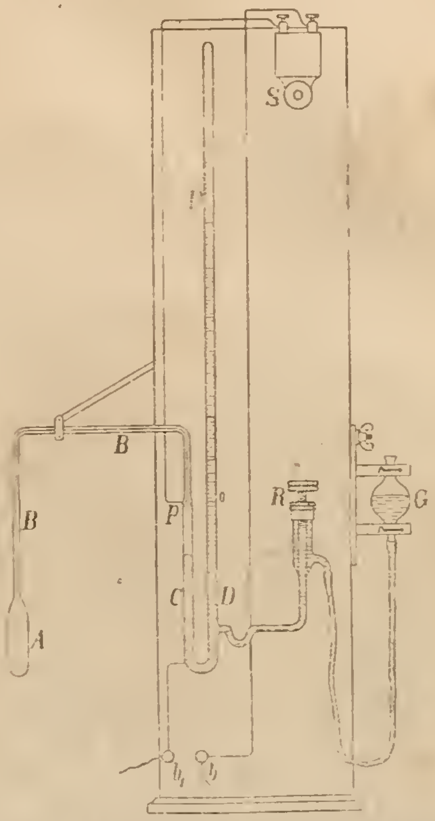
On the Value of Fuels. F. Fischer. Zeits. f. angew. Chem. **12**, 351—352.

Scheurer-Kestner, as well as Fischer, have pointed out that the heat of combustion, especially of coal, cannot be calculated from its elementary composition, but must be determined by direct experiment. For this purpose Fischer recommends the following calorimeter. A is a silver vessel, into which dry oxygen is admitted by means of the tube *a*, which is connected to A by an india-rubber ring at the level of the water. The tube *a* is continued down into *z* (a platinum crucible) by a platinum tube which has a few small lateral perforations near the top. The platinum crucible *z* is covered with a platinum wire gauze *u*, through which the products of combustion rise and heat the oxygen in the platinum tube and get mixed with oxygen, entering at the perforations, before they again pass down through the projecting hot wire gauze *u* and between a foil ring *v* and the glowing sides of the platinum crucible. The gases then pass down through *i* into the box *c c* where (by the arrangement shown above) they are made to touch the sides of c *c* before passing up the tube *e*. The temperature of the gases issuing from *e* is hardly 0·1° above the temperature of the water in B. Through *b* the gases are conducted through two calcium chloride tubes and three caustic soda tubes (for water and carbon dioxide determination), then through a tube with glowing copper oxide, to ensure complete combustion of any unburnt gases, and finally again through calcium chloride and soda-lime tubes. Any unused oxygen is collected in a gasometer and can be used over again. The space C between B and the wooden casing is filled with eider-down. The silver-plated lid *n n* is made in two halves, one of which is provided with two semicircular holes for *a* and *b*, a hole for the thermometer *t* (which can be read to ·01°), and two holes provided with ivory rings for the plated stirrer. The stirring rods are screwed to an ivory support, and can be worked from some distance.—F. W. T. K.



L. Cailletet's New Gas Thermometer. Dingl. Polyt. J. 269, 222—223.

CAILLETET's gas thermometer is one which is maintained at a constant volume. As it is intended for the measurement of very low temperatures, the gas in the bulb is hydrogen. The bulb *A* is of about 25 cc. capacity, and is connected with the short arm *C* of a manometer by means of a capillary tube *B*. The long graduated arm *D* of the manometer is connected with a spherical mercury reservoir *G* by means of an india-rubber tube. The support in which *G* is fixed works in a groove, and can be raised or lowered. In carrying out a determination with this thermometer, *A* is immersed in the space or substance the temperature of which is to be ascertained, and *G* is then raised or lowered till the surface of the mercury in *C* touches a platinum wire at *p*, which is fused into *C* as near as possible to the opening of the capillary tube *B* and on a level with the zero point of the scale on *D*. In doing so, the electric circuit *b b* is closed, and at the moment of contact the bell *S* rings. As soon as this occurs the supply of mercury is shut off by means of the screw-valve *R*, and the height of the mercury in *D* read off. Readings and the corresponding temperatures of the gas in *A* are previously calculated, tabulated, and confirmed by comparison with the readings of a mercury thermometer between the limits + 50° and − 30° C. The volume of the capillary tube *B* up to *p* is only 0·006 of the volume of *A*, and on the assumption that the *whole* of this tube remains at the ordinary temperature, the error will hardly amount to 0·3° on a difference of 200° C., *i.e.*, the error amounts to $\frac{1}{600}$ of the temperature measured. In calculating the table, the temperature of the mercury column is taken at + 15° C.; at other temperatures a small correction has to be applied to the numbers. The instrument is very delicate, as 2·36 mm. on the scale correspond to one degree.



Cailletet and Bouty have employed this thermometer in their experiments on electrical resistances at low temperatures.—F. W. T. K.

An Aspirator with Constant Outflow. O. Binder. Zeits. Anal. Chem. 27, 465—466.

THE usual form of aspirator draws in more gas at the beginning of the operation than towards the end, in consequence of the decreasing level of the water, and consequent slackening of the flow. An aspirator with a constant column of water is shown in the figure. It consists of a Mariotte's bottle, to the exit tube of which a Woulf's bottle is attached, serving as a mercury valve. If the pressure in the aspirator changes, a back-flow is prevented by the mercury. If the gases passing through the aspirator are soluble in water, the quantity dissolved is much decreased by enclosing the inlet tube within a larger tube, as shown in the figure. The gases then pass through a narrow column of water, and little absorption occurs.—J. B. C.

Fig. 1.

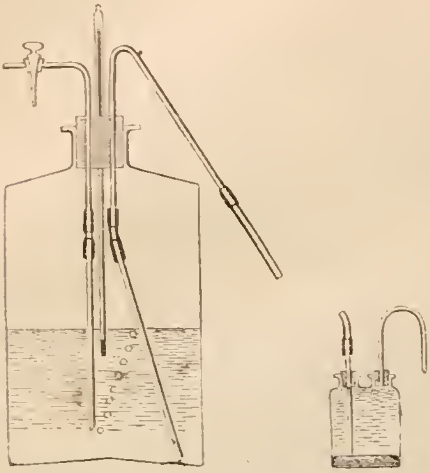
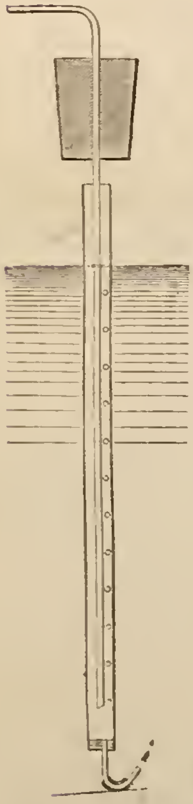


Fig. 2.



Determination of Nitric Acid. H. Wilfarth. Zeits. Anal. Chem. 27, 411—433.

The method described by the author is based upon that of Schlösing. The solution of the acid is decomposed with ferrous chloride. About $\frac{1}{2}$ grm. saltpetre is taken and decomposed with 20 cc. $FeCl_2$ solution and 60 cc. HCl, sp. gr. 1·124. The reduction is performed in an atmosphere of CO_2. The apparatus required is shown in the figure. The decomposition takes place in the flask A closed by a double-bored stopper. CO_2 passes through the U-tube *k* filled with water, then through the tube *a* to the three-way cock, and finally by *b*, which is drawn out to a point, into the flask. The nitric oxide passes through *f*, provided with a bulb, into the receiver B cooled in water. The HCl condenses here. The NO passes through *g* into C filled with soda solution, where it is freed from the last trace of HCl, and then into the absorption apparatus D and E. D is a flask of 250 cc. capacity to which 20 cc. standard NaOH solution and 30—50 cc. H_2O_2 is added.

Some of the liquor is drawn over into E by dipping the end *o* into the flask. D is then closed with a double-bored cork into which the tubes *l* and *p* are fitted; *l* does not dip into the liquid. In order to determine the end of the reaction metadiamidobenzene test paper is placed in the current of gas by disconnecting the apparatus at *h*. A trace of NO gives at once a brown stain. If no stain appears the alkaline solution is withdrawn and a second determination may be immediately commenced. The three-way cock is turned so that *a* is connected with *c* and the liquid in A is driven out through *d*. If *i* is now closed and the cock turned so that the connexion between *a* with *c* and *b* is closed, a partial vacuum is formed in A, which is sufficient to draw up the solutions required for a second determination. The oxidation of NO by hydrogen peroxide is not quite so simple as might

Fig. 1.

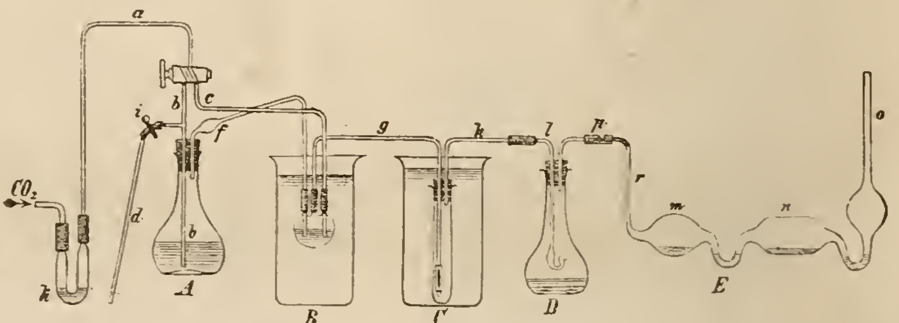


Fig. 2.

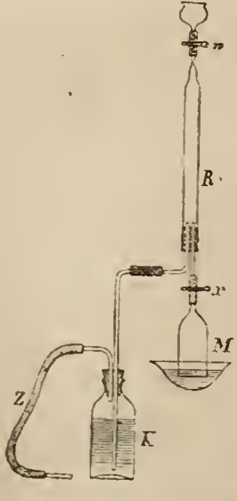
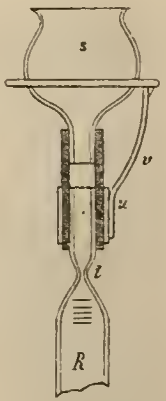


Fig. 3.



first appear. At 0° in an atmosphere of CO_2 nitric acid is oxidised to nitrous acid. If the air is not expelled the nitric oxide first forms the tetroxide, which is further oxidised to nitric acid—

$$N_2O_4 + H_2O_2 + 2\,NaOH = 2\,NaNO_3 + 2\,H_2O.$$

In a warm solution more nitrous acid is formed than in the cold. When all the NO is driven over into D and E, these vessels are allowed to stand for an hour. The tube *l* is disconnected. The contents of E poured into D and, after dilution, acidified with 20 cc. H_2SO_4. The solution is then boiled and titrated with soda solution. The amount of alkali neutralised corresponds to the quantity of nitric acid present.

In conducting the determination the apparatus must be completely filled with CO_2 gas. To determine this, the piece of apparatus shown in the accompanying figure is employed. A sample of gas passing through the apparatus is collected in M and is allowed to pass up into R, which is filled with KOH solution from the bottle K.

A series of analyses are given by the author showing good results.—J. B. C.

A Method by which the use of Tared Filter-papers in weighing certain Precipitates may be avoided, and reduction by Filter-paper prevented. L. L. de Koninck. Zeits. f. angew. Chem. 1888, 427.

In the estimation of potassium and ammonium by means of platinic chloride, the precipitate is removed as completely as possible and the residue adherent to the paper is washed off with hot water, evaporated dry in a crucible, to which the main precipitate is then added, and the whole dried as usual.

When weighing As as $Mg_2As_2O_7$, P_2O_5 as $Mg_2P_2O_7$, $ZnCO_3$ and $CdCO_3$ as ZnO and CdO respectively, the precipitates may be treated in a similar way. The residuary precipitates adhering to the filter-paper are dissolved in dilute HNO_3, evaporated dry in the crucible, to which the main precipitate is then added, and ignited and weighed as usual.—H. T. P.

The Electrolytic Method of determining Iron. E. F. Smith. Amer. Chem. J. **10**, 330—332.

The solution containing the iron has added to it an excess of sodium citrate, *e.g.*, 1 grm. of the air-dried salt in 10 cc. of water for 0·015 grm. of Fe, and a few drops of citric acid, and is electrolysed in a platinum dish with a current capable of liberating 6—15 cc. of oxyhydrogen gas per minute.

The volume of the liquid (40—150 cc.), quantity of sodium acetate, and strength of current, may vary within tolerably wide limits without affecting the results. The deposit is usually complete in from 4 to 8 hours.

All the experiments were made with pure ferric ammonium sulphate except three, in one of which aluminium was present, and in the other two a solution of titanium had been added, without influencing the results.

No iron was found in the liquid after electrolysis; the deposited metal was compact and steel-like in appearance, and underwent no alteration on exposure to the air of the balance room for some weeks.—B. B.

Employment of Hydroxylamine Hydrochloride in Quantitative Analysis. A. Lainer. Monatsh. Chem. **9**, 533—536.

As pure hydroxylamine hydrochloride can now be obtained at a relatively low price, it can be advantageously employed in quantitative analysis.

Silver chloride, bromide, and iodide are readily reduced by a warm alkaline solution of hydroxylamine hydrochloride; the metal is obtained in the pure state by simple decantation, and can be at once employed for the preparation of silver nitrate. Sodium thiosulphate solutions of these silver salts behave similarly. The silver in a potassium silver cyanide solution can also be estimated by this method, but the reagent must be added slowly to avoid frothing. When the first energetic reaction is at an end, the whole is boiled with an additional quantity of the reagent, and when no further separation takes place, the metal (90 to 98 per cent.) is filtered off. The filtrate is boiled with a fresh quantity of the reagent, evaporated to a small bulk, diluted with water, and the remainder of the silver separated. Quantitative experiments gave satisfactory results.—F. S. K.

Estimation of Carbon in Commercial Iron. De Koninck. Zeits. Anal. Chem. **27**, 463—464.

The method usually adopted for estimating carbon in iron consists in dissolving out the iron with cupric chloride and ammonium chloride solution, and then oxidising the residual carbon by means of chromic acid and sulphuric acid to CO_2, which is collected in potash bulbs. Unless the carbon is completely freed by washing from chlorides, the subsequent oxidation may give rise to the evolution of chlorine, which will vitiate the results. This may be avoided by bringing into the flask, in which oxidation occurs, a small quantity of silver sulphate.—J. B. C.

Qualitative Separation of Gold and Platinum from Arsenic, Antimony, and Tin. De Koninck and A. Lecremier. Zeits. Anal. Chem. **27**, 462—463.

The dry or wet mixed sulphides are heated in a current of HCl gas. Antimony and tin are rapidly volatilised as chlorides, and also the sulphide of arsenic, but without change. The residue consists of gold and platinum. The volatile substances condense partly in the cooler portion of the apparatus, partly in a receiver containing water. By filtration the arsenic is separated from the antimony and tin.—J. B. C.

Method for Estimating Manganese. L. Schneider. Dingl. Polyt. J. **269**, 224—230.

This method depends primarily on the fact that in presence of a large quantity of nitric acid a manganous salt is rapidly and completely oxidised to permanganic acid on the addition of bismuth tetroxide, and this at the ordinary temperature. The latter is an important point, for at a high temperature a solution of permanganic acid undergoes partial decomposition, and this decomposition takes place more rapidly still if manganous oxide is present, manganese peroxide being formed, which falls down as a flocculent precipitate.

Oxidation of Manganese to Permanganic Acid.—In using the bismuth tetroxide reaction, manganese peroxide is precipitated if the solution is neutral or only slightly acid. Other circumstances which also affect the action of the manganous oxide on the manganic acid are the relative proportions in which they are present, the concentration of the solution, the nature and quantity of the free acid present, and finally the temperature of the solution. Schneider finds nitric acid to be the most suitable, and when the proportions are 1 mgrm. of manganese to 2 cc. of nitric acid (about 1·2 sp. gr., obtained by mixing 1 vol. of concentrated nitric acid with 2 vols. of water), no peroxide is precipitated at the ordinary temperature during the process of oxidation or during the subsequent reduction. The nitric acid should be free from lower oxides of nitrogen. This is easily determined by adding a drop of permanganate solution to the nitric acid solution, when the pink colour should not disappear in the course of a few minutes. On adding finely-divided bismuth tetroxide in excess to the solution of manganese in acid, the latter immediately turns a deep violet, and oxygen is evolved. If bismuth tetroxide is present in excess the reaction is found to be complete when the evolution of oxygen ceases, and takes only a few minutes if it is assisted by shaking up the liquid. The solution is put aside for a few minutes, during which the bismuth tetroxide settles, and the liquid, containing all the manganese as permanganic acid, is then filtered through asbestos, and the manganese determined by titration. Experiments have shown that even in presence of considerable quantities of ferric oxide and sulphuric acid the oxidation is complete.

Titration of the Permanganic Acid.—Schneider finds that a solution of hydrogen peroxide is the only one which can be used for the direct titration of the permanganate in the nitric acid solution. It resists the oxidising action of the nitric acid and behaves like a reducing agent towards the permanganate. The reaction may be represented as follows:

$$2\ KMnO_4 + 5\ H_2O_2 = 2\ MnO + K_2O + 5\ H_2O + 5\ O_2.$$

No intermediate products are formed, and the titration can be accurately carried out with any quantity of manganese in a solution obtained as previously described. For standardising the hydrogen peroxide solution a known quantity of potassium permanganate is taken and dilute nitric acid (sp. gr. 1·2) is added in the proportion of 2 cc. to 1 mgrm. of manganese. The hydrogen peroxide solution should contain about 0·5 per cent. of peroxide, *i.e.*, 1 cc. nearly corresponds to 3 mgrm. of manganese. A solution of this degree of dilution is fairly stable and does not require frequent standardisation.

It should be noted that since commercial hydrogen peroxide solution frequently contains traces of chlorides, and commercial bismuth contains traces of silver, a white turbidity is often obtained during titration; this, however, does not interfere with the analysis. Silver nitrate should on no account be added to the hydrogen peroxide solution for the removal of the chlorine, as, on standing, it reacts with the hydrogen peroxide. The reaction is not known, and the products react more slowly on the permanganate and produce changes of tint. In these titrations a change in the intensity of the colour should occur, but never a change in tint.

Titration can be also carried out with a standardised oxalic acid solution, as this is not affected by dilute nitric acid, but in this case an excess of oxalic acid solution should be at once run in and the excess subsequently determined by titration with permanganate solution. Titrations with sulphurous acid solution are unreliable, as, in presence of nitric acid, the sulphurous acid is oxidised to sulphuric acid as long as a moderate quantity of permanganate is present; towards the end of the reaction, however, only thiosulphuric acid is got; so that in titrating a large quantity of permanganate a relatively smaller quantity of sulphurous acid is necessary than when a small quantity of permanganate has to be determined. Indirect titration with iodic acid is impossible in this case on account of the nitric acid.

Practical Application of the Method.—In the case of steels and samples of iron poor in manganese 5 grms. are taken, dissolved in 100 cc. of nitric acid (1·2 sp. gr.), and the solution when complete boiled for a short time. When the solution is cold 100 cc. more of the nitric acid are added, and then treated with about 10 grms. of bismuth tetroxide. In the case of irons containing several per cents. of manganese 1 grm. is taken, dissolved in nitric acid (1·2 sp. gr.), and 200 to 300 cc. of the nitric acid are then added to the solution.

Ores and slags which are insoluble in nitric acid are first boiled in hydrochloric acid, and the residue which contains manganese silicate in the case of most manganese ores is then washed into a platinum dish, together with the solution and treated with hydrofluoric acid. Finally a sufficient quantity of sulphuric acid is added, and the whole evaporated down till the sulphuric acid begins to come off. In the case of spiegeleisen very rich in manganese, ferromanganese, and rich manganese ores, 1 grm. is dissolved, the solution diluted up to one litre, 200 cc. taken mixed with 100 cc. of concentrated nitric acid, and this solution oxidised with bismuth tetroxide. The violet solutions obtained above are filtered through asbestos filters, transferred to a tall beaker, which is placed on a piece of white paper, and titrated with a hydrogen peroxide solution of known strength. The quantity of manganese can be determined to within 0·0003 grm., and the whole analysis can be carried out in about an hour in the case of steels and crude irons, so that the method is thoroughly efficient for practical purposes.

Preparation of Bismuth Tetroxide.—Fremy's is the simplest and most productive method. Equal parts of bismuth oxide and potassium chlorate are rubbed up together and heated together in a wrought-iron dish over a naked flame. The mass glows but does not fuse, and no oxidation of the bismuth oxide is observable. As soon as the glowing is over 2 parts of caustic soda are added, whereupon the mass instantly fuses without effervescence to a dark-brown mass. When cold the fused mass is thoroughly lixiviated with water till the latter is no longer alkaline. The light-brown sediment obtained is an aqueous compound of bismuthic acid and sodium, and on stirring this up with a cold 5 per cent. nitric acid solution it is decomposed, oxygen being evolved, the sodium going into solution, and a dark red-brown sediment of bismuth peroxide being obtained. The sediment is washed with acidified water, then with pure water, and is finally dried. Dilute sulphuric acid and even acetic acid decompose sodium bismuth similarly. The composition of the bismuth peroxide obtained approximately corresponds to the formula $Bi_4O_8H_2O$. On digesting this body with nitric acid (1·2 sp. gr.), the greater portion of it goes into solution. The brown to black residue obtained and dried at 100° C. does not materially differ in composition from the product mentioned above. For the recovery of the bismuth used in the analysis the solutions are collected and the free acid partially neutralised with soda. Basic bismuth nitrate separates out from the still slightly acid solution. This is ignited and can again be employed for the preparation of bismuth tetroxide.—F. W. T. K.

Detection of Antifebrine in Phenacetine. C. Schwarz. Pharm. Zeit. 33, 357.

The great resemblance which antifebrine bears to phenacetine in physical as well as chemical respects, and the difference in the commercial values of these products—phenacetine being about 15 times the price of antifebrine—may, in the author's opinion, give rise to the adulteration of phenacetine with antifebrine. A simple method of detecting such admixture is to heat the product with caustic soda in the presence of chloroform, when the characteristic odour of isonitrile is given off if acetanilide (antifebrine) is present.—D. B.

Detection of Sulphonal. E. Ritsert. Pharm. Zeit. 33, 312

Vulpius's reaction for detecting sulphonal (this Journal, 1888, 457) consists in reducing it with potassium cyanide, which gives rise to the odour of mercaptan. The author recommends the following modification on account of the inconvenience caused by using potassium cyanide:—0·1—0·2 grm. of sulphonal is fused in a test tube until bubbles of gas make their appearance in the clear liquid. A small amount of pyrogallic acid is then added. The liquid assumes a brown colour and fumes of mercaptan are liberated.—D. B.

Determination of Cane Sugar in Liqueurs, &c. F. Rathgen. Zeits. Anal. Chem. 27, 433—445.

The author employs a Soleil's or Schmidt-Hänsch saccharimeter. The substance is first tested with Fehling's solution. If no precipitate is formed it is immediately tested by the polarimeter. In case invert or grape sugar is present in quantity, Clerget's inversion method must be employed. The weighed substance is made up to 100 cc., and 50 cc. determined by the polarimeter. To the remainder 5 cc. conc. HCl are added and heated to 67°—70° on a water-bath for 15 minutes and then cooled. In determining the polarisation of the inverted solution the temperature *t* must be known. If A is the rotation of the original solution B, that after inversion for 2 dm. of solution and 26·048 grm. of substance, the percentage of cane sugar R may be calculated from the formula—

$$R = \frac{100\ (A - B)}{142{\cdot}4 - \frac{1}{2}\,t}$$

In the case of liqueurs 25 or 50 cc. is taken and made up to 100 cc.

The formula for volume V is in this case—

$$r = \frac{26{,}048\ (A - B)}{(142{\cdot}4 - \frac{1}{2}\,t)\ V}$$

If the temperature is maintained at 20°, the formula is simplified to—

$$r = 196 \cdot 7 \frac{A - B}{V}$$

The presence of vegetable acids in fruit preserves, &c. produces invert sugar from cane sugar, especially by long keeping. To determine the original quantity of cane sugar present, the amount of left-handed polarisation B after inversion will give the result. From the observation that a solution of 26·048 grms. cane sugar in 100 cc., after inversion gives $-42 \cdot 4 - \frac{1}{2}t$ degrees in a 2 dm. tube, the amount of another rotation B must be equivalent to—

$$\frac{26 \cdot 048\ B}{42 \cdot 4 - \frac{1}{2}t}$$

cane sugar.

The original quantity of cane sugar R must be—

$$R_1 = \frac{100\ B}{42 \cdot 4 - \frac{1}{2}t}$$

If $t = 20°$, $R_1 = 3 \cdot 086$ B.

For liqueurs the formula is—

$$r_1 = \frac{26048\ B}{(42 \cdot 4 - \frac{1}{2}t)\ V}$$

and gives the number of grms. per litre.

$$\text{If } t = 20°, \quad r_1 = 804 \frac{B}{V}.$$

For solid substances soluble in water the required quantity is weighed out and dissolved in water. In other cases the insoluble portion must be filtered off and well washed. If the solution is not clear aluminium hydrate, prepared by precipitation with ammonia, may be used; 2—3 minutes good shaking suffices to produce a clear solution. The author concludes his paper with a series of results.

—J. B. C.

Estimation of Fat in Milk, Cream, &c. W. Schmid. Zeits. Anal. Chem. 27, 464.

Five cc. cream or 10 cc. milk are placed in a test glass of 50 cc. capacity divided into tenths of a cc. To this 10 cc. conc. HCl is added and the mixture boiled until the liquid becomes dark brown. After cooling, 30 cc. ether are added, the contents of the vessel well shaken and allowed to stand. 10 cc. of the ethereal solution are withdrawn, evaporated in a platinum crucible, and dried in an air-bath at 100°. The time required should not exceed quarter of an hour. —J. B. C.

On the Estimation of the Carbohydrates. M. W. Bishop. Monit. Scient. [4] 2, 641—650.

This research was undertaken for the purpose of ascertaining what are the most favourable conditions under which, by the method of inversion with acid, (1), cane sugar may be determined in presence of dextrin, and (2), dextrin may be determined in presence of cane sugar.

With this end in view, a study was made of the action of hydrochloric and sulphuric acids, at a temperature of 95° C., on solutions of cane sugar, dextrin, and glucose (dextrose) respectively. Solutions of different densities and with varying percentages of acid were heated on the water-bath, at the fixed temperature, for periods of from 10 minutes to five hours.

The results of these experiments go to show that ½ cc. of acid was quite sufficient to completely invert 8 grms. of cane sugar dissolved in 50 cc. of water, when heated on the water-bath for only 10 minutes; that if the quantity of acid be increased to 2 cc., the levulose begins to undergo decomposition, even in this short time, as is shown by the liquid becoming dark in colour; that similar solutions of dextrin and dextrose undergo no change when heated for 15 minutes with ½ cc. of acid. If, however, the acid be increased to 2 cc., saccharification of the dextrin commences, but is, however, hardly completed when the digestion has been carried on for as long even as five hours, whilst a solution of glucose, heated for three hours with 2 cc. of acid, appears to undergo very little change. Hence, in order to determine the amount of cane sugar in a liquid containing such in solution, or dextrin or a reducing sugar in addition, it suffices to add ½ cc. of hydrochloric acid to a 10 grms. per 100 cc. solution, and heat on water-bath at a temperature of 95° C. for 10 minutes. Under such conditions the cane sugar is completely inverted, whilst the dextrin or other sugars that may be present practically undergo no change. If, however, it be required to determine also the dextrin in such a liquid, it is advisable to dilute the solution to about one-third, and then add acid to this at the rate of about 4 cc. per 100 cc. of solution, and heat for three hours at 95° C. Under these conditions only a relatively small proportion of the levulose is destroyed, whilst the greater portion of the dextrin is completely saccharified.

Applying the above results to the determination of dextrin, cane sugar, &c. in wine and other such liquors, the author proceeds as follows:—150—200 cc. of the liquid under examination are taken and decolourised, by means of animal charcoal or basic lead acetate, and then examined in the polarimeter; at the same time, the reducing sugar is determined in the usual way, by means of Fehling's solution.

The saccharimetric examination may reveal one or other of the three following conditions:—(1) The deviation is to the right; or (2) to the left; or (3) there may be no deviation, according to the nature and relative quantities of carbohydrates in solution, such as dextrin, dextrose, cane sugar, and invert. Therefore, we proceed to determine the relative proportions in which any or all of these carbohydrates may be present, as follows:—

50 cc. of the liquid under examination (and which has previously been decolourised) are introduced into a 100 cc. flask, 1 cc. of dilute hydrochloric acid (sp. gr. 1090) added, and the mixture heated for 10 minutes on the water-bath to a temperature of 95° C., then cooled and made up to containing mark with distilled water, any cane sugar that may have been present will by this means have become inverted, and may be determined by means of the saccharimeter or by Fehling's solution. A fresh portion of the liquid, 50 cc., are next heated with 4 cc. dilute hydrochloric acid for three hours at 95° C. on water-bath, cooled, made up to volume with water. The difference in saccharimetric readings or in cupric oxide per 100 cc. furnish data for calculating the percentage of dextrin which may be present.

Of course, if after inversion the Fehling's or saccharimetric indications undergo no change, then only dextrose or invert sugar can of necessity have been present.

When the liquid contains a large proportion of cane sugar (and hence a large proportion of invert sugar) and only a very small quantity of dextrin, it is somewhat difficult to determine exactly the amount of the latter substance, owing to the destruction of a large percentage of levulose during the saccharification of the dextrin, but as a matter of fact few wines are found to contain both cane sugar and glucose.

It is well known that all unsophisticated wines naturally contain an appreciable amount of reducing sugar, and which causes a deviation of + 1° to + 2° on the saccharimeter, hence in order to differentiate the natural from the artificial sugar we must in every case submit the sample under examination to the processes of inversion and saccharification.

This method is also applicable to the determination of syrups, conserves, confitures, &c. In such cases 40·475 grms. of substance are taken, dissolved in about 150 cc. of water introduced into a 250 cc. flask, a few cc. of basic acetate of lead added, and then made up to volume with distilled water. The mixture after being well shaken is filtered, when a complete examination by saccharimeter and Fehling's solution may be proceeded with as for wines.

—J. H.

Estimation of Cane Sugar by Inversion. Zeits. f. angew. Chem. 1888, 436—440.

The examination of molasses by the inversion method is discussed by A. Herzfeld (D. Zuckerind, 1888, 70). The molasses are inverted by Creydt's method, and not more than 0·5—1 grm. purified animal charcoal must be used for clarifying. The use of a jacketed tube is advisable. The percentage of cane sugar is obtained by the following formula :—

$$R = \frac{100\ S}{142 \cdot 4 - 0 \cdot 5\ t}$$

Where R = percentage of cane sugar, S = algebraic difference of the readings before and after inversion, t = temperature in degrees Centigrade.

R. Creydt (D. Zuckerind. 1888, 582) points out that, from the reading before and after inversion, it is possible to tell accurately whether a sample of molasses contains much or little of other optically active bodies. In carrying out the inversion process it is of importance to dilute always to the same extent before adding the acid. According to Creydt's further experiments the inversion can be done either by his original method (the normal weight of sugar dissolved up to 100 cc., 50 cc. extracted and inverted with 5 cc. concentrated HCl and diluted to 100 cc.) or by Clerget's method (half normal weight up to 50 cc. + 5 cc. HCl). By Creydt's new method the half normal weight + 5 cc. HCl are diluted to 50 cc. In presence of raffinose a correction must be made by means of Creydt's raffinose formula.

A. Herzfeld (*ibid.* 906) finds that invert sugar is destroyed when working by Creydt's method. At least 70 cc. of water must be used in dissolving the normal weight of sugar, when using 5 cc. of 38 per cent. HCl for the inversion. The author obtained the value − 32·66 at 20° C. by inverting pure cane sugar. Creydt's figure is − 32·4. Creydt's raffinose formula is unsuitable because it gives results in terms of crystallised raffinose (15·15 per cent. OH_2).

F. Herles (Z. Zucker. **12**, 381) finds that the quantity of basic acetate of lead usually taken to clarify sugar solutions has no effect on the result.

F. Wolf (Oesttereichungarn. Z. Zucker. 1888, 276) obtained the number − 32·4° on inverting pure cane sugar.

It diminishes by 0·46° for each degree Centigrade increase of temperature. The author also gives the results of a number of analyses of sugars got by the elution* process obtained by direct polarisation, by Creydt and Clerget's inversion methods and by titration with Fehling's solution. The differences between the results of direct polarisation and the other methods increase with the inferiority of the sample. For example, between direct and Clerget's methods, from 5·24 per cent. − 7·52 per cent., between direct and Fehling's method 5·53 per cent. − 8·61 per cent. (lower).—H. T. P.

Estimation of Paraffin, Cerasin, and Mineral Oils in Fats and Waxes. F. M. Horn. Zeits. f. angew. Chem. 1888, 458—460.

The author saponifies the mixture, evaporates the resulting mass to dryness, and extracts in a Soxhlet's apparatus with chloroform, which, unlike petroleum ether, does not dissolve any of the soap.

The solution in chloroform is then evaporated and the mineral oil weighed.

In the case of a wax, the chloroform solution will also contain the higher alcohols; these can be separated by digestion with acetic anhydride, which converts them into acetates soluble in excess of the anhydride. They are filtered off from the unattacked paraffin in a hot-water funnel, the paraffin being washed first with acetic anhydride and then with hot water; so long as the filter-paper is kept wet none of the paraffin passes through; when washed it is dried together with the filter, dissolved in chloroform or petroleum ether, the solution evaporated to dryness and weighed. Glacial acetic acid may be substituted for acetic anhydride, but it is less suitable, as the acetates of the higher alcohols are apt to separate out unless the solution is kept quite hot. The method is applicable if rosin, as well as paraffin, has been used for adulterating the wax; results of analysis of known mixtures show close concordance.—B. B.

Estimation of the Glycerol in Crude Glycerin. R. Benedikt and M. Cantor. Zeits. f. angew. Chem. 1888, 460—462.

A good and quick method is still much needed; the methods in which chromic acid is used are apt to give high results by reason of the oxidation of other organic substances to carbonic acid. Benedikt and Zsigmondy's permanganate process (Jahresb. 1885, 1103) is operose, as impurities in the glycerol have first to be precipitated with lead acetate and the lead then removed by sulphuric acid. Baumann's reaction (Ber. **19**, 3221) is used by Diez, who agitates the liquid in which the glycerol is to be determined with soda-lye and benzoyl chloride, whereby the glycerol is converted into a crystalline mixture of glyceryl di- and tri-benzoate: a part, however, remains in solution, and a correction (based on experiments with a known weight of pure glycerol) must be applied. The authors did not find this satisfactory for their purpose even when they estimated the percentage of glycerol in the benzoate by determining its saponification equivalent, calculating the alkali consumed into $(C_6H_5CO_2H - OH_2)$, and deducting the value thus obtained from the weight of the benzoate. The method is nevertheless useful for its legitimate purpose, viz., the determination of small quantities of glycerol in wine and similar liquids. The process finally devised was the "Acetin Method," which depends on the quantitative formation of glyceryl triacetate, when glycerol is heated with acetic anhydride. It is carried out as follows:—1 to 1·5 grm. of the crude glycerol is heated with 7 or 8 grms. acetic anhydride, and about 3 grms. anhydrous sodium acetate for 1 to 1½ hours with reversed condenser; it is allowed to cool, 50 cc. of water are added, and the heating is continued (still with the condenser, as glyceryl triacetate is volatile in a current of steam) until it begins to boil. When the oily deposit at the bottom of the flask is dissolved, the liquid is filtered from a white flocculent precipitate—which contains most of the impurities of the crude glycerol—allowed to cool, phenolphthalein added, and dilute caustic soda (about 20 grms. per litre) run in until neutrality is obtained. Care must be taken not to exceed that point as glyceryl triacetate is easily saponified. 25 cc. of strong caustic soda (about 10 per cent. strength) are now added from a pipette.

The mixture is then heated for 15 minutes, and the excess of alkali titrated back with N or $\frac{N}{2}$ hydrochloric acid.

The strength of the alkali used is determined at the same time by titrating another 25 cc., measured with the same pipette, with the same acid.

The difference between the two titrations gives the amount of alkali consumed in saponifying the glyceryl triacetate, and from this the quantity of glycerol can be calculated.

Proportion of di-glycerides in fats.—Mono- and di-glycerides are converted into triglycerides by digestion with acetic anhydride.

If, then, a fat containing a mono- or di-glyceride have its saponification equivalent determined before and after treatment, the percentage of the mono- or di-glyceride can be at once calculated, if its molecular weight be known, on considering that each additional equivalent of alkali required after treatment with acetic anhydride corresponds to the presence of an equivalent of acetic acid minus an equivalent of water (*i.e.*, an equivalent of the residue C_2H_2O), each of which gives proof of the presence of one equivalent of a di-, or half an equivalent of a mono-glyceride.

By this process the authors have found 30 per cent. of dierucin, $C_3H_5(OC_{22}H_{41})_2OH$ (which is the only di-glyceride hitherto isolated from natural fats), in rape oil stearin.

If the percentage of mono- or di-glyceride be small, the combined acetic acid may preferably be determined by Reichert's method.

If the fat contain a glyceride of a hydroxy acid, which will itself absorb acetic anhydride, it is necessary first to prepare the fatty acids from it and determine their acetyl number, an allowance for which must be made in the final calculation.

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* A method by which sugar is obtained from molasses by precipitation with CaO, SrO, or BaO.

Reimer and *Witt* (Ber. **20**, 2385) are of opinion that there is a liquid fatty acid in rape oil (rapinic acid) which is a hydroxy acid isomeric with ricinoleic acid; since, however, Benedikt and Ulzer have found the acetyl number for the fatty acids of rape oil to be 6·3, corresponding to only 3·8 per cent. of a hydroxyoleic acid, it follows that rapinic acid must have the third oxygen atom in some form other than as a hydroxyl group.

It is probable that rape oil contains an acid of the linoleic or linolenic series, inasmuch as its iodine number is about 100, while the fatty acids hitherto isolated from it, viz., erucic, behenic, and rapinic, all have lower iodine numbers, viz., 75·2, 0, and 85·2, respectively.

Allen has recently expressed the opinion that Japan wax contains dipalmitin. The authors obtained a negative result when the fat was examined by the above method, the saponification equivalent being unaltered by treatment with acetic anhydride.

Bell obtained an oil melting at 4·4° C. by saponifying butter fat with alcoholic potash in defect; this he considered to be a di-glyceride, but the authors have failed to obtain glycerin from it, and think it to be a mixture of the ethereal salts of various fatty acids.—B. B.

Sources of Error in Determinations of Nitrogen by Soda-lime, and Means for avoiding them. W. O. Atwater. Amer. Chem. J. **10**, 262—282.

The following conclusions are arrived at :—

(1.) Ammonification is affected by the action of the water-vapour expelled from the soda-lime at the temperature of the combustion.

(2.) Leucine and its congeners, alkaloids, amines, amido- and azo-compounds, and protein compounds (from their tendency to decompose into leucine, amines, &c.), do not easily yield all their nitrogen as ammonia.

(3.) Dissociation of the ammonia formed may be avoided by tolerably rapid combustion at a low red heat with plenty of soda-lime to furnish an ample supply of water-vapour.

(4.) Sources of error, other than obvious ones, are :—

(i.) Incomplete ammonification, accompanied by the formation of such bodies as cyanides, or free nitrogen.

(ii.) Loss of ammonia, after its formation, by dissociation (due to too high a temperature), oxidation, by the air in the tube at the beginning of the combustion, or by that used to sweep out the tube afterwards, and neutralisation by acid products if sugar has been used in the combustion.

(iii.) The use of soda-lime containing nitrates or nitrites which may, according to circumstances, furnish nitrogen to be transformed into ammonia, or oxygen to burn the ammonia formed from the nitrogen of the substance.

The author recommends the following precautions:—Close packing of the tube; the absence of any channel; the use of soda-lime, rich in lime and not too dry; the presence of an anterior layer, about 12 cm. long, of coarse soda-lime; the use of oxalic acid in preference to sugar; the adoption of a low red heat, and tolerably rapid combustion, with one hour as the maximum limit.

The indicator he uses is cochineal.—B. B.

A Method for the Analysis of Butter, Oleomargarine, &c. H. N. Morse and W. M. Burton. Amer. Chem. J. **10**, 322—328.

The method depends on the fact that the relation between the amounts of alkali needed to neutralise the soluble and insoluble fatty acids of any given fat is a constant quantity. This is shown by the following table, which gives the mean value of several concordant determinations in each case :—

Name of Fat.	Per Cent. KOH required for Insoluble Acids.	Per Cent. KOH required for Soluble Acids.
Butter	86·57	13·17
Cocoa-nut oil (unwashed)	91·95	8·17
Cocoa-nut oil (washed with hot water)	92·43	7·42
Cocoa-nut oil (washed with dil. Na_2CO_3)	92·33	7·45
Cotton-seed oil	92·05	7·76
Oleomargarin	95·40	4·57
Lard	95·96	3·82
Beef tallow	96·72	3·40

The process is conducted as follows :—

Between 1 and 2 grms. of the dry and filtered fat—the exact quantity need not be known—is placed in an Erlenmeyer flask of 250 cc. capacity, and heated with that amount of alcoholic potash, of approximately 20 grms. per litre, which exactly equals 40 cc. of a standard hydrochloric acid, of which 1 cc. = 20 mgrms. KOH. When saponification is complete, phenolphthalein is added, and the excess of alkali determined by the standard hydrochloric acid; this gives the total alkali required for all the fatty acids.

The alcohol is then evaporated off, during which process the solution becomes alkaline, doubtless from loss of a small amount of volatile acids in the form of ethereal salts. This loss, though inconsiderable, may be made good, if desired, by means of very dilute acetic acid, which is added until neutrality is restored.

The soap is then treated with just enough standard HCl to exactly liberate all the acids; this quantity is, of course, the difference between 40 cc. and the number of cc. used to neutralise the excess of alkali after saponification.

The flask is fitted with a condensing arrangement, consisting of a glass tube about 400 mm. long and 5 mm. in diameter, having its upper end bent downwards and attached to a small U-tube containing a little water; this is designed to prevent the escape of volatile acids during the heating of the flask, which is continued until its contents becomes clear. The solution, to which is added the liquid from the U-tube, is then filtered through thick paper, well wetted, and the insoluble fatty acids washed until the filtrate measures 1 litre.

The soluble fatty acids can be directly titrated with alkali of $\frac{1}{10}$ the strength of that previously used; but the insoluble fatty acids had better be dissolved in 50 per cent. alcohol, saponified with the quantity of the stronger alkali that was originally used for the fat, and the excess titrated back with an acid of $\frac{1}{10}$ the strength of that employed before.

The flasks used are little attacked by the comparatively dilute alkali, and therefore do not vitiate the results if they have been previously boiled with strong potash.—B. B.

New Books.

Dyeing.—Comprising the Dyeing and Bleaching of Wool, Silk, Cotton, Flax, Hemp, China Grass, &c. By Antonio Sansone. Illustrated with numerous Plates and Specimens. Manchester: Abel Heywood and Son, 56 and 58, Oldham Street. London: Simpkin, Marshall, and Co., Stationers Hall Court. Hamilton, Adams, and Co., 32, Paternoster Row. 1888.

Octavo volume bound in cloth, accompanied by imitation companion volume, really consisting of a box containing a large assortment of numbered and classified patterns and samples, illustrating the text of the work.

The book contains Preface, Table of Contents, List of Plates, one of Illustrations, 245 pages of Subject-matter, and an Alphabetical Index. The work is subdivided for treatment in detail into the following sections:—History of Dyeing, History of the Coal Tar Colours, General Characteristics of Fibres, Testing Colouring-Matters by Dyeing. Practical Processes: Cotton, bleaching, dyeing, and finishing. Linen, Jute, China Grass, &c. Wool, scouring, washing, bleaching, &c. Dyeing with Natural Organic Colouring-Matters. Silk, Weighting of Silk. Communications, Abstracts, &c. Alizarin Colours in Wool Dyeing; Various New Dyestuffs; Preparing Soaps for Wool Scouring; Hermite Bleaching Process; China Grass or Rhea Rami Fibre. Machinery employed in Dyeing. Explanation to the Dyed Patterns. Two hundred and twenty-one patterns on twenty-nine plates form the second volume. A well-engraved frontispiece representing the Obermeyer Mechanical Dyeing Process, opens the work.

Tabellarische Uebersicht der Künstlichen Organischen Farbstoffe. Von Gustav Schultz and Paul Julius. Berlin, S.W., Schönebergerstrasse, 26. R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder. London: H. Grevel and Co., 33, King Street, Covent Garden.

Large 8vo. volume bound in cloth, containing the Dedication to Professor Dr. A. W. Hofmann on the attainment of his 70th birthday, as a mark of high esteem and veneration, the Preface, Tables of Contents, and Abbreviations, also another Table indicating the manner of arrangement of the tabulated matter forming the text, the Subject-matter covering 79 pages, and finally a copious Alphabetical Index.

The tables forming the text are arranged in columns containing, 1st., the Number of the colouring-matter; 2nd., the Scientific name; 3rd, the Empirical formula; 4th, the Constitutional formula; 5th, In a brief sentence or two, the method of preparation, or rather the ingredients employed; 6th, the year of Discovery; 7th, the Discoverer, the patent, and reference to the literature of the dyestuff; 8th, Behaviour with reagents, employment and shade produced.

As regards the matter treated of, it is subdivided into the following groups. I. Nitroso-colours. II. Nitro-colours. III. Azoxy-colours. IV. Azo-colours. V. Hydrazone-colours. VI. Diphenylmethane-colours. VII. Triphenylmethane-colours. VIII. Anthracene-colours. IX. Indophenols. X. Oxazines and Hydroxazines. XI. Thionine-colours. XII. Eurhodines. XIII. Safranines. XIV. Indulines and Nigrosines. XV. Artificial Indigo. XVI. Quinoline and Pyridine-colours. XVII. Appendix.

The Analysts' Laboratory Companion. By Alfred E. Johnson, Assoc. R.C.Sc., F.I.C., F.C.S. London: J. and A. Churchill, 11, New Burlington Street. 1888.

Small 8vo. volume, bound in cloth, and containing Preface, Table of Contents, 90 pages of Subject-matter, and an Alphabetical Index. It is stated that the work "is the outcome and expansion of a MS. book of factors and tables the author has had in every-day use in the laboratory for the past four years." It has thus been gradually accumulated, and thus purports to be the outcome of experience as to its utility.

The following is an excerpt of the contents: After some 33 pages of general elementary tabulated matter, logarithmic constants, and other formulæ, we find set of signs used in medical prescriptions and other useful data. Tables required in Water Analysis. Tables required in Beer Analysis: I. Spirit Indication; distillation process. II. Spirit Indication; evaporation process. III. Value of the Acetic Acid. IV. Table for Salt in Beer. Specific rotatory powers of the Carbohydrates, with Table. Table for the determination of Levulose and Dextrose. Cupric Oxide reducing powers of the Carbohydrates, with Table. Table for Phosphates. Table for Ammonia and Albuminoids from Nitrogen found. Quinine. Estimation of Chicory in Coffee mixtures, with Table. Alcohol Table, &c.

Die Chemie der Steinkohlentheers, mit besonderer Berücksichtigung der Künstlicken Organischen Farbstoffe. Von Dr. Gustav Schultz. Zweite Vollständig umgearbeitete Auflage. Zweiter Band. Die Farbstoffe. Zweite Lieferung. Braunschweig. Druck and Verlag von Friedrich Vieweg und Sohn, 1888. London: H. Grevel and Co., 33, King Street, Covent Garden.

Octavo volume bound in paper cover, commencing with page 193 and ending on page 384. Its price is 6s.

It is a continuation of the work and so commences without table of contents or other prefacial matter, and ends without index. The page 193 commences with a study of the Homologues of Chrysoidine with Bismarck Brown. Then follows a section on the Sulphonic Acids of the Amidoazo-Compounds. On page 207 the 27th Chapter is arrived at. It is devoted to the Hydroxyazo-Compounds and their derivatives. Chap. XXVIII. treats of the Disazo Colouring-Matters. Chap. XXIX., the Colours of the Congo Group. Chap. XXX., the Hydrazone Colours. Chap. XXXI., the Triphenylmethane Colours; and Chap. XXXII., continued into the next volume, the Magenta Group (Parafuchsin and Fuchsin).

Chemisch-technisches Repertorium. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie mit Hinweis auf Maschinen, Apparate, und Literatur. Herausgegeben von Dr. Emil Jacobsen. 1887. Zweites Halbjahr. Erste Hälfte. Mit in den Text gedruckten Illustrationen. 1888. Berlin, R. Gaertner's Verlag. Hermann Heyfelder. S.W., Schonebergerstrasse 26. London: H. Grevel and Co., 33, King Street, Covent Garden.

Octavo volume, bound in paper cover. It contains Table of Contents, Title page, and 176 pages of Subject-matter.

The text is embellished with numerous well executed woodcuts, and the subject-matter subdivided into chapters classified as follows:—I. Building Materials, Cements, and Artificial Stones. II. Colouring-Matters, Dyeing and Printing. III. Fats, Oils, Illuminating and Heating Materials. IV. Fermented Liquors. V. Tanning, Leather, and Glue-making. VI. Textiles. VII. Glass and Earthenware. VIII. Wood and Horn. IX. India-rubber. X. Cements, Adhesives, &c. XI. Lakes, Varnishes, and Paints. XI. Metals.

Guide-Book for Distillers and Manufacturers of Arrack, Cognac, Gin, Rum, Cordials, Liqueurs, &c., &c. By E. Sachsse and Co., Leipsic.

Octavo volume, in cardboard cover. It contains Title page, Index, Preface, and 48 pages of Subject-matter.

The text contains articles on the Storage and Solution of Essential Oils; Sugar and Syrup; Spirit; Manufacture of the Liqueurs and Spirits; Clarification of Liqueurs; and General Remarks. Then follow numerous recipes for the preparation of all manner of Liqueurs, Essences, Bitters, Whiskies, &c. Lastly, after a paragraph on Wine-Bouquets, there follows a series of recipes for Essences of this description.

Trade Report.

(From the Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Russia.

Classification of Articles in Customs Tariff.

Note.—Poud = 36 lbs. avoirdupois. Gold Rouble = 3*s.* 2*d.*

Asbestos in powder to pay duty under section 145.—Duty 30 copecks gold per poud.

Zinc in powder to pay duty under section 102, point 1, similarly as zinc in pieces.—Duty 45 copecks gold per poud.

Switzerland.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lbs. avoirdupois. Kilogramme = 2·204 lbs. avoirdupois. Franc = $9\frac{6}{10}d$.

Rags of wool and of half wool, for the manufacture of manures.—Category 2. Duty free.

Soldering powder (made of borax, sal ammoniac, and colophane) for soldering iron and steel.—Category 18. Duty 2 francs per quintal.

Quebracho wood, ground, powdered, &c.—Category 52. Duty 2 cents per quintal.

Spain.

Classification of Articles in Customs Tariff.

Quintal = 220·4 lbs. avoirdupois. Peseta = $9\frac{6}{10}d$.

Resinous oil.—Category 59. Duty 23 pesetas per quintal.

Sulphate of potassium, unrefined.—Category 92. Duty 10 cents per kilog.

Glucose, including weight of immediate receptacle.—Category 91. Duty 1 peseta per quintal.

ROUMANIA.

Customs Regulations affecting clearances of Consignments of Linseed Oil and assessments of Duty thereon.

A communication, dated the 11th September last, has been received from the Foreign Office, transmitting a note from the Roumanian Minister for Foreign Affairs, stating the steps taken by the Roumanian Customs authorities to facilitate the clearing of consignments of linseed oil, and the assessment of duty thereon. The following is a translation of the note in question :—

"The Royal Department of Finance, desirous of facilitating, as much as possible, the Customs formalities relating to the chemical analysis and the taxation of boiled linseed oil, has placed at the disposal of the Customs offices of Galatz and Braila samples of this article in order that in future the above-mentioned oil will no longer be retained in the Customs until the receipt of the certificate of the chemical laboratory at Bucharest, but its substance and quality will be indicated by the Customs itself."

UNITED STATES.

Classification of Articles in Customs Tariff.

Certain santal, melissa, vetevert, angelica, geranium, mustard, and pine oils are held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 92) for "all preparations known as essential oils, expressed oils, distilled oils, rendered oils," &c.

So-called "hydroquinone," an article which may be produced from several sources, but which is, in fact, a chemical compound, is dutiable under the provision in Schedule A. (T. I., 92) for "chemical compounds," and is not free as a salt of quinia, under T. I., 629.

MISCELLANEOUS TRADE NOTICES.

A NEW TOBACCO DISEASE.

According to the *Journal de la Chambre de Commerce de Constantinople*, of the 25th August last, the cultivation of tobacco is in danger of a disease hitherto unknown. The malady has appeared in Greece, in some plantations of the Phtiotide. The plants, appearing very healthy during the day, bend suddenly at night to the earth, and the next day are dead.

THE PROGRESS OF THE STUTTGART COMMERCIAL MUSEUM.

The *Bulletin du Musée Commercial* for the 15th September last, with reference to the progress of the Stuttgart Commercial Museum, says :—

"The *Export-Musterlager* of Stuttgart has just published its sixth annual report, from which the following data are extracted :—

"The *Export-Musterlager* is a permanent exhibition of native products, founded by a Wurtemburg association of merchants and manufacturers, with a view to inform foreigners as to what may be procured in Wurtemburg.

"The society now includes 320 members, distributed according to trades, as follows :—Chemical industry, 22; food products, 22; minerals, pottery, and glass making, 5; machinery, rolling-stock for railways, tools, and apparatus, 30; carriages, apparatus for firemen, straps, &c., 7; leather industry, 21; works in metal, 72; works in wood and hardware, 35; textile industry, 71; musical instruments, 14; paper and polygraphic arts industry, 21.

"Statement of visitors :—

1882 - 170 visitors, of whom 26 were buyers.
1883 - 217 ,, ,, 121 ,,
1884 - 225 ,, ,, 110 ,,
1885 - 192 ,, ,, 145 ,,
1886 - 206 ,, ,, 186 ,,
1887 - 210 ,, ,, 196 ,,

"The total number of orders received, both by the establishment itself and by the similar association at Hamburg, have been :—90 in 1882, 760 in 1883, 913 in 1884, 1,087 in 1885, 1,413 in 1886, and 1,405 in 1887."

ADULTERATING WINE WITH PLASTER IN FRANCE.

See Board of Trade Journal for October, p. 439.

STATISTICAL ACCOUNT OF PARAGUAY.

Ib. p. 454.

THE EXPORT TRADE OF THE GOLD COAST.

Ib. p. 458.

EXTRACTS FROM BRITISH AND FOREIGN CONSULAR REPORTS.

CANTON.

Drugs and Medicines.

Foreign medicines and drugs continue in favour on the Canton market, as will be seen from the figures given below. The increase in the import of put-up worm-tablets is especially remarkable, as is that in condensed milk, which the natives find useful for their children, and occasionally eat as jam. The Consul thinks that it is worth drawing attention to these articles, for it is in such outside lines that great development of trade is to be looked for; and fortunes will be more readily made in aniline dyes, soap, glass, candles, Cockle's pills, and such like articles, beneath the attention of the merchant prince though they may be, than in the old-fashioned staples.

Drug and Chemical Imports.

Of foreign drugs and chemicals the following quantities were imported into Canton in 1886 and 1887 respectively :—

—	1886.		1887.	
	Piculs.	Hankow Taels.	Piculs.	Hankow Taels.
Quicksilver............	500	24,918	448	26,956
Aërated waters	875	2,673	1,095	5,257
Opium	25,291	407.431	7,702	2.411,121
Soap	2,949	14,453	31,718	10,896
Ultramarine	215	1,383	270	1,097
Worm-tablets {dozen bottles}	3,548	6,506	4,846	5,509
Borax	268	2,290	206	1,663
Chlorate of potash	118	2,080	53	1,344
Cochineal...............	51	2.509	21	1,121
Confectionery {dozen bottles}	3,168	3,153	2,961	2,731
Dyes	1,649	98,572	..	86,806
Glassware	2,181	26,253	..	24,648
Medicines	..	6,552	..	5,744
,, Japanese	425	1,485	434	1,468
Milk, condensed {dozen tins}	6,919	10,232	8,786	11.551
Mustard....dozen bottles	603	734	1,107	1,240
Paints	79	757	180	1,461
Perfumery.dozen bottles	10,790	11,015	..	9,808

Exports.

The exports from Canton comprise :—

—	1886.		1887.	
	Piculs.	Hankow Taels.	Piculs.	Hankow Taels.
Cinnabar	2,736	102,660	3,154	160,996
Cuttle-fish	4,922	44,535	196	1,722
Musk..................	2·97	11,826	3·13	28,671
Peppermint oil	28	5,693	19	3,457
,, crystals	6	1,216	..	1,820
Wax (white)............	1,264	57,148	4.772	226,866

—*Chemist and Druggist.*

PETROLEUM IN THE EAST.

The great Russian oil wells at Baku will have lost a good customer in India through the discovery of the oil springs at Khatun, about 40 miles to the east of the Sibi station of the North-Western Railway in Baluchistan. Borings were first made there three or four years ago upon certain indications that had been observed; the result was the discovery of large supplies of heavy petroleum at moderate depths. Experiments that have been recently made by pumping the wells for a period of 11 or 12 hours each have, according to the report of Colonel Conway-Gordon, shown that each well will deliver from four to six hundred barrels of oil in 24 hours. Thus, any one of the existing wells is more than competent to furnish the entire supply of 50,000 barrels of oil a year, which is estimated to be the amount required for the Sind-Pishin section of the railway. The tools, which have been specially obtained from Canada for making deep borings, have been worked efficiently during last year, and experiments have been instituted with a view to delivering the oil through a pipe line from the oil field, which lies at a height of 1,400 feet and more above the railway. Further important discoveries are expected to be made, and it has been determined to carry down the boring if necessary to the great depth of 2,500 feet in the search for lighter oil.—*Daily News.*

A Chemical Syndicate.

A meeting of caustic soda makers has been held at Liverpool, at which practically the whole of the trade was represented. Mr. Chance, of Birmingham, occupied the chair. It was unanimously resolved to form an association, and a week's cessation of production to allow the demand to overtake the supply was agreed upon. Makers have been driven to co-operate with each other, as the low prices recently ruling have involved serious losses, and the advances demanded for coal and salt will add to the cost of producing caustic soda. It is confidently expected that higher prices will rule in future.—*British and Colonial Druggist.*

The United States Drug and Chemical Trade.

The following figures, compiled from official sources, represent the quantities of the principal drugs and chemicals imported into and exported from the United States during the years (ending June 30) 1887-88 and 1886-87 respectively.

—	Imported.		Re-exported.	
	1888.	1887.	1888.	1887.
Duty Free Goods.				
Alizarine, natural or artificial......... Lbs.	2,454,243	2,095.212	..	..
Argols.............. „	17,226,491	22,024,763	..	..
Bark (cinchona).... „	2,801,443	4,788,044	2.712	5 252
Cochineal........... „	181,495	492,304	..	606
Logwood in sticks. Tons	77,697	59,265	90	1
Dyewoods (unen.) Value Dolls.	136,204	284,741	..	219
Gum arabic .... Lbs.	915.799	467,782	1,832	17,597
Camphor (crude) ... „	2,779,719	2,857,222	22,197	320
Cutch and gambier . „	36,896,670	25,598,212	25,283	35,123
Shellac .... „	4,206,850	4,722,538	513	2,248
Gums and gum resins (unen.).......... Lbs.	20,496,860	16,582,619	195,967	169,370
Indigo.............. „	3,114,279	3,469,182	2,470	20,038
Bleaching powder... „	95,318,471	103,087,827	15,000	11,611
Liquorice root ...... „	49,151,664	79,603,855	..	..
Mineral waters (not artificial)....... Galls.	1,800,803	1,834,411	2,534	597
Potash, muriate of. Lbs.	56,065.179	38,569,814	..	..
Quinine salts .... Oz.	1,628,414	2,753,962	5,098	162
Soda (nitrate)..... Lbs.	178,954,024	172,174,889	770,745	5,968,003
Brimstone (crude). Tons	99,253	97,283	4	20
Vanilla .... Lbs.	145,379	137.439	11,281	1,568
Drugs, chemicals, and dyes (unen.) .. Value Dolls.	4.035,470	3,355,714	230,023	213,406
Oils, fixed or expressed Lbs.	21,158,638	18,268,778	1,640,143	3,931,446
Oils (essential) ..... „	1,524,680	1,492,041	11,662	3,059
Sulphate of lime, unground.......... Tons	133,606	146,933	..	..
Plumbago......... Cwt.	181,329	169,021	450	..
Dutiable.				
Coal-tar colours and dyes Value Dolls.	1,839,678	1,540,067	15,059	22,867
Glycerin........... Lbs.	10,060,719	12,765,072	49,142	21,633
Dyewood (extracts) „	2,391.377	3,396,467	623,010	2,000
Opium (crude)..... „	447,920	568,263	33,303	64,168
Saltpetre (crude) .. „	7,983,812	10,313,866	363,733	484,850
Soda (bicarb.) ...... „	2,020,643	2,548,580	30,718	64,781
„ carbonate, including sal soda and soda ash Lbs.	284,580,151	287,704,468	34,821	127,123
Soda (caustic) ...... „	89,321,467	84,689,458	1,703,545	1,070,178
„ other salts..... „	17,609,223	15,739,772	6,800	13,449
Chemicals and drugs (unen.) .. Value Dolls.	3,800,278	3,399,726	37,345	37,330
Perfumery and toilet preparation . Value Dolls.	361,483	385,362	1,487	2,708
Oil (whale and fish) Galls.	242,450	174,278	2,709	3,691
„ (other animal). „	16,744	11,845	..	..
„ (mineral) ...... „	377,713	290,536	2,000	..
„ (olive) .... „	654.036	744,766	1,999	2,312
„ (other vegetable) „	650,822	498,086	33,008	31,465
„ (essential) ..... „	602,421	122,266	875	1,321
Paints and colours Value Dolls.	1,244,320	1,214,283	5,597	2,236
Soap (toilet)....... Lbs.	615,878	461,600	1,105	2,232
„ (other kinds) Value Dolls.	234,351	242,496	15	479

The Negotiations concerning the Renewal of the German Potash Manufacturers' Syndicate.

The negotiations concerning the renewal of the German potash manufacturers' syndicate terminated successfully in Berlin on September 21. The syndicate has now been renewed for 10 years, greatly to the disadvantage of its customers, most of whom are outside Germany, and who would have been large gainers by the murderous competition which would no doubt have ensued had the negotiations fallen through.—*Chemist and Druggist.*

Russia's Foreign Trade.

Russia's foreign trade during the first half-year of 1888 is reported to have been very much more active than in the corresponding period of 1887. Thus the declared value of the imports into European Russia rose from 38,965,900*l.* to 49,258,800*l.*, an increase of nearly 20 per cent., and the exports from 23,707,000*l.* to 34,843,000*l.*, the principal increase being in the exports of cereals. The Customs duties paid upon goods entering Russia also increased from 4,182,702*l.* to 4,567,600*l.* The figures referring to the chemical and allied branches are by no means so satisfactory as the general state of business would lead one to believe. All entries referring to such articles, except indigo, show a falling off, the figures being:—

—	Goods.		Value £	
	1887.	1888.	1887.	1888.
Drugs and chemicals....	2,188,000	2,082,000	536,900	508,500
Dyestuffs	..	..	258,500	245,900
Aniline	22,000	21,000	140,700	129,500
Indigo..................	22,000	35,000	234,300	429,800
Olive oil	309,000	199,000	250,000	159,100

DISCOVERY OF PETROLEUM AT NORTHWICH.

At a meeting of the Northwich rural sanitary authority on the 12th instant the surveyor reported that a well at Anderton, the property of Messrs. Greenall and Co., brewers, of Warrington, had ceased to yield water and had begun to yield petroleum, which burned freely. Several members expressed the opinion that the discovery was one of great importance. Mr. Blades, analytical chemist, Northwich, has personally procured a sample from the well, and, as the result of a few tests, declares that it contains a considerable proportion of petroleum. The jets of inflammable gas which occasionally occur in the neighbouring salt mines tend to establish the genuineness and importance of the find.—*British and Colonial Druggist.*

EXPORTS OF UNITED STATES MANUFACTURES AND PRODUCTS.

——		1888.	1887.
Barks extracts, for tanning ..	Value Dolls.	254,204	239,700
Acids	„	104,790	91,627
Ashes, pot and pearl	Lbs.	512,863	889,592
Dyes and dyestuffs	Value Dolls.	966,080	786,623
Ginseng	Lbs.	309,964	330,831
Medicines, patent and proprietary	Value Dolls.	1,545,514	1,447,067
Roots, herbs, and barks	„	137,756	145,113
Chemicals, dyes, and medicines (not enumerated)	„	2,194,531	2,145,265
Perfumery and cosmetics	„	391,866	322,059
Grease and soap stock	„	924,777	849,908
Rosin	Barrels	1,490,314	1,365,012
Paints and colours	Value Dolls.	492,799	452,388
Quicksilver	Lbs.	1,032,852	514,210
Soap, toilet	Value Dolls.	59,496	57,751
„ (other)	Lbs.	18,901,768	19,682,406
Spermaceti and spermaceti wax	„	226,576	336,222
Spices	Value Dolls.	36,270	42,112
Alcohol	Proof Galls.	329,317	1,264,513
Spirits of turpentine	Galls.	10,585,942	10,209,883
Varnish	„	143,926	96,427
Wax (bees')	Lbs.	78,070	90,350
Oil (lard)	Galls.	931,616	975,163
„ (sperm)	„	136,092	157,169
„ (whale and fish)	„	1,360,399	1,348,804
„ (other animal)	„	617,801	570,376
„ (illuminating)	„	456,427,221	480,845,011
„ (lubricating and heavy paraffin)	„	22,889,529	16,910,513
„ (cotton seed)	„	4,458,597	4,067,138
„ (linseed)	Value Dolls.	92,134	119,840
„ (essential)	„	325,100	309,460
„ (other vegetable)	„	56,890	65,689

—*Chemist and Druggist.*

EXTRACTS FROM THE AUGUST REPORT OF MESSRS. GEHE & Co., DRESDEN.

CHEMICAL AND PHARMACEUTICAL PREPARATIONS.

Acidum Aceticum.

Pure and glacial acetic acids have not experienced any noteworthy change.

Acidum Boricum.

The discovery of borax chalk deposits in Chili has powerfully affected the sale of Italian boric acid.

Acidum Carbolicum.

The demand for this acid continues to be important, in consequence of which a return to the formerly cheap price is not to be expected. A decrease seems also rendered more improbable, as it is rumoured that the German Government intends to use a large quantity of carbolic acid for the preparation of explosives. The quantity of coal tar obtained in England for manufacturing is six millions of hundredweights, whilst France has only one million, Germany, 750 thousand, Belgium and Holland 300 and 150 thousand respectively. If the experiment now in progress with reference to the artificial preparation of phenols, and indirectly aniline from benzene, have a favourable result, a remedy would be provided against the altogether too high price of the carbolic acid obtained directly from coal tar.

Acidum Hydrofluoricum.

The application of this acid as an inhalation against phthisis appears also to aim at taking a place in medicine in Germany.

Acidum Succinicum.

The demand for this remains weak, and the consumption is not able to keep pace with the preparation. A prominent firm of amber workers has therefore offered a prize for the discovery of new applications for succinic acid, and for amber oil.

Acidum Sulphuricum.

According to the official statistics the production of sulphuric acid and of crude oil of vitriol last year in Germany was—

347,529 tons, valued at M. 11,680,993, against
325,722 „ „ M. 11,848,716 in 1886.

The import and export during the same period was as follows:—

	1887.		1886.
Import	7,393 tons	....	6,602 tons.
Export	17,136 „	....	18,685 „

from which it is to be concluded that the home consumption during the past year has somewhat increased. To the amount produced in 1887 as expressed above, the different States contributed as follows:—

Prussia	253,556
Saxony	14,984
Hesse	19,350
Brunswick	14,669
Hamburg	15,759
Alsace Lorraine	12,805
The remainder	16,406

The price generally last year was falling again, from which it followed that though the total production exceeded that of 1886 by 21,807, the value was M. 167,723 less.

Acidum Tartaricum.

The price of this acid has fallen together with a weaker demand. Even in calico printing the consumption has fallen off, and at present the outlook for the future is not encouraging.

Aethers.

During the past few months the price of these, like that of spirits, has fallen. Even in pharmaceutical circles greater attention is being paid to their purity.

Aethylium Bromatum.

Bromide of ethyl is considerably sought after still for minor dental operations where a rapidly effected anæsthesia of short duration is desired. In such cases it does not cause vomiting, and the patient quickly recovers conciousness.

Ammonium Salia.

The demand for sulphate of ammonium in agriculture had been pretty lively in the last few months; after this want, however, was sufficiently supplied, all inquiries ceased and the market became again weaker.

Anthrarobinum.

This anthrachinon derivative up to now has not aroused any demand worth mentioning. The equality of the price to that of chrysorobin, which it is designed to replace, should not, in our opinion, hinder its introduction, as for the physician it is surely of importance to apply a substance of constant composition, which is not possible with chrysorobin and its frequently varying proportions of chrysophanic acid.

Atropinum.

A further weakness in this chemical has to be recorded for the past half-year. The long since recognised possibility of the conversion of hyoscyamine into atropine has to some extent been explained by a more intimate knowledge of the conditions under which it takes place.

Chloroformium.

The export of chloroform under the free trade principles of the German Government has in the last three years fallen off 66 per cent., whilst the import during the same period, in spite of the 20 M. per 100 kilos. import duty has increased to three times the amount.

Caffeine.

Messrs. Gehe and Co.'s August report also, alluding to the striking fall in the price of caffeine, expresses the conviction of the probability of a further decrease, owing to the manufacture of the alkaloid in England from duty free material, and adds that "the condition of our own industry will be considerably endangered thereby; not only will England be lost as a customer, but it is also to be expected that English competition will sooner or later make itself felt in commerce."—*British and Colonial Druggist.*

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports into the United Kingdom from Spain.

Principal Articles.		Three Months ending	
		Sept. 1887.	Sept. 1888.
Chemical products unenumerated	Value £	17,367	9,393
Copper ore and regulus	Tons	13,262	21,757
	Value £	214,459	512,480
Manganese ore	Tons	6	..
	Value £	23	..
Pyrites of iron or copper	Tons	125,231	127,027
	Value £	226,871	241,695
Quicksilver	Lbs.	289,125	..
	Value £	25,250	..
Rags, esparto	Tons	11,563	16,782
	Value £	65,891	100,424
Total Value	£	2,052,685	2,327,663

Exports of British and Irish Produce from the United Kingdom into Spain.

Principal Articles.		Three Months ending	
		Sept. 1887.	Sept. 1888.
Alkali	Cwts.	79,806	67,759
	Value £	26,873	19,688
Caoutchouc, manufactures of	Value £	4,868	5,414
Cement	Tons	1,010	3,245
	Value £	1,899	5,963
Chemical products and preparations (including dyestuffs)	Value £	11,632	16,321
Coal, products of (including naphtha and paraffin)	Value £	2,225	9,271
Glass manufactures	Value £	1,758	2,190
Manure	Value £	12,647	30,537
Oil, seed	Tons	99	91
	Value £	2,142	1,913
Painters' colours and materials	Value £	7,281	8,314
Paper of all sorts	Cwts.	1,066	1,280
	Value £	2,337	3,229
Soap	Cwts.	1,160	544
	Value £	966	575
Total Value	£	881,822	922,242

STATISTICS.

Board of Trade Returns.

Imports.

—	Month of September.	
	1888.	1887.
	£	£
Bark (Peruvian)	34,273	35,057
Chemicals, dyestuffs, and tanning substances:—		
Alkali	3,189	4,952
Bark for tanners' or dyers' use	17,115	13,510
Brimstone	5,842	14,910
Chemical manufactures and products, unenumerated	87,361	105,617
Cochineal	2,993	5,434
Cutch and gambier	42,751	62,050
Dyes (coal tar):— Aniline	18,562	25,340
Alizarin	23,979	23,227
Other coal-tar dyes	1,316	650
Indigo	8,214	14,617
Madder, madder root, garancine, and munjeet	1,630	1,820
Nitre, cubic (nitrate of soda)	48,950	23,131
Saltpetre	27,691	20,911
Valonia	31,641	22,234
Drugs, unenumerated	75,939	46,456
Guano	7,995	8,239
Gum:—		
Arabic	21,676	20,462
Lac, seed, shell, stick and dye	9,545	9,290
Gutta percha	21,696	16,424
Oils and fats:—		
Cocoanut	8,140	11,199
Olive	34,524	43,636
Palm	76,614	75,729
Paraffin	39,440	29,982
Petroleum	194,254	168,070
Seed of all kinds	30,279	29,139
Tallow and stearin	120,954	73,634
Train, blubber, and sperm	42,641	29,363
Turpentine	42,165	41,275
Quicksilver	11,962	3,252
Rosin	11,603	14,035
Seeds:—		
Linseed	475,672	284,128
Rape	21,220	43,131
Tar	10,964	13,627

BOARD OF TRADE RETURNS—*continued.*

Exports.

—	Month of September.	
	1888.	1887.
	£	£
Candles	15,569	16,114
Chemicals and chemical and medicinal preparations:—		
Alkali	134,577	153,434
Bleaching materials or preparations	50,030	48,380
Chemical manure	164,448	139,636
Medicines, comprising drugs and medicinal preparations	78,980	68,260
Other articles	200,488	181,101
Glass:—		
Plate	23,612	21,877
Flint of all kinds, and manufactures thereof	27,946	24,649
Bottles, &c.	37,161	38,264
Painters' colours and materials, unenumerated	122,362	121,427
Pickles, vinegar, sauces, condiments, and confectionery, unenumerated	126,631	119,141
Salt	37,297	47,068
Seed oil	131,096	109,345
Soap	37,889	37,908

QUICKSILVER.

	IMPORTS.			
	1888.	1887.	1886.	1885.
	Bottles.	Bottles.	Bottles.	Bottles.
September	1,670	510	850	300
Jan. to Sept.	65,132	57,341	56,362	50,921
	EXPORTS.			
September	3,714	3,367	8,053	9,643
Jan. to Sept.	38,464	49,757	56,370	40,711
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Average Price	8 9 0	7 10 0	7 2 6	5 19 6

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

13,611. J. B. Alliott and H. S. Firman, London. Vacuum apparatus. September 20.

13,625. H. H. Leigh.—From B. E. Gasquet and A. de Gaulne, France. Filtering apparatus. Complete Specification. September 20.

13,655. D. Stewart, Glasgow. Centrifugal apparatus. September 21.

13,879. A. Howatson, London. A novel construction or arrangement of apparatus for heating feed water. September 26.

13,885. R. Sickel, London. Means for promoting the consumption of smoke in steam boiler tubes and other flues. September 26.

13,886. G. Torry, London. Improvements in furnace grates. Complete Specification. September 26.

13,936. H. F. Clayton and G. H. Holdroyd, Huddersfield. An improved method of filtering and apparatus therefor. Complete Specification. September 27.

14,063. J. S. Fairfax, London. Improvements in and relating to metallic vessels for containing and supplying fluids under pressure for various purposes. September 29.

14,183. T. A. Bullough and G. H. Bolton. *See* Class VII.

14,394. W. G. Forster, London. Furnaces and apparatus for heating pots and crucibles. October 6.

14,432. J. Horn, London. Furnaces for heating steam boilers and gas retorts, and for similar purposes. October 8.

14,448. L. Block, London. Apparatus for compressing gas, &c. Complete Specification. October 9.

14,599. S. Binks.—From J. Binks, United States. Apparatus to prevent deposit or incrustation in boilers. October 11.

14,616. M. Hecking, London. Centrifugal pumps. October 11.

14,643. I. S. McDougall and J. T. McDougall. *See* Class XIX.

* COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,678. F. Pelzer. Centrifugal pumps. October 20.

14,231. H. H. Lake,—From O. S. Andersen. Centrifugal apparatus for separating liquids of different density. October 20.

15,434. C. A. Jensen.—From Schuchtermann and Kremer. *See* Class IX. September 22.

15,688. A. Anderson. Apparatus for consuming smoke and economising waste heat in boilers and furnaces. September 22.

16,222. S. Cutter. Gas washers or scrubbers. September 22.

16,545. J. S. Sawrey and H. Collet. Apparatus for separating liquids from solid matters in suspension therein. September 22.

16,787. H. E. Newton.—From E. Theisen. Apparatus for condensing and cooling. October 13.

16,805. W. T. Walker. Distillatory apparatus for use in chemical operations. October 13.

16,806. W. T. Walker. Apparatus for driving off from liquids volatile constituents thereof. October 13.

17,049. I. S. McDougall and T. Sugden. Apparatus for separating solid matter from fluids, and liquids from vapours or gases. October 20.

17,370. J. S. Sawrey and H. Collet. Apparatus for separating liquids from solid matters suspended therein. October 13.

1888.

3911. C. P. Kinnell and G. Rothnie. Thermostat for automatically regulating the supply of gas or liquid fuel. October 6.

8127. F. Vyrazil. Apparatus for evaporating, distilling, or condensing. September 22.

11,118. J. W. Jones. Taps and valves. September 29.

11,734. H. H. Lake.—From B. A. Moody. Furnaces for burning liquid fuel. October 6.

12,384. E. Rutzler and G. W. Blake. Thermostats. October 13.

12,391. S. M. Lillie. Evaporating apparatus. October 6.

12,753. C. Latarche. Means and apparatus for evaporating, concentrating, and distilling liquids, and condensing the vapours produced therein. October 13.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

13,286. A. C. Jeffrey, Birkenhead. Improvements in the method of preparing blocks from coal for fuel, and for utilising the waste and dross of shale, coal, and coke. September 14.

13,329. J. Jameson. *See* Class III.

13,370. T. C. Fawcett, Halifax. A new or improved combination of machines for manufacturing briquettes and other like articles from small coal. September 17.

13,389. D. H. Saul, London. An improved atmospheric gas burner for burning coke, coal, or any inflammable fuel, or heating any substance to an incandescent heat, that may be used in gas fires. Complete Specification. September 17.

13,540. S. de la Grange Williams, London. New or improved burners for heating lime kilns, brick kilns, and other kilns by the combustion of gas, and for other like purposes. September 19.

13,626. C. Wells, R. E. C. Shann, and M. H. C. Shann, London. An improvement in the manufacture of candles and the like. September 20.

13,651. A. Lutschaunig and H. N. Warren, Liverpool. Improvements in or relating to gas lighting. September 21.

13,679. S. Pitt.—From D. Aikman, Canada. Improvements in the treatment of peat. September 21.

13,753. J. A. Wanklyn, London. Improvements in the manufacture of hydrogen gas. September 24.

13,768. R. Stone, London. Improvements in the manufacture of artificial fuel, and in refractory material for lining retorts, and in machinery in connexion therewith. September 24.

13,913. H. C. Webb, Croydon. An inconsumable wick for lamps. September 27.

13,958. L. E. Chagniat, London. Improvements in the composition and preparation of firelighters. September 28.

14,008. H. Aitken, Glasgow. Improvements in making gas from coal or other bituminous or combustible substances. September 29.

14,105. W. T. Sugg, London. An improved mode of and means for lighting by gas. October 1.

14,510. J. de Brouwer, London. Improvements in apparatus to be used in the manufacture of gas. October 9.

14,557. T. L. Callender, Beverley. Making perforated blocks of coal dust, &c. October 10.

14,575. H. H. Leigh.—From T. von Bauer, Germany. Improvements in coke ovens. October 10.

14,585. W. M. Johnsen and J. Jörgensen.—From Träfärädlingsaktiebolaget Victoria Nykoping, Sweden. An improved firelighter. October 10.

14,642. E. B. Ellice-Clark and L. Chapman, London. Improvements in apparatus for the production of oxygen and nitrogen gases from atmospheric air. October 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,670. G. Porter. Apparatus and fittings for enriching and burning illuminating gas. September 29.

15,852. J. H. R. Dinsmore. Manufacture of illuminating gas from coal. September 22.

16,222. S. Cutter. Improvements in gas washers or scrubbers. September 22.

16,582. J. Dempster. Apparatus for the continuous production or distillation of gas and other products from coal and other materials. October 22.

16,631. A. F. Firth. Improvements in pipes employed in the manufacture of illuminating gas. October 13.

16,866. R. Good. Apparatus for injecting liquids into gas retorts. October 13.

16,987. E. B. Ellice-Clark and L. Chapman. Apparatus for the production of oxygen and nitrogen gases from atmospheric air. October 20.

17,223. J. Cobbe. Improved method of reflecting gas or other artificial light. October 20.

1888.

1315. C. Brotherhood. Apparatus for automatically generating gas from liquid fuel. October 13.

2943. R. Palmer. Seal pipes for reducing the pressure in gas retorts. September 22.

3310. W. A. Byrom. Making charcoal from peat, &c., and recovering tho volatile matters therefrom. October 20.

12,733. H. C. Rew. Manufacturing illuminating and fuel gas. October 20.

13,329. J. Jameson. Apparatus for obtaining bye-products in the manufacture of hard coke. October 20.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATION.

13,329. J. Jameson, Newcastle-on-Tyne. Improvements in apparatus for recovery of bye-products in the manufacture of hard coke. Complete Specification. September 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,067. J. C. Kräyenbühl, H. C. Petersen, and C. C. Burmeister. Process for the cleaning or separation of ammoniacal liquor and other matters from tar. October 6.

16,582. J. Dempster. *See* Class II. October 20.

1888.

13,329. J. Jameson. Apparatus for obtaining bye-products in the manufacture of hard coke. October 20.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

13,767. T. R. Shillito.—From J. R. Geigy, Switzerland. Production of new colours. September 24.

13,798. O. Imray.—From G. C. Zimmer, Germany. Improvements in the manufacture of colouring-matters. September 24.

13,876. J. Hickisson, London. Improvements in the manufacture or production of coloured marking inks. September 26.

13,920. T. R. Shillito.—From J. R. Geigy, Switzerland. Production of yellow, orange, and brown colours of alizarin-like properties. September 27.

14,353. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. A new class of derivatives of alizarin-blue. October 6.

14,142. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. New or improved manufacture of azo-dyestuffs. October 8.

14,478. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The production of a colouring-matter from carbazol. October 9.

14,479. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. The production from carbazol of a new derivative, to be used in the manufacture of colouring-matters. October 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

17,466. R. Worms. New or improved dyes, and process for the production thereof. October 20.

17,583. O. Imray.—From R. Nietzki. Production of yellow and brown colouring-matters or dyestuffs. October 20.

17,952. C. D. Abel.—From The Actiengesellschaft für Anilinfabrikation. Manufacture of new azo-dyestuffs. October 20.

1888.

170. C. D. Abel.—From G. C. Zimmer. Production of sulpho acids of diphenylamine. October 13.

9614. H. H. Lake.—From K. Oehler. Manufacture of colouring-matters. October 6.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

13,299. A. C. Lossell and E. Farrar, London. An improved yarn. September 14.

13,971. D. Nicoll, London. Improvements in the manufacture and application of waterproof fabrics. September 28.

14,039. G. Burnell and A. Burnell, London. An improved apparatus for cleansing wool and other textile products. Complete Specification. September 29.

14,100. L. de Kien, London. Process and apparatus for treatment of textile plants. October 1.

14,101. I. Singer, London. Improvements in apparatus for cleansing wool and the like. October 1.

14,247. I. Singer and M. W. Judell, London. Improvements in apparatus for cleansing wool and like materials. October 3.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,896. T. F. Wiley. Process and apparatus for rendering textile fabrics waterproof. September 29.

15,899. T. F. Wiley. Apparatus for waterproofing textile fabrics. October 13.

15,900. T. F. Wiley. Process and apparatus for rendering textile fabrics waterproof. September 22.

1888.

12,122. P. M. Justice.—From W. J. Williams. Treating fibres, yarns, and fabrics. October 20.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

13,702. J. G. Sington, Manchester. Improvements in apparatus for dyeing textile materials. September 22.

13,999. W. E. Heys.—From R. Nickels, France. Improvements in the method and apparatus for dyeing and otherwise treating cotton and other vegetable fibres in sliver, roving, yarn, or other state of preparation. September 29.

14,019. S. Mason, jun., and W. T. Whitehead, London. Improvements in machines for dyeing, bleaching, and otherwise treating yarn in cops or bobbins. September 29.

14,346. J. Rhodes and R. Rhodes, London. Improvements in or connected with the dyeing of animal and vegetable fibrous materials. October 5.

14,360. W. H. Preston and A. Torpey, Liverpool. Improvements in apparatus for drying, cleaning, or bleaching wool, cotton, grain, and other material. October 6.

14,617. A. Torphey, Liverpool. Improvements in apparatus for drying, cleaning, or bleaching wool, cotton, grain, and other material. October 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,350. M. Ashworth and R. Wild. Means for and method of washing, scouring, boiling, and bleaching fibrous and textile materials, and for stripping fibres from hides or skins. October 13.

17,586. C. D. Abel.—From R. Koepp and Co. *See* Class XIII. September 29.

1888.

13,193. E. M. H. Andreoli. *See* Class XI.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

13,306. W. P. Thompson.—From W. Spilker and C. Loewe, Germany. Improvements in the manufacture of soda, potash, and chlore. September 14.

13,462. C. Glaser and C. F. W. Dambmann, London. Process of converting insoluble phosphoric acid in mineral or petrified phosphates into available phosphoric acid. Complete Specification. September 18.

13,991. J. C. Butterfield. *See* Class X.

14,026. R. H. Steedman, Glasgow. Improvements in treating impure carbonate of lime produced in making alkali, and in recovering sulphur from alkali waste in order to utilise it for making cement, and for other purposes. September 29.

14,046. C. T. J. Vautin, London. Improvements in the treatment of chloride of lime to facilitate safe transport. September 29.

14,183. T. A. Bullough and G. H. Bolton, Liverpool. Improvements in mixing black ash or other granular or pulverulent solids in bulk with liquids, and conveying the mixture to a converter, and in apparatus therefor. October 2.

14,199. T. Parker and A. E. Robinson, Manchester. Improvements in the manufacture of chlorine, alkalis, and salts from the chlorides of sodium and potassium. October 3.

14,203. H. Kenyon. Clayton. Improvements in preparing ammonia, cyanogen, and soda salts, Leblanc waste and other matters being utilised in the reactions. October 3.

14,238. A. J. Boult.—From F. Jean, France. Improvements in the manufacture of neutral sulphate, sulphite of sodium, ammonia, and soda. October 3.

14,239. J. Greenwood, London. Improvements in the generation of chlorine, in forming a solution therefrom, and in apparatus therefor. October 3.

14,333. M. Cannon, London. Improvements in the manufacture of acetic acid. October 5.

14,563. G. H. Bolton and T. A. Bullough, Liverpool. Improvements in or relating to manipulating and washing, filtering, or otherwise treating lime, mud, black ash, or other materials in bulk during the course of manufacture, and in apparatus therefor. October 10.

14,831. Baron M. von Maltzan and L. Tralls. Process for obtaining nitrogen or nitrogenous mixtures from nitrogenous substances. October 13.

14,927. L. Guéret and C. Guéret. Process and apparatus for obtaining a continuous and determined quantity of carbonic acid or other gas. September 29.

15,168. H. Senier. Process for the separation of zinc hydrate as a crystalline body from solution in the fixed alkali hydrates. October 13.

15,540. G. E. Davis. Apparatus for the distillation of ammoniacal fluids. September 29.

16,084. F. Foster. Apparatus for generating carbonic acid gas. September 29.

17,095. W. White and A. Rickmann. Packing acids. October 13.

17,255. D. Herman. Condensers and towers for the condensation of acid and corrosive gases. October 20.

17,273. L. Mond and G. Eschellmann. Manufacture of chlorine. October 20.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

377. J. Park. Obtaining chromium. September 29.

8208. H. Leffmann. Manufacture of carbonic acid and magnesia. September 22.

12,795. A. Sommer. Manufacture and application of the compounds of chloride of sulphur with fatty bodies. October 13.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

13,387. The Worcester Royal Porcelain Company, Limited, and E. P. Evans, London. Improvements in earthenware or china gravy dishes or holders for food. September 17.

13,765. J. P. Guy, Burslem. Dispensing with woad clay in placing and firing glost ware. September 24.

14,052. E. Leak and H. Aynsley, London. Improvements in the manufacture of "pins" used in supporting pottery ware while being baked or fired. Complete Specification. September 29.

14,466. S. Washington, Manchester. Glass bottles. October 9.

14,619. J. Chapman, London. Improvements in casting or forming articles of pottery, including porcelain, china, and earthenware. October 11.

14,631. J. R. Thame and T. Griffiths, London. Improvements in plastic compositions, and in the moulding or manufacture thereof into various forms. October 11.

14,644. J. Hamblet, London. New or improved machinery for the manufacture of seggars, crucibles, melting pots, pipes, and other hollow and tubular articles from clay or other plastic material.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

10,004. E. Smith and F. Smith. Producing sparkling effect in or from glass alone, or from a combination of glass and metal. September 22.

12,546. A. D. Brogan, J. French, and J. Craig. Improvements in glass annealing kilns. September 22.

15,185. M. Swain. Manufacture of hollow-ware. September 22.

15,875. S. Pitt.—From M. S. Higbie and G. G. Freylinghuysen. Manufacture of compounds from earthenware admixed with other materials. October 6.

16,168. T. Taylor, W. Tunnicliff, and W. H. Slater. Ornamentation of china and earthenware surfaces. October 13.

16,621. J. Larmanjat. Method of and apparatus for moulding, pressing, and drying tiles having inlaid patterns. October 13.

17,125. A. D. Brogan and A. M. Malloch. Apparatus for rolling plate glass to produce rippled, dappled, vermicular, chequered, or other patterns thereon. October 13.

1888.

622. A. Jones. Ornamenting vitreous surfaces. October 20.

9225. S. Sheppard, F. Hazlett, and S. J. Cluff. Apparatus for blowing glass. September 29.

9556. J. Holroyd. Construction of faiénce or glazed terra-cotta mantelpieces, firesides, &c. October 20.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

13,386. E. Robbins, London. A new or improved crystal coagulation, silicified concrete or vitreous manufacture for building, *i.e.*, primary lights. September 17.

13,556. J. H. W. James, Liverpool. Improvements in apparatus for burning and cooling hydraulic lime and cement. Complete Specification. September 20.

13,696. C. H. Scott, Sheffield. Improvements in brick kilns fired by gas. September 22.

14,187. D. Wilson, London. Improvements in wall tiles or slabs, and in frames for fixing them in position. October 2.

14,286. J. W. Ransome, London. Improvements in the manufacture of artificial stone and concrete blocks. October 4.

14,341. J. C. Newbery and C. T. J. Vautin, London. An improved process for the separation of fine clayey matter from a liquid in which it is suspended. October 5.

14,536. E. W. Stead, London. Improvements in moulds for moulding and pressing bricks, blocks, and slabs, applicable also for expelling moisture from clay, whiting, prepared fuel, turf, peat, and the like. October 10.

14,539. T. Stephenson, Halifax. Certain improvements in earthenware tiles. October 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,133. W. P. Thompson.—From J. Winkler. Stamping machines for moulding artificial stones, &c. October 6.

14,554. R. B. Lee. Manufacture of concrete and cement fireproof building materials and parts of buildings, bridges, slabs, blocks, tanks, &c. September 22.

15,434. C. A. Jensen.—From Schuchtermann and Kremer. Apparatus for moving and stirring pulverulent or granular materials and the like in drying, calcining, and similar ovens or stoves. September 22.

1888.

10,319. J. Kleinpeter. Moulding blocks of concrete with a metal facing on one or more sides, for fortifications, &c. September 22.

11,456. F. Neukirch. Method and apparatus for effecting the solidification of loose ground for making foundations, applicable also for making concrete or mortar. September 22.

11,909. J. W. T. Stephens and R. Clark. Manufacture of Portland cement. September 22.

11,969. F. Siemens. Rotative furnaces or kilns for roasting, calcining, or otherwise treating granular or pulverulent materials. October 6.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

13,340. W. H. Willatt, Hull. Improvements relating to the heating of iron and steel, and to apparatus therefor. September 15.

13,358. Sir H. H. Vivian, London. The manufacture of plates and other articles from an alloy or alloys of copper and nickel by rolling at a red heat. September 15.

13,359. H. Doetsch, London. Improvements in the extraction of copper from copper ores. September 15.

13,455. A. E. Alexander.—From L. D. Chapin, United States. Improvements in the manufacture of wrought iron. Complete Specification. September 18.

13,474. W. A. Baldwin, London. Improvements in a method or process of alloying or aluminising metals with aluminium. Complete Specification. September 18.

13,493. E. Fielding and E. Hodges, London. Improvements in, and apparatus for, the treatment of gold, silver, and copper ores. September 18.

13,516. J. Frankland and W. H. Summerscales, Halifax. Improved apparatus for forming sand cores for moulding purposes. September 19.

13,620. R. Parkinson.—Partly communicated by J. Moffatt, North Queensland. Improvements in furnaces for smelting silver, copper, and other ores. September 20.

13,624. H. S. Maxim, London. Improvements relating to the tempering and toughening of ordnance, and to apparatus therefor. September 20.

13,682. P. F. Chalon and C. R. Guérin, London. An improved cartridge or material for extinguishing the flames produced during blasting operations in mines or quarries. September 21.

13,718. C. Meissner, London. An improved method of and means for working mines. September 22.

13,742. H. Eckardt, Berlin. Improvements in alloys. September 24.

13,745. J. L. Walker, Bradford. Improvements in the construction of sheet metal hollow-ware. September 24.

13,790. A. Feldbacher, London. Improvements relating to the plating or covering of boiler-shells and other objects with sheet metal. September 24.

13,795. C. A. Sahlström, London. Improvements in apparatus for melting metals and other substances. September 24.

13,830. O. M. Thowless, London. Improvements relating to the production of manganese alloys. Complete Specification. September 25.

13,843. H. J. Smith, Glasgow. Improvements in and relating to the manufacture of steel and iron. September 25.

13,884. L. Q. Brin, London. The production of alloys of copper with iron or steel. September 26.

13,991. J. C. Butterfield, London. Improvements in treating sulphurised ores. September 28.

14,061. H. J. Kirkman, London. Improvements in and relating to the utilisation of waste pickle from tinning and galvanising works where hydrochloric acid is used in the process of pickling. September 29.

14,150. H. Schneider, London. Improvements in the manufacture of alloys of steel and nickel. October 2.

14,214. J. C. Newbery and C. T. J. Vautin, London. An improved process for the separation of metallic bearing solutions from the finest ore dust or débris mixed with or held in suspension therein. October 3.

14,240. J. Greenwood, London. Improvements in and relating to the extraction of gold from refractory and other ores, and in apparatus employed therein. October 3.

14,287. L. Q. Brin, London. Process for alloying iron and steel with aluminium in the blast furnace. October 4.

14,299. J. Harris-James, Grampaud Road, Cornwall. An improved apparatus for separating ores from the associated gangue. October 5.

14,331. H. Havemann, London. Improvements in and relating to the manufacture of lead from its ores or compounds. October 5.

14,332. H. W. Wallis, London. Improvements in the hardening and tempering of steel. October 5.

14,397. J. G. Landström, London. An improved process of and apparatus for enriching and separating ores. October 6.

14,400. H. Hutchinson, London. Improvements in the treatment of complex gold and silver bearing ores and other substances, and the recovery of other metals therefrom. October 6.

14,435. J. R. R. Yeats, London. An improved process for amalgamating gold by volatilised mercury. Complete Specification. October 8.

14,445. P. Marino, London. Improvements in processes for the extraction of aluminium from aluminium compounds or from aluminous clays. October 8.

14,511. W. H. Jenkins, London. Improvements in mining drills. Complete Specification. October 9.

14,512. N. Lebedeff, London. An improved process for the direct production of aluminium and aluminium alloys and other metals, and furnace employed therein. October 9.

14,517. W. A. McCool, London. Improvements relating to the drawing of metals, and to apparatus therefor. October 9.

14,582. C. Allen, J. Clark, and W. G. Dickson, London. Improvements in furnaces for metallurgical purposes, and in working the same. October 10.

14,597. A. W. Brewtnall, Manchester. Improvements in the methods of and apparatus for annealing and drawing wire. October 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

9200. A. G. Greenway. Manufacture of steel. October 6.

12,332. S. Pearson, A. W. Turner, and W. Andrews. Extracting aluminium from minerals, and making aluminium alloys therefrom. September 22.

13,570. T. R. Weston. Manufacture of steel bolts, nuts, &c., usually made by forging. October 6.

14,271. S. J. Evans and C. D. Phillips. Hydraulic apparatus for preventing upsetting of converters employed in the manufacture of steel. October 20.

14,664. J. H. Bell and W. Rockliffe. Plates for shipbuilding, &c. September 29.

14,700. L. A. Groth.—From V. Rouff and E. Rouff. Manufacture of chromium and its alloys. October 6.

14,728. W. Crawford and J. Crawford. Shaping sheet iron, steel, or copper into various forms, and apparatus therefor. October 6.

15,327. M. A. Ende and A. Buchanan. Iron and steel flooring for railway and other bridges. September 29.

15,593. L. Grabau. Production of aluminium and compounds containing the same, and apparatus therefor. September 29.

15,952. H. S. Maxim. Manufacture of projectiles or shells and other forged metal articles, and apparatus therefor. September 29.

16,192. P. J. Ogle. Improved arrangement of the amalgamated plates employed in the treatment of gold ores, in supports for same, and apparatus connected therewith. October 13.

16,436. G. J. Snelus. Manufacture of steel, and apparatus therefor. October 6.

16,553. A. Sehanschieff and D. Marks. Extracting gold, silver, and other metals from their ores and alloys. October 6.

16,727. A. B. Cunningham. Production of aluminium and aluminium alloys. October 13.

16,784. W. Pilkington. Manufacture of steel and iron shells for ordnance and machine guns. September 29.

17,036. W. D. Allen. Means for carrying, turning, and otherwise manipulating ingots of iron or steel in the process of heating and forging. October 6.

17,105. C. Taverdon and A. L. Taverdon. Manufacture of metallic casts or castings. October 13.

17,156. J. Bedford. Purifying alloys of iron and manganese or other metal for use in admixture with other materials. October 13.

1888.

587. W. Becker. Casting metal ingots. September 22.

3601. A. B. Cunningham. Manufacture of sodium and potassium. October 20.

3806. A. Leslie.—From A. S. Massey. Cupolas or furnaces for melting iron and other metals. October 6.

7685. W. G. Forster. Manufacture of aluminium. October 13.

8234. S. Pitt.—From T. F. Rowland, W. E. Hill, and A. McLachlan. Welding furnaces. October 6.

10,619. J. Kleinpeter. *See* Class IX. September 22.

11,855. F. Siemens. Open-hearth furnaces. September 22.

12,313. F. Bosshardt.—From J. Molas. Apparatus for detecting and announcing the presence of explosive gases in mines. October 13.

12,401. Baron A. W. S. von Oldruitenborgh and O. Neef-Orban. Manufacture of iron and steel. October 20.

13,455. A. E. Alexander.—From L. D. Chapin. Manufacture of wrought iron. October 20.

13,474. W. A. Baldwin. Process for alloying metals with aluminium. October 20.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

13,341. P. Scharf, London. Improvements in gas batteries. Complete Specification. September 15.

13,402. S. A. Varley, London. Improvements in the construction of secondary batteries. September 17.

13,687. R. E. B. Crompton, Chelmsford. Improvements in and connected with electrical furnaces. September 22.

13,984. B. J. B. Mills.—From J. Barbier, France. Improvements in electric accumulators. Complete Specification. September 28.

14,149. B. Willcox.—From C. S. Bradley, United States. Improvements in and connected with dynamo-electric machines and electric motors. October 2.

14,226. R. Dick and R. Kennedy, Glasgow. Improvements in and relating to continuous current dynamo-electric machines and electric motors. October 3.

14,322. S. Miller, London. An improved galvanic cell or battery for electric lighting, or for other purposes. October 5.

14,323. S. Miller, London. An improved electrolyte or depolarising solution for galvanic batteries. October 5.

14,522. D. Humphreys, London. Improvements in galvanic batteries. Complete Specification. October 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,461. A. Stetson. Secondary batteries. October 20.

15,063. P. Skrivanow. Galvanic batteries. October 6.

15,385. E. Hermite, E. J. Paterson, and C. F. Cooper. *See* Class XVIII., B. September 22.

15,760. W. Webster, jun. *See* Class XVIII., B.

16,305. H. C. Donovan and T. Weatherall. Voltaic cells. September 22.

16,623. W. T. Goolden and L. B. Atkinson. Dynamo-electric generators and motors. October 6.

16,863. F. King. Means for the automatic electrical distribution and charge of secondary batteries. October 20.

16,870. R. Tatham. Electro-dynamic generators and motors. October 6.

1888.

729. D. Urquhart. Electric batteries and elements therefor. October 13.

12,706. W. P. Thompson.—From C. D. P. Gibson. Storage battery plates. October 6.

12,761. A. G. Waterhonse. Dynamo electric machines. October 6.

13,192. E. M. H. Andreoli. Bleaching by electrolysis. October 20.

13,193. E. M. H. Andreoli. Bleaching paper pulp by electrolysis. October 13.

13,311. P. Scharf. Gas batteries. October 20.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

13,673. L. Grave, London. Improved preparation for cleansing purposes. September 21.

13,850. H. Hamelle, London. Improvements in apparatus for filtering and clarifying oil. Complete Specification. September 25.

13,877. S. P. Moon, G. Burn, and A. Elliot, London. Improvement in the manufacture of material for the removal of paper and paint, and for cleaning paint. September 26.

14,467. E. Ryan, Dublin. An improved soap. October 9.

14,526. W. P. Thompson.—From M. Crawford, United States. Improvements in or relating in the treatment of oil-bearing substances during expression of the oil, and in presses applicable for receiving and discharging such substances without intermission. October 9.

COMPLETE SPECIFICATION ACCEPTED.

1887.

15,647. G. Tall and W. P. Thompson. Treating crude cotton seed oil, and separating colouring-matter therefrom. September 22.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

13,444. N. K. Morris, London. Improvements in the manufacture of white lead, and in the means or apparatus employed therein. Complete Specification. September 18.

13,721. W. C. Nangle, London. A new or improved composition or paint to be used for coating and preserving metal, wood, and other substances and materials. September 22.

13,939. A. de Rossi-Gallico, London. Improvements in treating gums, resin, varnishes, &c., for the production of French enamels. September 27.

14,107. J. W. Hall.—From G. T. Lewis, United States. Improvements relating to the manufacture of lead pigments and to apparatus therefor. Complete Specification. October 1.

14,167. A. Thomson, Glasgow. A new or improved paint or enamel. October 2.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,320. J. Hickisson. Manufacture of coloured marking ink pencils, and mordants to be employed therewith. October 13.

17,586. C. D. Abel.—From R. Koepp and Co. Improvements in the use of chromium compounds in dyeing and printing. September 29.

1888.

7607. V. J. Kuess. Manufacturing and treating vitrifiable colours or pigments, and apparatus therefor. September 22.

10,292. W. Langford. Composition for ornamenting and preserving materials exposed to the influences of the atmosphere or of water, and for rendering the said materials impervious to heat and water. October 20.

11,209. A. J. Davison. Non-corrosive and anti-fouling compositions. September 29.

13,444. N. K. Morris. Manufacture of white lead, and apparatus therefor. October 20.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

13,547. J. Y. Betts, London. Improvements in the process of tanning hides and skins. September 19.

14,235. W. A. Burrows, London. Improvements in the utilisation of leather waste. October 3.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,350. M. Ashworth and R. Wild. *See* Class VI. October 13.

16,469. F. H. Colley. Improvements in the process of tanning. October 6.

1888.

12,303. H. J. Haddan.—From F. y Vilaseca. Manufacture of decorative leather. September 29.

XV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

13,303. R. Nicholls, London. Improvements in making and saving hay, corn, and farm produce generally, and in apparatus employed therein. September 14.

13,462. C. Glaser and C. F. W. Dambmann, London. *See* Class VII.

13,773. R. Bradshaw, Manchester. Improvements in treating or preparing ensilage, and preserving same from decay. September 24.

14,385. M. Reymondier, London. Improvements in the treatment of phospheretic slag or scoria for agricultural purposes. October 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,831. Baron M. von Maltzan and L. Tralls. *See* Class VII. October 13.

1888.

9750. P. Piffard. Manufacture of manure. September 22.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATIONS.

13,534. J. Grass, G. C. Heilmann, and O. Ohme, London. Improvements in the manufacture of saccharine liquors for brewing and other purposes. Complete Specification. September 19.

13,595. J. G. Lorrain, London. Improvements in the treatment of sugar solutions. September 20.

13,655. D. Stewart, Glasgow. Improvements in centrifugal apparatus for drying sugar or other granular matters. September 21.

COMPLETE SPECIFICATION ACCEPTED.

1888.

12,645. A. N. Pearson. Process and apparatus for treating soluble and partially soluble gums to render them fit for industrial purposes. October 6.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

13,293. A. de Meritens, London. A process for treating and rectifying alcohol, and apparatus therefor. Complete Specification. September 14.

13,294. A. de Meritens. A process for treating and purifying water, beer, wine, and other liquids, and apparatus therefor. Complete Specification. September 14.

13,534. J. Grass, G. C. Heilmann, and O. Ohme. *See* Class XVI.

13,675. J. Henning, London. Improvements in pneumatic malting drums. September 21.

13,724. Brin's Oxygen Company, Limited.—From L. Q. Brin and A. Brin, France. Improvements in the treatment of spirits, wines, and beer for the purpose of ageing or maturing them. September 22.

13,946. A. R. White, Bristol. An improved method of treating malt. September 28.

14,225. A. Behr, London. Improved apparatus for malting grain. October 3.

14,328. J. C. Shears and A. Maubré, sen., London. An improved apparatus for acetifying alcoholic wash and liquor in the manufacture of vinegar. October 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

11,688. A. Holle. Method of treating beer for export. September 22.

13,293. A. de Meritens. Treating and rectifying alcohol, and apparatus therefor. October 20.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

14,113. W. C. Hallett.—From K. G. Dahl, Norway. Improvements in or connected with apparatus for preserving milk. Complete Specification. October 1.

14,591. L. E. Blackwell, London. An improved process for the manufacture of sauces and condiments. October 11.

B.—Sanitary Chemistry.

13,282. H. Harris, London. The filtration and purification of water for domestic usage by "an automatic apparatus." Complete Specification. September 14.

13,761. A. Bobrownicki, Manchester. Improvements in the treatment of town's refuse and other putrescible matters. September 24.

14,108. W. Clark and W. A. Clark, London. Improvements relating to the treatment of sewage, and to apparatus therefor. October 1.

14,156. W. Y. Hardie, London. Improvements in the precipitation and the mechanical, chemical, pneumatic, and electric treatment of town's sewage, and the utilisation of the solids therein, as well as the preparing from town's refuse a deodorising and purifying power, which is also applicable for other purposes. October 2.

14,340. J. C. Newbery and C. T. J. Vautin, London. Improvements in the process for the treatment of sewage. October 5.

14,341. J. C. Newbery and C. T. J. Vautin. An improved process for the separation of fine clayey matter from a liquid in which it is suspended. October 5.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1887.

16,652. F. Graeff. Method of preparing ferment of rennet. October 13.

17,268. M. Frischer. A composition of matter to be used as a preserved food. October 13.

17,313. J. M. Dowden. Method of enriching and preserving milk. October 20.

1888.

3363. M. P. Hatschek. Extract for use as a ferment and as a food preparation. October 6.

4631. S. M. Caffyn. Preparation of liquid extract of meat. September 22.

11,147. A. C. Drenckhan. Process for rendering milk consistent without any chemical alteration of the same. September 22.

11,875. Countess R. Ventura. Process for separating butter from the other parts of cream. September 22.

12,704. F. Bauder. Manufacture of cocoa or chocolate. October 20.

B.—Sanitary Chemistry.

1887.

15,384. E. Hermite, E. J. Paterson, and C. F. Cooper. Process for disinfecting impure liquids. September 29.

15,385. E. Hermite, E. J. Paterson, and C. F. Cooper. Apparatus for disinfecting impure liquids by electrolytic action. September 22.

15,750. W. Webster, jun. Electrolytic treatment of sewage and sea water for the production of certain products therefrom, and apparatus therefor. September 29.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

13,396. F. Salomon and H. Brünzzer, London. An improved method of and means for protecting apparatus used in the manufacture of sulphite cellulose. September 17.

13,558. W. S. Mackie, London. An improved process of preparing paper for the preserving of fresh fruit in its natural condition. September 20.

13,741. H. Schulte, London. Improvements in and relating to machinery for use in the manufacture of paper. September 22.

13,969. V. Walter, London. Treating vegetable fibrine in a manner to render it more applicable for sundry useful purposes. Complete Specification. September 28.

14,643. J. S. McDougall and J. T. McDougall, London. Improvements in and connected with boilers or digesters lined with lead or other and resisting metal or alloy, especially suited for use in preparing paper-making materials, or for analogous purposes. October 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,733. J. Jameson. Preparation of safety paper, affording protection against erasure or other alteration. September 29.

16,330. A. C. Henderson.—From C. Stocker. Manufacture of non-inflammable celluloid matters. September 29.

1888.

9093. E. C. de Bollemont. Manufacture of vegetable fibre from wood. October 6.

11,848. H. H. Lake.—From A. Selkirk. Treatment of vegetable substances for the manufacture of paper stock, pulp, or fibre. October 13.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

13,551. J. Wilson, London. Improving the therapeutical value of cod liver oil by the addition of it to phosphorus and iodine, without rendering it unpalatable and unstable. September 19.

13,892. H. H. Lake.—From C. L. T. Muller, Germany. Improvements relating to the production of pure ethylic alcohol from crude spirits. September 26.

14,443. H. Baum, London. A process for the production of aromatic dithio-oxycarbon acids. October 8.

COMPLETE SPECIFICATION ACCEPTED.

1887.

14,820. E. Ostermayer. Production of iodised sulpho-acids of phenol, cresol, and thymol. September 29.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

13,301. H. C. Bond, London. An improved process for the true reproduction of the colours of nature in a compound photographic print. September 14.

13,521. H. J. Shawcross, Liverpool. Improvements in or connected with the production of photographic sensitised paper, woven or tissue fabrics, gelatin or collodion films, glass, porcelain, metal, wood, and like media, for use in the production of copies of photographs, pictures, drawings, designs, writings, and the like by the action of light. September 19.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,727. E. H. Farmer and H. K. Tompkins. Preparation and use of sensitising materials and sensitive surfaces for photographic purposes. October 6.

16,018. J. E. Thornton. Flexible films for photographic and other purposes, and apparatus for manufacture thereof. September 29.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

13,308. J. M. T. Anderson and A. Anderson, London. Improvements in the manufacture of explosives. September 14.

13,360. T. Chaudelon, London. Improvements relating to the manufacture of explosives. Complete Specification. September 15.

13,656. C. F. Hengst, London. An improved smokeless safety gunpowder. September 21.

13,789. P. M. Justice.—From L. Fraenckel, Sweden. An improved explosive compound. September 24.

13,912. R. Bateman, Birmingham. Improvements in railway fog signals. September 27.

14,027. C. O. Lundholm, Glasgow. Improvements in the manufacture of dynamite. September 29.

14,081. H. C. L. Holden, London. Improvements in firing keys for firing ordnance, mines, fuses, and like purposes. October 1.

14,229. C. J. F. M. Lilliehöök, London. Improvements in percussion fuses for shells. October 3.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

16,083. W. H. Percival. Improvements in matches. September 29.

16,919. A. V. Newton.—From A. Nobel. Improved explosive compound. October 13.

16,920. A. V. Newton.—From A. Nobel. Improved explosive compound. October 13.

17,167. J. Y. Johnson.—From F. C. Glaser. Manufacture of explosives. October 13.

17,409. C. A. McEvoy. Electrical primers or fuses. October 13.

1888.

370. S. H. Emmens. Preparation of new compounds from picric acid, and manufacture therefrom of explosives, partly applicable also to coloured fires. October 13.

13,360. T. Chandelon. Manufacture of explosives. October 20.

XXIII.—ANALYTICAL CHEMISTRY.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

13,313. J. W. Skoglund, London. An improved method of and apparatus for ascertaining the quantity of fat contained in milk September 14.

15,667. B. Nicholson and T. Palmer.—From C. Collin and L. Benoist. Process for testing or estimating the strength of solutions of tannin. September 22.

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Notice is hereby given that the numbers for January, 1882, 1883, and 1886, and February and April, 1886, are exhausted, and no orders for those copies can be executed.

Members who require back numbers are requested to make application only to the General Secretary.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

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Tarn, A., l/o Newhall Hill; 26, Summer Hill Terrace, Birmingham.

Deaths.

Wallace, Dr. Wm., of 138, Bath Street, Glasgow. November 5th.

Wishart, G. J., of 8, Dryden Street, Edinburgh; at Iquique, Chili. July 10th, aged 30.

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SESSION 1888-89.

The second Meeting of the Section will take place on Monday, December 3rd, 1888.

Paper to be read by—

Mr. A. H. Allen. "The Analytical Examination of Water for Technical Purposes."

Monday, January 7th, 1889.

Mr. C. Napier Hake. "Notes on Explosives."

Mr. W. Crowder will introduce for discussion the following technical query:—"Have any experiments been made to ascertain the quantity of nitrous acid, soluble in sulphuric acid of sp. gr. 1·750 at temperatures ranging between 32° and 120° F.; and what is the *maximum* temperature at which nitrous acid can be economically absorbed in the Guy Lussac Tower during the summer season?"

Meeting held Monday, November 5th, 1888.

MR. DAVID HOWARD IN THE CHAIR.

In opening the business of the Session, the Chairman said that he did not propose to give an address, but he would like to make known to the members of the Section a suggestion which had been made to him, and which he thought they would do well to act upon. It had been suggested that questions arose from time to time which were well worth discussing, but which were of such a nature that it might be difficult for members to found papers upon them. If any such subjects should occur to members during the session, he would beg them to inform the Secretary, and, if they appeared to be of sufficient importance, the Committee would be glad to arrange for their discussion, either at the regular meetings of the Section, or at special meetings called for the purpose. It would be remembered that on one occasion a similar course had been taken, when Mr. Cresswell, senior, introduced the question of the

Rivers Pollution Bill without reading a formal paper; and he thought that the same method might be followed in respect of many matters which came within the experience of members. He had no doubt that if the suggestion was taken up much valuable information would be elicited.

NOTE ON A POLARIMETER FOR BREWERS.

BY JOHN HERON.

Since reading a paper before this Society last March on the polariscope applied to brewing, my attention has been drawn to a form of polarimeter manufactured by Messrs. R. Field and Co., of Birmingham, the invention of Mr. Thos. Bayley, and which I have much pleasure in bringing under your notice this evening, the more so as I believe it is the first polarimeter exclusively manufactured by an English firm, and which can most favourably compare with similar instruments manufactured abroad. It is just as sensitive, as readily adjusted, and as easily manipulated as the ordinary "Laurent," whilst its price is about half that of the cheapest instrument of this celebrated maker.

The instrument before you is constructed on the same principle as the "Laurent," that is to say, it is an instrument of the half-shadow type, sodium light being used as the illuminating medium. It consists of the usual Nicol's prisms, polariser and analyser, with the half-wave plate between, at the polarising end. In the Laurent instrument the half-wave effect is produced by means of a thin plate of quartz cut parallel to its axis, and just large enough to cover exactly one-half of the circular glass plate to which it is attached; and although by this means a most delicate and sensitive arrangement is obtained, at the same time it is rather an expensive one. Now, in order to reduce the great cost attending the cutting, polishing, and fixing of such a quartz plate, advantage has been taken by Mr. Bayley of certain optical properties possessed by mica, whereby, after several trials, he has at last succeeded in obtaining the same optical effects by substituting a thin film of this substance for the quartz plate usually employed. In a letter which I received from Mr. Bayley a short time ago he thus describes the principle of his half-wave plate.

"Instead of a plate of quartz cut parallel to the axis I use a single film of mica (the 'talc' of commerce). I split this 'talc,' and find by trial a piece which gives a very sensitive change. Such a piece is found pretty easily, and, of course, quite a number of plates can be cut from it. When held in the proper position it has no influence upon the dark field, but when rotated through the slightest angle, brings about brightness. There are thus two conditions:— (1.) Darkness in the proper position; and (2.) Rapidity of change."

In order to obtain the maximum amount of sensitiveness in this instrument I find the best plan to be as follows:—First rotate the analyser until its principal axis is at right angles to that of the polariser; whilst in this position rotate the polariser slightly to the right or left until one-half of the divided disc appears brilliantly illuminated, and the other half just as dark. Then clamp the polariser in this position by means of the clamp and screw to which it is attached. Next determine the zero point by bringing the analyser into that middle position where the partition line becomes almost invisible, and both sides of the field are equally illuminated. The zero point of the graduated circle being thus determined, the zero on the vernier is next made to coincide with this: the instrument is then set true for taking observations. The graduated circle is divided into degrees and tenths of a degree as being more convenient for purposes of calculation than the division into minutes. Although this instrument has been, at my suggestion, somewhat modified, and, I believe, considerably improved thereby in some of the mechanical arrangements, so as to render it specially adapted for brewers, it may nevertheless be employed for the examination of all other substances possessing optical activity, such as essential oils, alkaloids, tartaric and other acids, &c.

My sole object in bringing the instrument before the notice of this Society lies in the fact that an increasing demand is springing up for a polarimeter which shall combine accuracy with relative cheapness. This instrument seems to me to meet those requirements, and in the interests of that section of chemical industry with which I am connected have I ventured to introduce to your notice this evening Bayley's polarimeter.

DISCUSSION.

The Chairman said that he considered the members had to thank Mr. Heron for a valuable piece of information—very valuable, at any rate, to those who had to work with polarimeters. Those who had had experience of the older soleil instrument would remember the bewildering doubt of the sensitive tint, and that still more cruel infliction to the eye, the older instrument of the Wild fringes, which exceeded anything he had ever experienced for producing temporary blindness. They would remember the immense relief which the introduction of the modern penumbra instrument brought, and they would no doubt welcome heartily the appearance of a cheaper form of that apparatus. He thought the polarimeter was not so much used or so well known as it should be. Where one had to deal with organic bodies which rotated polarised light, there could be no safer or more valuable method of analysis than that afforded by the polarimeter. He spoke with especial reference to the organic alkaloids. Of course, as in all other available methods of analysis, there were difficulties to be got over and traps into which one might fall; but so characteristic and so remarkable a property of organic bodies as that of the rotation of the polarised ray could not be safely ignored by anyone who desired to get accurate results. It was, without exception, the most characteristic of all the properties of those bodies, and anyone working with hydrocarbons, alkaloids, or organic acids, could by it obtain indications which, if rightly interpreted, were of the utmost value. Brewers and sugar refiners had already discovered that, notwithstanding all the difficulties of the polarimeter, there was no equally valuable indicator. But to all who had to deal with organic bodies possessing this optical peculiarity he would say, get the best instrument you can, and see what you can learn from it. At first sight it might appear to be one of those ticklish processes which look almost too fine for practical work. But it was capable of very wide practical application, and was a process which no student of organic chemistry should fail to get as much experience of as possible. He saw present several gentlemen learned in other forms of the polarimeter, whose remarks on the subject he would be glad to hear.

Mr. Heron said, in reply to questions as to the probable cost of the instrument introduced, and as to the fractions of a degree to which it could be read, that he could not state the price positively, but it might be assumed to be about half that of the cheapest form of the ordinary polarimeter—probably from seven to eight guineas. With regard to the reading of the instrument, the circle was, he thought, originally graduated to two minutes, but for brewing purposes he had found it much more convenient to have the degree graduated so as to read to tenths. The instrument shown was so graduated, but by skilful use he thought it could be made to read to a considerably smaller division. For all practical purposes, however, he had found tenths quite sufficient.

The Chairman added that he considered the tenth of a degree a tolerably accurate reading. When he saw in published researches on the rotation of the polarised ray such wonderfully minute readings as hundredths of a degree, he always felt inclined to inquire what was the maximum error between two readings. To read to a tenth of a degree one must have a tolerably easy solution to work with, and a very accurate eye too.

* * *

ON THE COMPARATIVE ANTISEPTIC VALUES OF CHLORIDES, NITRATES, SULPHATES, AND OTHER CHEMICAL SUBSTANCES. Part II.

BY C. T. KINGZETT, F.I.C., F.C.S.

During last winter I communicated to this Section a paper[*] on the comparative antiseptic values of chlorides, nitrates, and sulphates, and as since then, and contributory to the main investigation which is still in progress, occasion arose to repeat many of the earlier observations, and to test other substances, I have pleasure in falling in with your energetic Secretary's request for a further communication on the subject.

In the earlier stage of the investigation, the comparative antiseptic values of the several substances were determined in respect of two standard mixtures, viz., extract of beef and flour-paste. As, however, the results were mutually confirmative, there was no occasion to employ in the later observations more than one standard, for which purpose extract of beef was chosen.

In reviewing the results to which reference has been made, several medical papers commented upon the fact that putrefactive agencies were alone examined, and this was coupled with an expression of regret in one case that specific micro-organisms isolated from all others, and known or assumed to be the direct or indirect cause of specific diseases, were not studied. Now, in reference to this matter, I may at once state that such experiments were not required for the purpose I had in view. Moreover, not only is it very difficult to obtain such specimens, but, as a matter of fact, the prohibitive effects of various chemical agents are more or less general in character in the sense that, as they act in relation to any one micro-organism so they do to others, either by destroying them or so altering the composition of the medium that it becomes either incapable of sustaining the life or development of the respective species.

It is now generally taken for granted that micro-organisms do not of themselves give rise to disease, but that under favourable circumstances, that is to say, by development in suitable media, they cause the formation of certain chemical products which are noxious in character and behave as poisons to the human organism. This is the view I have consistently taken since I have interested myself in such subjects, and I am glad to know that, while when first propagated it was held up to a good deal of scorn, it is now universally accepted, but of course, as is usual in such cases, but few writers now remember to have held or expressed any other view of the case.

If, then, this view be correct (and there can be little doubt of the fact), it is not at all improbable that the same or allied poisons may be elaborated or produced through several distinct agencies, that is to say, by different micro-organisms; and if it can be shown that antiseptics act uniformly as a class in prohibiting the processes of chemical change or fermentation by which such poisonous products arise, the experiments which I have already described, in common with those about to be referred to, are truly comparative in character, and are reliable for guidance in dealing with sanitary matters and the prevention of disease.

That antiseptic agents act more or less uniformly, and are therefore to that extent comparable, is borne out by the fact that the processes, for the inhibition of which they are applied, are also uniform in character. Writing broadly, it is fair to state that most processes of fermentation or chemical change induced by micro-organic life depend upon two chemical acts, the one hydration and the other oxidation; that is to say, more or less complex molecules (like albumen) are split up in the first place into a certain number of more simple bodies, and oxidation of these or some of them proceeds simultaneously or subsequently. It is not improbable that the more active poisons are produced when the chemical changes are mainly hydrolitic in character. For instance, tyrotoxicin (a substance which Victor C. Vaughan claims to have identified chemically as diazobenzol) is said to be produced by inoculating ordinary milk with the butyric ferment and keeping the mixture in a closely-stoppered vessel for some eight days.

As further bearing upon these views it may be noted that in course of some observations made by Dr. Burdon Sanderson, F.R.S.,[†] upon the results of an experimental investigation then lately carried out by Dr. Klein and Mr. Lingard, he has characterised them as affording "solid ground for the anticipation that whatever means may be found effectual as prophylactics against septic infection, will also be effectual, *in so far as they are applicable*, against tuberculosis."

In commenting upon the same researches, Dr. George Buchanan[‡] has carried the argument even further, and finds "one noteworthy point vouched for by Dr. Klein," viz., that "when it is possible to recognise, as in the case of anthrax, tubercle, and swine-fever, the minute organisms that play an essential part in the disease, and to compare them with other and similar organisms which are not so much infective as putrefactive, it is found that chemical agencies which are wanting in destructive effect upon the putrefactive organism have a power, often when present in extremely minute quantity, of arresting or destroying the life of the infective organism."

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[*] "Journal of the Society of Chemical Industry," November 30, 1887, No. 11, Vol. VI.

[†] Report Med. Off. Local Gov. Board, 1884, p. 184.

[‡] *Ibid*, Med. Officer's Report, p. xxxiii.

In order to bring the later results of my observations into general accordance with the former ones, I deemed it advisable to repeat the whole of the tests originally made with chlorides, nitrates, and sulphates in respect of extract of beef. For this purpose, 5 lbs. of lean fresh beef was minced and then digested with water at a temperature under 40° C. during three hours, after which the extract was made up to 4 litres, and when cold was strained several times through fine muslin, to remove the undissolved portions and the solidified fat. In each observation 95 cc. of this extract was taken, and to it was added 5 cc. of the particular antiseptic solution to be tested. These antiseptic solutions, except where otherwise noted, were of 5 per cent. strength; but in cases where the substances were not perfectly soluble, the solutions containing the undissolved particles in suspension were used. The series of experiments first to be described were commenced on November 19th, 1887, and the following table will show the respective days on which the several mixtures became putrid.

Summary of Results. Series D.

Chlorides.

On the fourth day, the mixtures containing the following chlorides had become putrid: Chlorides of potassium, sodium, ammonium, barium, strontium, calcium, and magnesium, as also the standard extract.

On the ninth day, the chlorides of iron, lead, zinc, and tin.

On the 15th day, chloride of aluminium.

The mixtures containing the chlorides of copper and mercury remained intact.

Nitrates.

On the fourth day, the nitrates of potassium, sodium, ammonium, barium, strontium, calcium, magnesium, and iron.

On the sixth day, nitrate of zinc.

On the ninth day, nitrate of lead.

The mixtures containing nitrates of copper and mercury alone remained intact.

Sulphates.

On the fourth day, the sulphates of potassium, sodium, ammonium, magnesium, iron, and manganese.

On the fifth day, sulphate of zinc.

On the 11th day, sulphate of aluminium.

The mixtures containing the sulphates of copper and mercury alone remained intact during the whole period of observation, viz., 16 days.

It may be noted, as a rule, that as the mixtures became putrid, the colour changed from a dull dirty red to bright scarlet, a change probably associated with the initiation of oxidation by the agency of ærobic micro-organisms.

The next lot of observations were made in February of this year, using a similar extract of beef (containing 1·796 grms. of total solid constituents dry at 100° C.) with some selected chlorides, nitrates, and sulphates, and the following other substances:—

5 cc. of a saturated solution of "Salufer" (Thomson's fluo-silicate of sodium).

5 cc., 10 cc., 15 cc., and 20 cc of ordinary "Sanitas" fluid of commerce.

5 cc. "Bactericide" (that is a solution containing 5 per cent. mercuric chloride in 5 volume peroxide of hydrogen).

The mixtures broke down in the following order:—

On the third day, the standard solution was putrid.

On the fifth day, the sulphate of zinc and nitrate of lead mixtures.

On the sixth day, the 5 per cent. Sanitas mixture.

On the seventh day, the chlorides of lead and tin mixtures.

On the eighth day, the "Salufer" and sulphate of aluminium mixtures, but mould had appeared on the Salufer mixture on the fifth day.

On the 12th day, nitrate of mercury and chlorides of iron and aluminium mixtures.

On the 15th day, chloride of zinc mixture.

On the 21st day, nitrate of zinc mixture.

In this series it will be observed that nitrate of mercury broke down on the 12th day, thus confirming the general evidence adduced by the earlier series of experiments, that this salt is not so reliable as either the chloride or the sulphate.

The mixtures containing 10 cc. "Sanitas" and upwards remained quite free from putrefactive change collaterally with the mixtures containing "Bactericide" and the chlorides and sulphates of copper and mercury during the whole period of observation, viz., 34 days.

These results give the information which was asked for, in course of the discussion on my earlier paper, by Mr. A. H. Hutchinson, concerning the antiseptic value of Sanitas fluid, 10 cc. of this reagent being equal in effect with 5 cc. of a 5 per cent. solution of mercuric chloride.

The remaining series of observations were made with solutions of peroxide of hydrogen of so-called five-volume strength having dissolved therein 5 per cent. of the following substances respectively:—

Potassium hydrate (caustic potash), potassium chlorate, bisulphate of potash, borax, borax neutralised with boric acid, sodium benzoate, ethylic ether, glacial acetic acid, quinine disulphate, quinine sulphate dissolved in a slight excess of sulphuric acid, chloroform,* phenol (absolute carbolic acid), chloral, pure hydrochloric acid, oxalic acid, boric acid, and sulpho-phenic acid.

On the second and third days, the standard extracts broke down in all cases; so also did the sodium benzoate and neutral borax mixtures.

On the 3rd day, the ether and caustic potash mixtures.

On the 4th day, the quinine disulphate mixture.

On the 5th day, the potassic chlorate mixture.

On the 7th day, the chloroform mixture.

On the 10th day, the borax mixture.

On the 13th day, the boric acid mixture and the mixture containing quinine sulphate dissolved in an excess of sulphuric acid.

On the 17th day, the mixture containing bisulphate of potassium.

On the 19th day, the acetic acid mixture.

On the 24th day, the chloral and oxalic acid mixtures.

On the 27th day, the sulpho-phenic acid mixture.

After 39 days the following mixtures were still good:—hydrochloric acid and phenol.

Now, in dealing with these results, it must be borne in mind that all the test solutions contained peroxide of hydrogen, which exhibits of itself a considerable antiseptic property, so that the comparative results of the experiments present the specific additional values, so to speak, of the dissolved substances.

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* This antiseptic mixture was made up as follows:—5 cc. chloroform + 50 cc. absolute alcohol + 45 cc. of 10 vol. H_2O_2.

Of course, also, the tests, in common with the previous series, were somewhat severe, as they only give the antiseptic values of 5 cc. of 5 per cent. solutions when diluted 20 times.

One of the most interesting facts elicited by this inquiry is the pronounced antiseptic value of chloral, which may henceforth find, therefore, an extended use in the domain of medical practice.

Only somewhat less pronounced is the antiseptic character of potassium bisulphate.

Again, sulphate of quinine, if administered together with sulphuric acid, may be expected, not only to act as a tonic, but also to produce an antiseptic state of the human body.

It is interesting also to observe that borax is much more effective than when neutralised with boric acid, notwithstanding that that substance has a higher antiseptic value than borax.

Of the other pronounced antiseptics, phenol is, of course, well known, but its application is limited on account of its dangerous character.

The influence of the acid reaction is significant, acetic, oxalic, sulpho-phenic, and hydrochloric acids exhibiting very marked antiseptic action.

Acetic acid has been known for ages to be a good antiseptic, whilst hydrochloric and other mineral acids formed the subject of study by Dr. John Dougall,[*] and were then found to be powerful antiseptics and disinfectants. Unfortunately they are much too corrosive to be of extended use, either in the household or for medical applications.

Sulpho-phenic acid (in common with phenylacetic and phenylpropionic acids) is strongly antiseptic in character, but in the human organism it would probably yield phenol and thus exhibit toxic effects.

As regards sulphuric acid (the influence of which is perhaps seen in the result of the observations made with quinine sulphate dissolved in it, and with bisulphate of potassium) it may be remarked that Mr. J. P. Laws has made some interesting observations[†] concerning the restraining and killing power of that substance, both of which he found to be considerable. The antiseptic properties of chloroform water have been studied by E. Salkowski,[‡] but in the form of an alcoholic solution they do not appear at any rate to be so pronounced as those of borax. Respecting "Salufer," it is seen to rank about equally with 5 per cent. solutions of sulphate of aluminium and the chlorides of lead and tin, but this shows the statement made by Dr. Conrad Berens,[§] of Philadelphia, to the effect that it is more efficient than corrosive sublimate in preventing decompositions, to be very exaggerated.

As a matter of fact, experience so far seems to point to the last-named substance (corrosive sublimate) as the most powerful antiseptic yet discovered. Klein takes this view, while Koch claims that a solution of 1 in 5,000 can be relied upon for perfect disinfection, since it suffices, according to him, to annihilate all life in micro-organisms and their germs within a few minutes. Klein, I think, rightly regards this statement as an exaggeration of its powers, but there is no doubt of the effects of somewhat stronger solutions. Unfortunately, again, the terribly poisonous nature of the substance disqualifies it for use except by medical men.

Useful as corrosive sublimate is in the practice of medicine and surgery, it is, however, deficient in one respect, and that is power of oxidation. It is capable of killing all germs and spores, but it has no power of oxidation over the toxic products which may exist in association with them, and this is the more important because these products give rise to the toxic effects which are witnessed in many diseases, in fact they constitute the real infectants. I have therefore introduced a compound solution of this substance with peroxide of hydrogen and a number of other solutions, all containing peroxide of hydrogen, and definite percentages of various antiseptics under the name of "Bactericides." The preparation of these fluids has involved me, not merely in this and the preceding investigation of a similar character, but also in another study of which I may have the pleasure of giving an account to the Society later in the Session.

In conclusion, I may perhaps be permitted to make one remark concerning "Sanitas" fluid, and indeed, it is only fair that I should again insist upon its great value as a disinfectant for popular and medical use, being wholly innoxious and thoroughly reliable, it having been shown that 10 cc. is equal in effect to half that quantity of a 5 per cent. solution of perchloride of mercury.

With respect to the comparative antiseptic values of the better known chlorides, nitrates, and sulphates, the results confirm generally the earlier ones, but the chloride of aluminium appears to have a somewhat higher value than that formerly assigned to it.

It may be said by way of summary that the chlorides, nitrates, and sulphates of the alkalies exhibit but slight antiseptic effects, and those of the alkaline earths are not much better. The compounds of manganese, zinc, tin, iron, lead, and aluminium are all of more or less pronounced value. As a rule the chlorides are to be preferred. The compounds of copper and mercury are comparatively most effective; the nitrate of mercury is, however, not so reliable as the chloride, which is the most active antiseptic amongst these classes of substances.

The general results will, I hope, be of service in this way, among others, that when a so-called new disinfectant or antiseptic preparation is submitted to the public, directly the composition is known the approximate value may be ascertained by reference. For instance, so-called kamphorkalk is said to be a mixture of the chlorides of sodium and calcium with a sprinkling of camphor, and it cannot therefore be assumed to have a much higher antiseptic value than the chlorides alone, and that is of the weakest character from the comparative point of view indicated in my observations.

I have pleasure in making reference to the careful help afforded in these experiments by my assistant, Mr. J. C. Belcher.

DISCUSSION.

The Chairman said that the meeting was indebted to Mr. Kingzett for a form of paper for which he had a high regard, namely, a statement of facts. It was in the study of these micro-organisms more than in any other that it was valuable to have accurate observations of facts. They might not answer all the questions that those interested in the subject would like to have answered; indeed, the subject was so wide that it was hardly possible for any person to study exhaustively even one particular branch of it. Therefore, he hoped to hear suggestions as to what might have been done that had been omitted. Such suggestions were always valuable. It was important to have accurate records, such as Mr. Kingzett's, not only for their own sake, but as a starting point for others. The subject was one about which there appeared to be still much to be learned. It had passed beyond the stage in which the most dogmatic statements were made on the smallest basis to that later stage which was so bewildering to the looker on, in which there was a vast mass of facts requiring careful sifting and careful study. He would invite Dr. Percy Frankland to give some of the results of his experience on this interesting question.

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[*] Trans. Nat. Assoc. for the Promotion of Social Science, 1874, pp. 708—719.

[†] Rep. Med. Off. L. G. Board, 1884, p. 208.

[‡] British Medical Journal, May 5th, 1888.

[§] Reported in the "Chemist and Druggist," August 25th, 1888.

Dr. Percy Frankland said he had listened with great interest to the paper just read. The subject of disinfectants or antiseptics was of high importance, and in dealing with it it was necessary to keep carefully in view what the nature of the information to be derived from our experiments was to be. It was obvious that antiseptics might be used for different purposes; for example, one might merely wish to arrest the development of organisms, or one might intend to destroy them; and the kind of antiseptic to be used, as well as its strength, would vary according to which of these results one wished to attain. For instance, the chlorides of the alkaline metals, when added to food in sufficient quantity, would arrest the process of putrefaction or decay, but they had little or no power of actually destroying the organisms present; and if one could remove the concentrated solution of the chlorides, the organisms would commence to grow and multiply as if they had not been treated at all. It seemed to him that in the present instance Mr. Kingzett had not adequately discriminated between the two objects to be kept in view. In the first place it was desirable to ascertain for each particular antiseptic its power to arrest the growth of micro-organisms, and secondly, to determine of what strength the antiseptic must be used in order to destroy micro-organisms. It appeared to him that in such investigations as were the subject of the paper, it was essential to use either pure cultivations of particular micro-organisms, or at any rate such mixtures as could be readily reproduced on any occasion. He understood that in Mr. Kingzett's experiments he had simply exposed various materials, such as meat extract and starch paste, and had relied on organisms from the air falling into them and setting up processes of putrefaction. If one did that, of course the results, especially the length of time which various bodies took to break down, would depend upon the prevalence of microbes in the atmosphere, the temperature, and other variable conditions. He would expect, for instance, that the length of time required by extract of meat to break down would be very much shorter if exposed in a barn to what it would be if exposed in an ordinary dwelling-room or laboratory. Thus there might have been very different sources of infection around Mr. Kingzett's experiments at different times. Moreover, the exact regulation of the temperature was a matter of great importance. In experiments of this kind, it was usual to take some specific organism known to have great powers of resistance, the one generally selected being the *anthrax bacillus*. It was essential not only to use the pure cultivation, but to employ it in its most hardy form; because if the *anthrax bacillus* was present simply as the *bacillus* and not in the condition of spores, its power of resistance was comparatively small. He would like to suggest that, on the one hand, careful experiments should be made as to the doses of these various antiseptics required for arresting the growth of some specific organism, and, on the other hand, similar experiments to determine the doses necessary to actually destroy such specific organisms and prevent them from growing, even when subsequently introduced into a suitable medium. It was also obvious that different disinfectants should be used according to the end in view; for preserving food one would use antiseptics of a different kind to those employed for disinfecting wounds or for treating sewage. Another point to which he would like to draw attention was the great importance of the reaction of these antiseptics. In comparing the antiseptic properties of these bodies, it was necessary to use them in liquids of a definite reaction. Acid liquids were incapable of undergoing putrefaction, provided the degree of acidity was sufficiently great, so that a substance might exhibit entirely different antiseptic powers according as it was used in an acid, a neutral, or an alkaline medium. This point was of special importance in connexion with the use of corrosive sublimate, which was so much in favour with medical men. Corrosive sublimate, although, perhaps, the most powerful disinfectant, was yet deficient in the power of penetrating into albuminous substances, because it produced with albumen a compound called mercury-albumen, which was insoluble; so that if applied to the surface of a wound, its action did not penetrate very far into the tissues. If, therefore, the formation of this mercury-albumen could be prevented, the field of activity of the corrosive sublimate would be extended, and its antiseptic power immensely increased. This end could be gained easily by using a little hydrochloric acid with the corrosive sublimate, but in most surgical cases the use of hydrochloric acid was objectionable. It was found, however, that weaker acids, such as tartaric acid, were capable of effecting the desired result, and so the antiseptic efficiency of corrosive sublimate had been extended and improved. The only other point he would touch upon was that Mr. Kingzett had seemed to imply that all fermentations were processes either of hydrolysis or of oxidation. He must have accidentally omitted to mention that in many cases they were processes of reduction. He would remind him of the reduction of nitric acid to nitrous acid and ammonia, as well as of the reduction of sulphates to sulphides and even to free sulphur, all of which changes were effected through the agency of bacterial life. However, any accurate observations on these matters were most important and acceptable both to medical men and to chemists.

Mr. F. Nettlefold considered that in comparing the values of different antiseptics it was a matter of some importance whether the bodies were in the solid or the liquid state. There existed a want for a good disinfectant of a solid nature and of slow operation, such as thymol and menthol. He believed that a Fellow of the Chemical Society, Mr. Borland, had devoted considerable study to such bodies, and had brought out some solid disinfectants, chiefly consisting of manganate of potash and some granules of eucalyptol and thymol, which had been found very useful. He would refer members to Mr. Frank Hatton's researches on the life of bacteria, showing the action of gases on bacteria, and proving how difficult it was to effectually destroy them. Dr. Frankland had spoken of the action of chloride of mercury in coagulating albumen, and he would like to refer to some surgical operations for the reduction of swellings in which a mercurial oleate and mercury was used. In many cases it was effectual in reducing the swellings, but, as Dr. Frankland had observed, it caused considerable solidification of the albumen, so that in order to succeed in the reduction it became necessary to make cuttings to let out the coagulated masses of white blood corpuscles.

Mr. F. Adair Roberts desired to know why Mr. Kingzett, when testing so many salts, had omitted all consideration of the antiseptic power of salts of sulphurous acid on organic solutions. It was well known that sulphites of various kinds were used for the preservation of many organic fluids, such as beer and wine, and it would have been interesting if the author had compared the action of such salts with those which he had enumerated. He would also like to ask why Mr. Kingzett had omitted salicylic acid, which was a well-known preservative of such fluids as those which he had treated.

Mr. Jno. Thomson said that another antiseptic of great value and importance had been omitted by the author, namely, biniodide of mercury. He felt justified in saying that biniodide of mercury possessed much more antiseptic power than chloride of mercury, while it was not nearly so poisonous. That fact had been established by Dr. Archibald in a series of experiments on bacteria, devised by Dr. S. Woodhead, in which he had found that biniodide of mercury not only arrested the growth of micro-organisms, but killed the most resistant forms outright. He believed the proportion necessary to achieve this result satisfactorily was 1 in 4,000 or 5,000. It was absolutely safe, and had been tried on the worst forms of disease germs. The experiments were carried out and repeated so as to leave no room for doubt. The nutrient gelatin used was sterilised, as were the test tubes and all materials used, and the results obtained and tabulated* appeared to him to be exact and accurate, and to establish absolutely the fact that biniodide of mercury was the most powerful antiseptic of all the mercury salts.

Mr. Kingzett, in reply, said that, of course, from a purely scientific point of view, he could not but agree with much that Dr. Frankland had said. At the same time he would point out that the labour of subjecting all the antiseptics mentioned to exact determinations with respect to their restraining and killing powers would be so enormous as to be quite beyond the capability of one individual. He would, therefore, invite Dr Frankland and other gentlemen interested in the matter to assist in getting such results. His own position had been specific. He was anxious to be able to present to those who wanted them, solutions or preparations for definite purposes. To arrive at such results, he had exercised the powers of selection arising from some knowledge of the subject, and had chosen a large number of substances likely to be suitable, and had subjected them to these tests by way of a preliminary examination. So far as he had availed himself of the results in a commercial way, he had prosecuted his inquiries further, but was not then in a position to lay the results before the meeting. With respect to the restraining and killing powers of chemical substances, those terms had been used in a sense which he could not regard as satisfactory. If a chemist, used to quantitative considerations, took a solution of glucose and fermented it with yeast, and after a sufficient time determined the results, he would find (if the experiment had been carefully made) that there was an exact balance of quantities. The same consideration would apply to the fermentation of starch by yeast; the acetic fermentation of alcohol; the ammoniacal fermentation of urine, and indeed to all such processes. In all cases, even if the inoculation were conducted somewhat haphazard, there would, as a rule, be only one change from a chemical point of view. For instance, in the alcoholic fermentation so much sugar would disappear and so much alcohol and carbonic anhydride would be produced. To his mind it was almost immaterial whether the ferments were killed by antiseptics; their action would be stopped by suitable antiseptics; and if yeast cells and, say, the butyric ferment were comparable — as they were — to the micro-organisms which produced disease, there was no necessity to kill the micro-organisms. At the same time he did not say they were not killed. On the other hand, if they were not killed, what became of them? They were living organisms dependent upon proper food for sustenance, and therefore if the medium were rendered unsuitable for their existence, they must of necessity die. The effect might be slow, but die they must, sooner or later, after their means of living were taken away. And so it was with disease germs. Dr. Klein had clearly shown that those antiseptics which were capable of destroying putrefactive micro-organisms were also even more capable of killing infective micro-organisms, and this was not merely true of one particular class, but as a general statement, the truth of which had been confirmed by Burdon Sanderson, who had made this subject his especial study. He therefore did not attach so much value to these considerations as did Dr. Frankland. At the same time he admitted that they offered ample scope for investigation, and were calculated, when investigated, to thrown an important light on the question at large. With respect to the *anthrax* bacterium — which was generally taken as a type when a particular micro-organism was to be investigated—Dr. Frankland had admitted that well-developed micro-organisms were readily killed by almost any antiseptic which was effective as against putrefactive organisms; and though the spores of this *bacillus* were harder to kill, still they could not resist the treatment if given an adequate exposure. Again, why should the *anthrax bacillus* and its spores be taken as representative any more than putrefactive germs and spores. The medical practitioner in the treatment of wounds certainly had not to deal with the former but with the latter, and with respect to most specific diseases the active organisms had not been determined, so that there was no reason to regard anthrax as more allied thereto than septic poisoning. In concluding his reply to this part of the discussion he insisted upon the importance of the fact which had been clearly demonstrated by practical investigations that, so far, those chemical agents which are most effective in preventing putrefaction are also most effective in restraining and killing other specific disease germs and spores.

With respect to the action of perchloride of mercury on albumen when used for dressing wounds, there were several ways of getting over that difficulty, as, for instance, not merely by the addition of a suitable acid, but also by the addition of a small proportion of common salt. Dr. Frankland had referred to reduction. Speaking scientifically, he must confess that he did not know what it meant. He could understand hydration and oxidation as definite processes, but not reduction *per se*. As to the choice of antiseptics, he must admit that there was much to be said on the subject. If one wanted to administer a non-poisonous antiseptic to a man suffering from typhoid fever or cholera, one was of course shut out from chloride of mercury or phenol in such quantities as would be effective to restrain or kill the organisms; but such a preparation as thymol might be used; and it was that consideration which had led him to place on the market not merely one, but twenty or thirty varieties of preparations, all containing definite percentages of antiseptics (so that a medical man might make a choice), and all associated with peroxide of hydrogen of five-volume strength. In practically dealing with the prevention and cure of disease, it was essential not only to aim at killing the micro organisms and their spores, because the fact of their existence implied that they had already produced various specific toxic compounds. In dealing with open wounds, for instance, one must not only destroy the living disease germs, but must also get rid of the toxic products which they might have already produced, thus leading to septic poisoning. For that purpose, oxidising agents must be employed, and he knew of none better for the purpose than peroxide of hydrogen.

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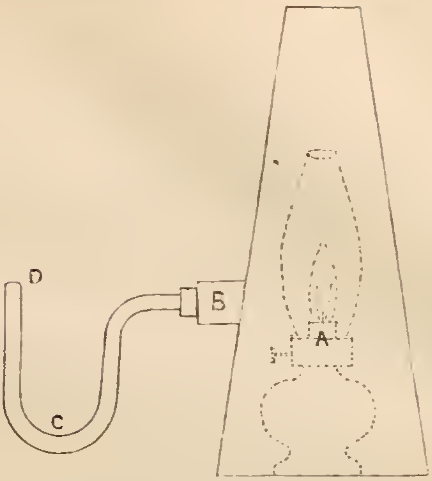
* *See* Vol. VII., No. 3, pp. 172—4.

With respect to salts of sulphurous acid as antiseptics, he had supposed that in the hands of his friend. Mr. Roberts, and his partner, they were sure of a thorough investigation, and that it was not necessary for him to deal with them. Iodide of mercury had also been referred to, but as it was comparatively insoluble, it was not comparable with the solutions investigated by him. With regard to the preservation of albumen, however, it might interest the Society to know that, some years ago, before fast dyes were so much used as now for printing on cotton goods, albumen, both egg and blood, was largely used as a mordant, but a much higher price was commanded for egg albumen than for blood, on account of its superior colour. With an eye to business, he had conceived the idea of converting (so far as this quality was concerned) blood albumen into egg albumen. He used to buy the dark coloured blood albumen of commerce in the form of scales, and also serum from which the clot had been removed. The scales were then dissolved in the serum, so as to obtain a product containing from 1 to 4 lbs. albumen per gallon, and, in the presence of turpentine, a current of air was then blown through the mixture, just as in the process of manufacturing "Sanitas," the result being the bleaching of the solution by the peroxide of hydrogen which was produced *in situ*, and its preservation from putrefactive change by the agency of the soluble camphor and other substances which were formed and dissolved in the product. For a long time considerable sales of this albumen were effected, when suddenly the fast dyes were introduced, and becoming popular, the demand for preserved albumen ceased—to his misfortune.

* * *

A NEW MICROSCOPE ACCESSORY.

Mr. Thomas Christy exhibited a novel form of microscope illuminator which he saw at the Medical Congress at Cologne. It consists of a metal cone A, which slips over an ordinary oil lamp. A tube B is fixed at the side, and carries a bent glass rod C, which can be moved in any direction. The position of the tube B should correspond with that of the maximum light of the lamp. By means of internal reflection from the outside of the rod C, the light is carried with comparatively little loss to the polished end D, which is placed under or over the object to be illuminated. The light thus obtained is very soft and bright, and quite free from heat rays. Any convenient form of rod may be used. The cone A may be made of tinned iron. Such an apparatus is easily and cheaply constructed. By having more than one side tube, several lights may be obtained from one lamp.



This apparatus was patented some years ago, but the patents have lapsed, and therefore anyone may construct the apparatus for himself.

Liverpool Section.

Chairman: F. Hurter.
Vice-Chairman: A. Norman Tate.

Committee:
E. Bibby.
J. Campbell Brown.
H. Brunner.
E. Carey.
H. Deacon.
T. Fletcher.
H. Gaskell, jun.
S. Hamburger.
J. W. Kynaston.
E. K. Muspratt.
G. Shack-Sommer.
James Simpson.

Hon. Local Sec. and Treasurer:
W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Wednesday, 7th November 1888, at University College, Brownlow Street.

DR. F. HURTER IN THE CHAIR.

CHAIRMAN'S ADDRESS.

Last spring my learned friend Professor Lunge published an interesting paper dealing with the reactions of the Leblanc process from the thermochemical point of view. This paper was followed shortly after by another one announcing the success of Chance's process for the recovery of sulphur from alkali waste. In these two papers Professor Lunge gave utterance to some very interesting thoughts, which, in my own words and my own way, I will shortly bring before you.

Chance's process for the recovery of sulphur is the last link in a complete chain of reactions of a circle process, and it reduces the raw materials required in the manufacture of soda, and of chlorine compounds by the Leblanc process theoretically to those which contain the constituents of the products sold, *i.e.*, of soda and bleaching powder. These raw materials are sodium chloride, calcium carbonate, and oxygen. The reagents used during the manufacture, which do not enter into the composition of the products, viz., sulphur, sodium nitrate, and manganese dioxide are continually recovered.

Apart from the quantitative aspect of the reactions in practice, and apart from the intermediate auxiliary processes, the Leblanc process may be stated to begin with

$$2\,NaCl + CaCO_3 + O,$$

and to produce therefrom,

$$Na_2CO_3 + CaCl_2O.$$

Whilst the raw materials, oxygen excepted, are comparatively inert substances, the products on the other hand are energetic reagents, and the greater energy which they possess had been supplied to them in the form of heat, entirely derived from processes of combustion or oxidation.

Seeing that the auxiliary reagents, sulphur, nitrogen compounds, and manganese dioxide are really only the tools by means of which this additional energy is transmitted from the burning fuel, and that they can be used over and over again, the question arises, whether they are an intrinsic necessity or whether this roundabout mode of conveying energy could not be supplanted by a more direct method. There is at least one mode now known of supplying energy to do molecular work more directly; that mode consists in converting heat into mechanical energy, this into electricity, and cause the electric current to do directly the molecular work.

Professor Lunge is quite well aware that at present, at any rate, this mode is more expensive than even the Leblanc process, and in his first paper he distinctly says so; still he expresses a belief that posterity will be sure to find more favourable conditions for the transformation of heat into chemical energy by means of the electric current, and will utilise for production of such currents, beside the process of combustion, other cheap elementary forces.

Similar thoughts have occupied other men's minds. In his inaugural address to the Liverpool Polytechnic Society in 1884, Mr. James Hargreaves drew attention to the fact that the net energy utilised in the decomposition of one pound of salt and its equivalent of water into soda and hydrochloric acid only represents 460 units of heat. The fuel employed, he says, is over three pounds per pound of salt decomposed, developing 42,000 units of heat, say 90 times as much, so that the duty rendered by the reaction is barely over one per cent. An error has crept into Mr. Hargreave's calculations: the 42,000 units of heat developed by the fuel are British units, the 460 are centigrade. It does not alter the question very much, the correct statement being that the reaction only renders a duty of barely over two per cent., or, as Professor Lunge puts it, practice requires 50 times as much heat as is theoretically required.

Moreover, Mr. Hargreaves states that the preliminary operations of burning pyrites and the formation of sulphate of soda yield five times the quantity of heat necessary for the reaction, and he says that here there is an ample field for the exercise of the talents of the scientific and inventive members of (I will say) society.

Now the point of gravity of the observations of both these gentlemen evidently is this: the Leblanc process is a roundabout and wasteful mode of converting chloride of sodium and water into caustic soda and hydrochloric acid. I suppose we all agree with them, the evil is an old one, and many minds have been at work to cure it, but so far with no very marked success. The fuel used now differs but little from that used in former times. We use decidedly less, but not so much less as to affect the argument, as these two gentlemen put it.

Of the many eminent men who were constantly thinking of improvements in the Leblanc process, I will only mention our late president, Walter Weldon. One of his earliest proposals related to a more direct way of decomposing common salt. The method was extremely simple. Common salt was to be heated to a high temperature, and steam passed over it.

This process, which would be represented by the equation—

$$31{,}660\ c + NaCl + H_2O = HCl + NaHO$$

would, of course, be the most direct of all, and ought to be (if, for a moment, we admit that a direct application of 31,660 units of heat is better than a roundabout one through a steam boiler, engine, and dynamo) cheaper even than the electrolytic process, and, judged by such calculations as those made by Mr. Hargreaves and Professor Lunge, the reaction ought to be able to be carried out, theoretically, with a consumption of fuel of about four pounds to every 58·5 of salt. Of course, this is a limit which never can be reached.

It is readily seen that all such methods of calculation yield but one result, viz., that all processes are, theoretically, equally good, for whether these units of heat are first calculated into ampères and volts, then into fuel, or directly into fuel, makes no difference.

There is a serious error running through all such comparisons, and my purpose is to point out that error, to show where and why the electrolytic process is superior to the other processes, where it is inferior, and to what points posterity will have to pay attention if it means to come up to Professor Lunge's expectations.

The manufacture of soda and chlorine compounds from common salt involves, as we have seen, by whichever mode we accomplish it, the supply of a certain amount of energy, which energy is consumed in doing the work of re-arranging the grouping of the atoms of the raw materials; and having thus re-arranged them, we must effectually separate the newly-formed bodies one from the other, so as to prevent a backward reaction, and a consequent waste of energy.

The problem consists then essentially of two parts, though they cannot always be separated: that of supplying the energy and that of keeping the newly-formed molecules from changing backwards into the original condition, *i.e.*, of separating them.

I will first consider the facilities or otherwise which the various processes offer for the supply of the energy as the more serious question.

When we say that 1 lb. of carbon gives out 8,000 units of heat, that does not mean that the whole of these 8,000 units can be made available for the purpose of producing either mechanical or molecular work, and it is wrong to say that for supplying chemical energy equivalent to 31,660 units of heat

$$\frac{31{,}660}{8{,}000} = 3\cdot95\ \text{lbs.}$$

of carbon or fuel would be sufficient to supply it, even from a theoretical point of view. If the 31,660 units of heat could be made useful at a temperature of 15°, and were equivalent to a simple transmission of heat, the 3·95 lbs. of carbon would supply them; but if the reaction for which the 31,660 units of heat are necessary takes place at a higher temperature, then the 3·95 lbs. of fuel are no longer sufficient, for the simple reason that when the products of combustion of the fuel have cooled down to that temperature at which only the reaction will proceed, the heat which those products of combustion then contain is no longer available for that reaction, since heat cannot pass from a colder to hotter substance. The utmost amount of effect, measured in units of heat, which can be transmitted by the application of a quantity Q of heat between the limits of T_2 and T_1 of absolute temperature is of course given by the equation—

$$(1.)\qquad N = Q\,\frac{(T_2 - T_1)}{T_2 - T_0}.$$

Where Q represents the units of heat given out by the fuel, T_2 the temperature of combustion and T_0 the atmospheric temperature, N then represents the utmost amount of heat which can be utilised for a reaction proceeding at a temperature T_1 if the heat has simply to be transferred. But if the heat has to do work in separating certain molecules, then the amount of useful effect to be obtained from the fuel is much less. In that case the amount of heat which can be converted into useful work is given by a formula which I have borrowed from Professor Zenner's work, *Technische Thermodyndynamik*, but which I have slightly modified, viz. :—

$$(2.)\qquad N = Q\,\frac{\left[T_2 - T_1\left(1 + \log \epsilon\left(\frac{T_2}{T_1}\right)\right)\right]}{T_2 - T_0}.$$

There is only one among the operations of the Leblanc process which is supposed to be endothermic, that is, a process in which heat is not evolved during the reaction, but consumed.

This process is the one in which the sulphate of soda is changed into carbonate in the black ash furnace. The reaction which is usually stated as follows:—

$$Na_2SO_4 + 2\,C + CaCO_3 = Na_2CO_3 + CaS + 2\,CO_2$$

requires approximately the supply of 34,000 units of heat. But the reaction does not proceed at ordinary temperature. It requires a temperature of about 1,000° C. Consequently we have to raise the whole of the materials to that temperature first, and then supply them with an additional 34,000 units of heat. For heating the materials up to 1,000° we require another 64,000 units of heat, so that in all 98,000 units are required.

On the usual erroneous system of calculating the fuel theoretically required, we should find

$$\frac{98,000}{8,000} = 12\cdot25 \text{ parts,}$$

and, adding the carbon required for mixing with the sulphate, viz., 24 parts, we find that for 142 parts of sulphate of soda a total of 36·25 parts of carbon should suffice; or, say, 5 cwt. fuel per ton sulphate. In practice this operation requires on an average 20 cwt. of fuel to 22 pro ton of sulphate. Consequently we should arrive at the conclusion that the Leblanc process in this part of its operations wastes 75 per cent. of fuel.

Let us assume that the flame of a revolver has a temperature of 1,800° C., then we can utilise for heating the material per lbs. of fuel at 8,000 units—

$$N = 8,000 \times \left(\frac{1,800 - \frac{1,000 + 20}{2}}{1,800 - 20}\right) = 5,760.$$

We should therefore require for supplying the 64,000 units for heating the materials—

$$\frac{64,000}{5,760} = 11\cdot1 \text{ parts of fuel,}$$

which, with the 24 mixing carbon added, give 35·1 parts of fuel as required for heating. The 34,000 units necessary for the reaction would require different amounts of fuel, according to the view we take. If they have simply to be transmitted as heat, at 1,000° C. from a flame 1,800° hot, we shall according to formula (1) obtain from 1 lb. of fuel—

$$8,000\left(\frac{1,800 - 1,000}{1,800 - 20}\right) = 3,680,$$

and to supply 34,000 units we shall require 9·24 parts of fuel, or in all 44·3 parts pro 142 sulphate, or 6·24 cwt. per ton. On this view the reaction in the black ash furnace utilises 31 per cent. of the heat which could possibly be utilised under the most favourable circumstances. But if we take the other view, and assume that a mere transmission of 34,000 units of heat will not do, but that work must be performed, then the performance of molecular work equivalent to 34,000 units of heat requires by formula (2) the consumption of 47 parts of fuel; and adding these to the 35·1 parts otherwise required for heating and mixing, we arrive at 82·1 parts of fuel pro 142 of sulphate, or 11·5 cwt. per ton of salt cake as the theoretical quantity, with less than which the reaction could not be carried out. Whichever view we take, excluding the erroneous one, the black ash operation utilises from 31 to 57·5 per cent. of that part of the heat of the fuel which is theoretically available for the reaction. Such an efficiency compares very favourably with the best caloric engines, none of which have reached an efficiency of 30 per cent., and the great field for improvements which Mr. Hargreaves thought there was, is narrowed very considerably by these considerations.

As already stated, all the other reactions constituting together the Leblanc process are exothermic, *i.e.*, evolve heat. Among these the one which yields most heat, as Mr. Hargreaves puts it, five times as much as is required for the endothermic reaction, is the operation of pyrites burning. But if we calculate the temperature produced by burning pyrites under circumstances such that the products of combustion are suitable for sulphuric acid making, we find that temperature to be between 800° and 900° C., and in practice as usual much lower. But no amount of heat at 800° can be made useful for a reaction which only proceeds at 801°, so that even if this heat were more than five times as great, it is no use for the one endothermic reaction of the Leblanc process.

In the ammonia-soda process hardly any energy has to be supplied. It may be considered to change a solution of common salt and dry calcium carbonate into dry sodium carbonate and a solution of calcium chloride, and for doing that only a very trifling amount of heat is required. But even this trifling amount requires proportionately quite as much waste of fuel as the larger amount needed in the Leblanc process. It is of course necessary in both operations to move about large masses, and the fuel required for this purpose cannot be considered as wasted.

By far the best chance of supplying this energy for splitting sodium chloride into an alkaline compound of sodium and into chlorine is offered by the electrolytic method. I need hardly remind you that when we pass an electric current through a solution of sodium chloride, we obtain on the one hand a solution of caustic soda and evolution of hydrogen, and on the other chlorine gas.

The application of electric currents to the manufacture of soda was the subject of a patent, dated November 1851 (No. 13,620). The patentee, W. Cook, divides a long tank, lengthwise, into three compartments by porous diaphragms. The two outside compartments receive a charge of saturated salt solution, the middle compartment water. Into the outside compartments Scotch pig iron is placed, into the central compartment two plates of copper. Metallic connexion is made between iron and copper and the tank covered up air-tight with a lid provided with a luted escape pipe for the hydrogen gas. In a tank, 11 feet by 6 by 3 feet, the equivalent of a ton of sodium carbonate can be produced in seven days. The iron is converted into ferrous chloride. According to the inventor's very explicit statements, 2,489 lbs. of salt give 2,240 Na_2CO_3 or 1,327 of Na_2O, and consume 1,161 lbs. of iron, or 28 parts of iron produce, 32 parts of dry caustic soda (Na_2O) from 60 parts of common salt. This at once shows that the inventor never tried it. The caustic soda solution is said to contain 40 lbs. of soda per cubic foot, and a little salt.

This is the only attempt at using electricity generated by a battery, which I will refer to, as batteries are out of the question.

The only other way at our disposal to generate electric currents is the dynamo machine. Thermo-electric currents are at present out of the question. Edison's pyrodynamo is yet in its infancy, and is not, I fear, likely to produce more electricity from a given quantity of fuel than the ordinary dynamo, which has been brought to great perfection.

To convert the heat of burning fuel into the useful form of an electric current, we have first of all to change it into mechanical energy, and this afterwards into electric current.

Now, I have already given you Professor Zeuner's formula for calculating the useful mechanical energy which may be obtained as a theoretical limit from burning fuel. Supposing we had a perfect caloric motor, working between the temperatures 1,200° C. and 20 C. as extremes, from 8,000 units of heat per pound of carbon burnt we could obtain as mechanical energy only 67·4 per cent. Most of you are acquainted with the efforts Mr. Hargreaves has made to construct a calorie or thermodynamic machine which should utilise a very considerable interval of temperature. In the same inaugural address, which I have already quoted, he announced that he had succeeded to bring the fuel consumption, per horse-power, down to below 1½ lbs. of coal. Since that time he has given up the use of solid fuel, and has achieved still greater results by the use of liquid fuel. Still his labours are not complete, and until they are the thermodynamic machine, utilising such a range of temperature as above mentioned, is a thing of the future. It is remarkable that at the exhibition held at Munich there was not a single caloric engine (hot-air engine) exhibited. It appears that the German engineers consider the solution of the problem of changing heat efficiently into motive power to lie in the direction of gaseous fuel, and the results obtained with gas motors rival those obtained by the best steam engines. From some statements published I find that one ton of coal will, if manufactured into 10,000 feet of gas, yield 100 horse-power hours, but, of course, there is a credit due to coke and ammoniacal products if the gas is made for the purpose, *i.e.*, the retort replaces the boiler. One ton of coal usually yields 1,000 horse-power hours with the very best steam engines, but more often only 500 to 600 horse-power. But some engineers are thinking of converting the whole of the coal into producer gas, and employ this for obtaining motive power; thus the old notion of hot-air engines seems to be entirely abandoned. For the present, however, we must take an ordinary steam engine as the only means of converting very large quantities of heat into mechanical energy, and for a long time to come it will be the medium for transforming heat into mechanical energy.

Now, the very best compound, jacketed, condensing engine hitherto required about 2 lbs. of fuel per effective horse-power hour, which is equivalent to saying that out of the 8,000 units of heat, 1 lb. of carbon will yield on combustion only about 640 are converted into useful energy, so that if we compare this with the reaction I have spoken of in the Leblanc process, to supply the 98,000 units of heat in this fashion, 153 parts of fuel would be requisite, against 140, which are actually used for that purpose. The comparison is not quite fair, however, since the results produced would not be the same, and I only made it for the purpose of showing that nothing is really gained by the application of fuel, first to raise steam, then to drive an engine and dynamo to produce heat afterwards, over the direct application of fuel for heating purposes, where the temperatures required are within those producible by the fuel direct.

All the later proposals for the conversion of common salt into alkali by electrolysis make use of the current in such a manner as to obtain chlorine as well. The reaction which goes on in the electrolytic decomposition of common salt is supposed by inventors to be capable of being expressed by the equation—

$$2\,NaCl + 2\,H_2O = \underbrace{2\,NaHO + H_2}_{\text{Cathode.}} + \underbrace{Cl_2}_{\text{Anode.}}$$

This reaction is endothermic, and requires the supply of 53,060 units of heat per 58·5 of sodium chloride. The very remarkable thing is that if these 53,060 units of heat are presented in the form of electricity, the reaction will proceed at all temperatures, whereas if they are presented as heat, it will not proceed except perhaps at very high temperatures; and it is this which has suggested to me the thought that at temperatures at which heat does perform the work, it is only the work equivalent of the heat which is useful, *i.e.*, that given by some such formula as Zeuner's formula, and not that given by formula (1).

And herein lies the superiority of the electrolytic method over the direct method, (1) that the energy can be supplied at ordinary temperatures; and (2) that in transforming heat into mechanical work greater intervals of temperature can be made use of than in the direct application of heat. These advantages are, however, accompanied by serious drawbacks. Compared with our mechanical powers, the molecular forces are very large, and the consequence is that it requires very large plant to do comparatively little work.

The largest dynamo of which I have heard is one manufactured for Messrs. Cowles' aluminium process by the Brush Company. That dynamo gives, according to my information, a current of a little over 3,000 ampères. Now that sounds a large figure, but one ampère does very little work indeed. Many of my friends have asked me from time to time what kind of a battery they should employ to test certain electrolytic processes, so that they should obtain, say, a kilogramme or two of product. The public at large have not an adequate conception of the large quantities of electricity required for electrolytic operations, and they are ready to believe anything. The production of 5,000 barrels of refined sugar per day by means of electricity does not appear a great task to them.

In order to impress you with the very small amount of decomposition which one ampère produces, I will state it in this way: It takes a current of 1,000 ampères day and night every day for three years to produce in one electrolytic cell one ton of hydrogen gas, or its equivalent of any other substance. I think that statement will bring a clearer conception of the disadvantages of electrolysis than any other. The statement, if, instead of the English ton, 1,000 kilos. is referred to, is sufficiently accurate to use as basis for calculations, and it is easily remembered.

At the works of Messrs. Gaskell, Deacon, and Company, about four tons of salt are decomposed per hour. To do that work with the theoretical amount of electricity, engine-power equivalent to 5,728 horse-power would be necessary, and it would require 100 large boilers to supply the necessary steam, and of course this plant would only accomplish one single step in the operations of producing alkali and bleaching powder.

That is the one disadvantage of the electrolytic method. But there are others.

Although we are told every day, and I believe it to be quite true, that the construction of dynamos has reached such perfection that 90 per cent. of the available horse-power is changed into electricity, and that of the electricity so obtained 90 per cent. are available for the external circuit, *i.e.*, for the electrolytic work, yet even in the most simple applications of electrolysis the results of the work done in the cells is far below that which can be calculated from such statements.

Take the operation of copper refining for instance. It is one of the simplest processes which can be carried out, and it is carried out now to a very large extent.

According to some statements recently published, the cost of a plant for refining 30 tons of copper per month is about 1,000*l.* to 1,250*l.*, viz., 450*l.* for a dynamo, 300*l.* for a six-horse engine, the rest for electrolytic tanks. Now if it takes a six-horse engine a month to yield 30 tons of copper, this statement is equivalent to saying, not that 80 per cent. of the power are utilised, but that 80 per cent. are lost.

According to Messrs. Siemens and Halske's statements, seven to eight horse-power will give 250 to 300 kilos. of copper per day, which indicates a loss of nearly 50 per cent.

Another authority states that six horse-power produce 272 kilos. of copper per day; the plant to produce this ¼ ton per day covers 80 square metres of ground, and to produce plates of 1 cm., say ½-inch thickness, requires five months.

And the cause of this waste of power is not far to seek. The difference of potential between an impure and a pure plate of copper is about 0·25 volt. If the whole resistance of the lead connexions and the liquid in the tank together amounts to ·001 ohm, we shall require, to send 1,000 ampères through the tank, an electro-motive force of 1·25 volts, and if the resistance is only ·0005 ohms, we shall require ½ volt per tank; that at once accounts for the whole loss of 50 per cent. of the energy calculated as needed at ¼ volt. Where the dynamos employed are such as give high voltage, there is, in addition, considerable risk of loss by simple leakage.

It will thus be evident that electrolysis practically requires considerably more electricity for a given amount of work than that calculated from theoretical considerations.

We have, therefore, in converting heat into chemical energy by means of electricity, a treble loss to contend with: first, the loss of heat during its conversion into mechanical energy, 90 per cent.; second, a loss during the conversion of mechanical energy into current of 20 per cent.; and third, during the application of the current a loss, the magnitude of which cannot be foretold, but, taken all in all, the picture I have so far drawn of the application of electrolysis to the manufacture of soda from common salt does not look a very promising one.

If I take one horse-power to cost per hour ¼*d.*, and take an efficiency of 80 per cent. for the conversion of mechanical power into electric current, and of 50 per cent. for the conversion of that current into molecular work, I find that it would cost nearly 4*l.* to decompose one ton of salt and to obtain therefrom chlorine as gas and a solution of salt containing caustic soda and other things (for it could not be anything else). The Leblanc process sells the whole of the products from one ton of salt for less than 6*l.*

So far as regards the various modes of supplying the energy for endothermic reactions. Let us now glance at the other part of the problem, that of keeping the newly-formed molecules from rearranging themselves.

The Leblanc process uses, of course, the ordinary chemical means for this purpose. It separates the chlorine from the sodium by converting the chlorine into a gaseous compound, which is but little soluble in the solution from which it is evolved at the temperature of reaction. When the sulphur has to be separated from the sodium, the sulphur is converted into an insoluble solid compound. Similarly the ammonia-soda process converts the soda into a comparatively insoluble compound, whilst the chlorine remains in solution. Both these processes therefore solve that part of the problem very effectually.

Now, the electrolytic method, in those metallurgical operations to which it has been successfully applied, does exactly the same thing. The copper of the impure anode is dissolved and reprecipitated at the cathode in the pure condition. The impurities partly remain in solution, partly are deposited at the bottom of the tank. Thus this very essential condition of keeping the products separate from each other and from the raw material is complied with. But when we inquire about this aspect of the question with regard to the electrolysis of common salt, we find most serious difficulties which have not, so far as I am aware, yet been met by any inventor, and, I am afraid, difficulties which will require some considerable increase of our knowledge of electrolysis in general before they can be surmounted.

In the first place, if we wish to utilise to the utmost the horse-power of the engines, it is necessary to have the electrodes as little distant from each other as possible. But if in the close proximity, indeed surrounding the spot where chlorine is to be generated, there happens to be present a solution of caustic soda, where is the chemist who would expect the whole of the chlorine due to the current to be obtained, and who would expect the caustic soda to remain such in the presence of a current of chlorine gas?

The first patent, Clark's, I mentioned in connexion with this subject did not allow the chlorine to evolve, but caused it to combine with iron, and separated the two products by a porous partition.

There is another proposal for applying electrolysis to the manufacture of caustic soda from common salt by C. A. Faure (1742 1872). This inventor uses the current from thermo-electric batteries, he also uses as anode cast iron and separates the liquids by a porous diaphragm of stout canvas. Richardson and Grey (4417 1884) evolve chlorine gas; they show a remarkable drawing, which reveals at once the amount of knowledge which these inventors had of their process at the time they filed the specification. They also employ a porous diaphragm.

The last specification which it is my intention to mention to-night is one by Julius Marx, 1887, No. 6417. This inventor has got a step further, a step of which I will speak presently, but his mode of preventing the recombination of chlorine and soda consists in employing a porous diaphragm.

From the year 1851 to 1887 we have thus this vast progress, that while William Cook describes a method of producing a porous diaphragm 11 feet by 3 feet of biscuit or earthenware, the later inventors simply content themselves by mentioning a porous diaphragm.

The application of a porous diaphragm does not, however, stop the recombination of the caustic soda and the chlorine formed, it simply lessens it; and it lessens it at a very great expense. I have shown already that the loss of energy in copper refining is accounted for by the resistance of the tanks, leads, and connexions. In that process porous diaphragms are not wanted, and the resistance is consequently very small, from 0·0005 to 0·001 ohm per tank. But once we put porous diaphragms in, the resistance will increase to ·01 ohm and even to 0·1 ohm, according to the size and thickness and porosity of the partition.

Take it at 0·01 ohm, and see what electro-motive force there will be needed to send 1,000 ampères through the tank. By Ohm's law, if the electro-motive force of polarisation is v, and that between the terminals of the tank V, the current passing will be—

$$A = \frac{V - v}{O}$$

and if we put 1,000 ampères for the current, 0·01 ohms for the resistance, and two volts for the electro-motive force of polarisation, we find that the electro-motive force needed to send the current through the tank is 12 volts. This, again, means that 85 per cent. of the power of the engines are wasted on sending the current through a diaphragm.

I have already said that the diaphragm only partly prevents the recombination of soda and chlorine. There is one thing which it does not prevent at all, and that is it cannot prevent the products formed from being conductors. Though there is a diaphragm the current will travel not only *viâ* common salt, if this expression be permitted, but *viâ* caustic soda also. I have drawn attention to this in my paper on the Hermite process, and I shall presently add the results of experiments I made in this direction.

Now this is one of the two stumbling blocks over which it is difficult to get. This difficulty also is absent in the electro-metallurgical operations. The electrolyte in the refining of copper is usually an acid solution of sulphate of copper. As fast as copper deposits as pure copper, just as fast the impure copper dissolves and the electrolyte remains tolerably constant for a long time, and the whole of the current can be utilised for the deposition of copper, the losses being chiefly due to leakage, to resistance, and to excessive polarisation from various causes.

It is different in the electrolysis of common salt. As soon as caustic soda is formed this itself is a conductor also, and in that part of the cell in which the cathode is placed the current is conducted by both salts and divides itself among them. In the other portion of the cell a solution of chlorine in brine is formed, and this by no means gives off pure chlorine gas at the anode.

A solution of chlorine in a very dilute salt solution submitted to electrolysis gave me a gas of the following composition:—

Chlorine	2·89
Oxygen	23·84
Hydrogen	73·27
	100·00

When the salt solution is more concentrated the oxygen of course diminishes, but it is always present, and present in larger quantities when chlorates, which soon are formed, begin to conduct electricity as well.

That this difficulty is not removed by the interposition of porous diaphragms is also confirmed by the experiments of Dr. Jurisch, who showed that only 60 per cent. about, of his current yielded chlorine, although a porous diaphragm was inserted purposely to prevent such losses as I pointed out in my paper on the Hermite process as unavoidable.

All investigations which have so far been made as regard the conductivity of salts, show that when two salts are in solution both of them conduct. That this is the case is readily shown by the analysis of the gas evolved. Thus gas of the following composition is obtained from alkaline sulphate of soda, and an alkaline mixture of chloride of sodium and sulphate of soda.

—	Sulphate only.	Sulphate and Chloride.
Oxygen	34·0	10·1
Hydrogen	66·0	89·9
	100·0	100·0

Similarly a solution of magnesium chloride, and a mixture of solution of magnesium chloride and magnesium sulphate, gave the following gases:—

—	$MgCl_2$.	$MgCl_2 + MgSO_4$.	$MgSO_4$.
Oxygen	4·43	21·79	33·2
Hydrogen	95·57	78·21	66·8

Such experiments clearly demonstrate that the current electrolyses both oxygen salts and chlorides at the same time.

I have already referred to the specification of Julius Marx. This inventor attempts to overcome the difficulty I have mentioned by only carrying the electroysis so far as to decompose a portion of the salt. The solution of salt is then to be treated with carbonic acid gas in order to precipitate the soda as bicarbonate. I need not point out to you the insufficiency of this proposal; suffice it to say that this is adding the great expense of the ammonia-soda process to the costs of the electrolysis.

To sum up the chief points, the supply of energy for the purpose of decomposing sodium chloride is theoretically easiest to procure by the electrolytic method, but in practice is more expensive by that method than by the ordinary methods.

(2.) The separation of the products of the reactions from each other is practically easy and complete in the Leblanc process and ammonia-soda process, but offers almost insurmountable difficulties in the electrolytic process.

These considerations led me to the conclusion that for the production of articles of low price electrolysis as a manufacturing operation was impracticable.

There are, however, many cases in which, though the expense is great, the process may be applied. Thus, for instance, I attempted a few years ago myself to apply it to the purification of alkaline solutions from sodium sulphide. The solutions of carbonate of soda from the Leblanc process contain always a certain amount of sodium sulphide, which is a great nuisance to the alkali manufacturer. The oxidation by chlorine is expensive, because the chlorine in oxidising the sulphide will also neutralise alkali. The removal by metallic oxides in concentrated solutions is almost an impossibility, the sulphides will not readily settle ; the sulphide of zinc in particular is disagreeable in that respect, nor does the filter press assist much. The oxidation by means of air only transforms the sulphide into hyposulphite (thiosulphate), and this salt is almost as objectionable as the sulphide. I therefore proposed to oxidise it by means of electrolytic oxygen evolved in the solution itself. The results of the following experiments encouraged me to do so.

Electrolysis of a dilute solution of pure sodium sulphide yielded a gas consisting of—

	Per Cent.
Hydrogen	96·4
Oxygen	3·6

Similarly a dilute solution of sodium hyposulphate yielded a gas containing—

	Per Cent.
Hydrogen	96·27
Oxygen	3·73

so that it appeared as if nearly the whole of the oxygen which the current would have evolved had been absorbed by either of the two compounds. We therefore erected dynamo and engine for the purpose, and though the expense might be great per ton of sulphide of sodium, yet seeing there is seldom more than 2·4 per cent. of the soda in form of sulphide, the cost might be bearable per ton of soda. The results were simply disastrous, and to those who intend to apply electrolysis for similar purposes I recommend these considerations I have had the honour of laying before you as the afterthoughts of one who burnt his fingers.

DISCUSSION.

Dr. S. **Hamburger** thanked the Chairman for his kindness in allowing his address to be discussed. He availed himself of this permission, and wished to refer to the first portion of the paper, where Dr. Hurter spoke about the conversion of heat into chemical and mechanical energy. As Dr. Hurter mentioned, and this was right in many cases, investigators frequently contented themselves with expressing chemical processes by thermo-chemical equations, and after comparing both sides of the equations, the balance was stated as the minimum of heat required for a certain chemical process, and any excess over this minimum as so much heat wasted. Such calculations were of no use, as, unfortunately, in many instances, chemical reactions only proceeded at high temperatures ; and as the materials to be acted upon had to be heated up to the temperature of reaction, this amount of heat ought to be taken in account and added to the minimum. Dr. Hurter had mentioned other items, but he begged to be excused if he reminded the lecturer that he overlooked another source of loss of heat, which also concerned the Leblanc process. In the first portion of this process, the decomposition of salt by sulphuric acid, hydrochloric acid was given off, and although the liberation of the gas was facilitated by the chimney draught, still the gas had to overcome the atmospheric pressure. This was really mechanical work done by the gas, and for this work heat was required. A similar case occurred in the black ash furnace, where carbonic acid was liberated, which likewise had to do mechanical work. In adding this item, Dr. Hurter's figure as to the utilisation of heat in the black ash furnace would come out more favourably still. He did not refer simply to the heat unavoidably carried away by the gases, but to the work these gases performed in overcoming the pressure of the atmosphere, and in thermo-chemical calculations no item must be omitted or dismissed as inconsiderable. There was another point : Dr. Hurter said that in the first part of the Leblanc process no heat was required. Now if they wished to make bisulphate of soda, no heat would be required. The two sides of the equation were practically the same, and no heat was absorbed ; but in making sulphate of soda there was considerable amount of heat absorbed. He could not give them figures, but not long since he had calculated that, and for making sulphate of soda a considerable amount of heat was absorbed ; and in practice, as they all knew, the manufacture of sulphate of soda required a great deal of heat.

Mr. S. G. **Rawson** remarked that in both the Leblanc and ammonia-soda processes one of the advantages was the complete and entire separation of the products as soon as formed. In the electrolytic process, however, it seemed that either there was a great tendency on the part of the chlorine and caustic soda to unite again when there was no diaphragm, or else that with a diaphragm a large excess of current was required. Supposing, therefore, that the chlorine was removed as an insoluble choride, would the residual caustic soda pay for the cost of the operation ?

Mr. **Simpson** said that he had taken especial interest in the paper, from the fact that his partner, Mr. Parnell, had conducted a number of experiments about 10 years ago with a view to producing alkali and chlorine by the electrolysis of sodium chloride. The experiments had cost about 150*l*. In these experiments he had used a porous diaphragm, but he found he could scarcely ever get any material that would stand the action of the current. If he used porous earthenware of some kind it always cracked ; another difficulty was that the chlorine seemed to destroy any metal used for electrodes. He used iridised platinum, and that was too expensive. Finally he found that the horse-power was simply enormous—8,000 h.p. for 24 hours to make one ton caustic, and they did not follow it any further.

Mr. **Muspratt**, in proposing a vote of thanks to Dr. Hurter for his admirable paper, said he did not feel competent to discuss it, and he doubted very much whether, in the whole Society, there was another man who could read a paper which combined so thoroughly scientific with practical knowledge as that they had just heard. He thought they should be proud that their Section included a member so able to be an exponent of the objects of the Society, namely, the union of science with practice. (Hear, hear.) He thought that those members who were Leblanc soda manufacturers might feel some consolation from what they had just heard. He thought they had all felt that the prospect of making caustic soda and chlorine by electrolysis was rather distant, but, from the paper, it was practically proved that it would not take place in their time. They might also be very well satisfied that they had advanced so far in the decomposition of salt for the purpose of obtaining soda as to get the results which Dr. Hurter had put into figures. He considered it very remarkable that they had utilised between 30 and 40 per cent. of the energy of the carbon, particularly when they found, when heat was converted into mechanical energy by means of the steam engine, that conversion was not so perfect as in the Leblanc process in the revolver. Dr. Hurter had not mentioned, but doubtless had considered a proposition, which took the form of an invention and a patent some two or three years ago, for the direct production of chlorate of potash from chloride of potassium. He (Mr. Muspratt) had the pleasure of meeting the inventor some two years ago, and was told by him that he was going to make chlorate of potash by that process in very large quantities and at a very low price. He (Mr. Muspratt) confessed that he was not very much frightened at the time, and, after hearing Dr. Hurter, he thought the prospect more distant than ever. The difficulty always arose in the use of electrolysis of separating the product from the raw material. Dr. Hurter pointed that out very clearly in his former paper upon the Hermite process, and had again referred to it that evening. He thought, when they considered the results which had been obtained in the deposition of copper by electrolysis, a process comparatively simple, because the copper itself was separated in the process from the liquid; when they considered the results were so inferior, *i.e.*, the energy which was utilised was so small compared with the energy generated, they might be assured there was no prospect of applying electricity to the separation of the chlorine and sodium at a low cost even under the most favourable conditions.

Dr. J. Campbell Brown, in seconding the vote of thanks, said, that when the President of the Society read his interesting paper in the early part of this year on the Pechiney process it was anticipated that it would not be long before Dr. Hurter had something to say on behalf of the Leblanc process, which was then indirectly threatened. A process which has lasted so long, and performed its work so very efficiently, must have advantages over other possible processes which can be theoretically accounted for. How well Dr. Hurter had fulfilled those anticipations they had seen in his address this evening. In the thermo-chemical portion of his paper Dr. Hurter had not only performed a service to the Leblanc manufacturers, but had given an illustration of method which would be of great service to all who might attempt to employ the science of thermo-chemistry to the working out of manufacturing problems. In the electrical portion of his paper he had shown what had been frequently shown of other applications of electricity, that electricity was not usually the most economical way of applying energy.

Electricity has popularly been thought to be about to replace ordinary modes of applying heat, chemical energy, and mechanical energy, but the anticipations of the public are certainly doomed to disappointment. In all of these applications, unless where some special requirement can be fulfilled by it which cannot be fulfilled by ordinary methods of application, electricity is not the most economical means of applying other forms of energy. Dr. Hurter had shown them one example where loss of energy occurred in applying electricity to chemical decompositions, and the principle of this example would apply in many other cases.

Dr. Hurter, in reply, said he was very much obliged to them for their kind words and attention.

With regard to Dr. Hamburger's remarks, he really did not wish to show where in the Leblanc process heat was evolved and where absorbed, his great aim being to show that the number of units of heat evolved in the exothermic reactions of the Leblanc process were not available for the endothermic ones, owing to their being evolved at too low a temperature to be useful for a reaction which only took place at a high temperature. He did not attempt to give a complete balance of gain and loss of heat. If he had attempted to do so and had forgotten the heat necessary for mechanical work in overcoming atmospheric pressure, he would no doubt have made a serious mistake. With regard to the mechanical work done by the fuel gases in overcoming atmospheric pressure, that was provided for in Zeuner's formula.

In reply to Mr. Rawson, it would clearly be cheaper to get the chlorine as well; the same current would be wanted to get the caustic, and the whole costs would fall upon the caustic soda produced.

He was glad to hear Mr. Simpson confirm his views.

He thanked Mr. Muspratt for his remarks. With regard to the invention which Mr. Muspratt had mentioned, if there was any chance for an electrolytic process at all it would be for the manufacture of chlorates. He must say, however, that in his own experiments, made with a view to obtain sodium chlorate at a time when the price of that substance was very high, he found that the amount of electricity wanted was so large that such a process could not be made commercially successful.

THE HERMITE PROCESS.

BY DR. F. HURTER.

When I published my experiments on the electrolysis of magnesium chloride, I did so partly to show that Messrs. Cross and Bevan must have been in error when they obtained in a tank holding 845 litres, 3·25 kilos. of chlorine with a current of 200 ampères in 12 hours, and that consequently their calculations of costs based on such an experiment must be erroneous also; and I showed what difference in the costs it would make if, instead of their experiments, I chose one of the experiments as basis which I had described in my paper. The great aim of my research was, however, to demonstrate that there was no exception to Faraday's law in this particular instance, as from Messrs. Cross and Bevan's experiments one was led to believe.

I am now accused by Messrs. Cross and Bevan, in their paper published on p. 292, Vol. VII. of our Journal, of having condemned the Hermite process on the result of experiments in the conduct of which an "essential detail" was omitted.

Messrs. Cross and Bevan commended the process on the result of experiments in which this essential detail was also omitted, or, to say the least of it, no mention of it was ever made.

This essential detail was the agitation of the solution by means of a stirrer. I consulted the specification of M. Hermite, then accessible, and the reports of Messrs. Cross and Bevan and "the essential detail," the stirrer, is not mentioned in any of them. But is this detail essential? I shall answer that question later on.

There is, in spite of my omission of this "essential detail," now very little difference between us as regards the principal phenomena observable during the electrolysis of magnesium chloride. We agree that this process is no exception to Faraday's law. We agree that the amount of chlorine obtainable from the current is less than 100 per cent. We agree that the difference is due to the formation of chlorates and the evolution of oxygen gas at the anode. We agree that the solution does not contain any hydrogen peroxide, and owes its bleaching efficiency to a chlorine compound.

We differ still as to the explanation of the electrolysis, and as to a few secondary phenomena.

The explanation of the electrolysis which I gave was: the current splits the $MgCl_2$ into magnesium and chlorine. This reaction is denied by Messrs. Cross and Bevan. They say there is not one scintilla of evidence that any free chlorine exists at any time in the solution. I must say, on the contrary, that if the solution did not contain some chlorine, the gases evolved would not contain it. But they do contain it, and it takes no finer reagent to discover the chlorine than one's nose.

I further explained that this chlorine then formed hypochlorites. That hypochlorites are formed is not denied.

Having now two salts in solution, I went on to show that both of them were electrolysed, the hypochlorite yielding chlorates and oxygen, and upon this, as a premise, I based a method of calculating from the analysis of the gases evolved, the efficiency of the current for available chlorine. I showed that in many instances this calculation gave fair results; but I specially drew attention to the discrepancies, and went to the trouble of producing special experimental evidence to explain these discrepancies, and, in addition, independent proof that the result of the electrolysis of hypochlorites are chlorates.

If this, my view, must be contradicted, experiments ought to have been brought forward in which a hypochlorite had been electrolysed without the production of chlorates. That would have been the proper way of opposing my view. Instead of that, Messrs. Cross and Bevan produce a table of results to show that the oxygen evolved did not bear any constant ratio to the chlorate formed, as if I had ever said it did. They have, inadvertently, no doubt, made a misquotation. I am reported to have said, referring to magnesium chloride, "that the formation of chlorate exactly corresponds to the oxygen in the gas." If Messrs. Cross and Bevan will refer to my paper again, they will find that this statement refers to the special experiment with calcium hypochlorite, which they consider irrelevant, but which I made specially to prove that the chlorate arises from electrolysis of hypochlorite. As regards the magnesium chloride solution, I never used those words at all. I said, "the gases are enriched by a certain amount of oxygen, to which there is no corresponding transformation of hypochlorite into chlorate." The whole of the experiments performed with chlorates would not have been wanted if I had found a constant oxygen ratio.

Now, their own experiments, Nos I. and II., which were expressly made to discredit my theory of this electrolysis, are interesting from this point of view. By my method of calculating the current efficiencies from gas analysis, I would, for these experiments, have obtained the following figures:—

Cross and Bevan's Experiments.	Total Chlorine.	Available Chlorine.
Experiment I.	89·2	67·5
Experiment II.	92·0	80·7

Whilst they, from the analysis of the solution, give:—

Cross and Bevan's Experiments	Total Chlorine.	Available Chlorine.
Experiment I.	89·4	72·8
Experiment II.	93·0	84·0

Their experiments agree with my explanations quite as well, and better, than some of my own. But these experiments, unfortunately, bear internal evidence that they are erroneous, and therefore I must deny myself the pleasure of using them for the purpose of verifying my theory, more particularly the first experiment.

In that experiment 99·44 per cent. (or say the whole) of the hydrogen was evolved which the current possibly could have evolved. During the last period, when the available chlorine in the solution had already reached 3 grms. per litre, 101·4 per cent., or say the whole, of the hydrogen due to the current was actually evolved. I declare this to be utterly impossible. From a solution containing so powerful an oxidising agent as magnesium hypochlorite and free hypochlorous acid, the whole of the hydrogen due to the current cannot be obtained.

When electrolysing bleaching powder solutions, I only got 12 per cent.; when electrolysing a solution containing 1·8 grms. of free chlorine per litre, only 60 per cent. of the hydrogen could be obtained. I will not point out other consequences of such an error in the measurement and analysis of those gases. I will simply dismiss the experiment as erroneous, and with it the comparison with my own for which that experiment is used in Table II. of Messrs. Cross and Bevan's paper.

As there is absolutely no other evidence against my explanation of the electrolysis in the whole of Messrs. Cross and Bevan's paper, I see no reason for abandoning it yet, and repeat that the proper way to upset my explanations would be to produce an experiment on the electrolysis of hypochlorites in a single cell in which no chlorates are formed.

During my experiments on the electrolysis of potassium chlorate, I found the potassium perchlorate was formed. Before I was thoroughly satisfied of the presence of this salt, I was obliged to pass a current capable of depositing about 12 grms. of copper through a cell holding about 150 cc. of chlorate solution. Messrs. Cross and Bevan decided that magnesium perchlorate is not formed from the chlorate, because, in an experiment in which ¼ of a grm. of copper was deposited, they could not prove the presence of magnesium perchlorate analytically. If that experiment had given as large a yield of perchlorate proportionately as my own, the percentage of chlorate would only have diminished in the third decimal place. I quite agree with them that magnesium perchlorate is not formed so readily as the corresponding potassium salt, but I have been able to prove its presence by passing a current through 100 cc. of the solution, which deposited in the voltameter 7 grms. of copper. Their own experiment on this point is not decisive. But the formation of perchlorate is of no importance as it does not affect my explanations in any way. The oxygen evolved by the chlorates did not, however, explain all discrepancies, and as I had observed that the solutions were not very stable, I explained part of the discrepancies by this instability of the solutions. Messrs. Cross and Bevan now assure us that these solutions are quite stable. So they are after a few hours, but M. Hermite only agrees with what I observed, when, during the discussion, he says, "The efficiency with an old solution is not so great as with a new one. For its greatest efficiency, the solution must be tested when it leaves the electrolyser."

But I can quote Messrs. Cross and Bevan themselves to the same effect. In one of their reports occur these words, "The bleaching agents were found to be in a highly unstable condition." The fact was that the available chlorine had in one night diminished by 52 per cent.

After all, we have very similar experiences to record, for in the same report are also contained the words, "On continuing to pass the current, no further accumulation of bleaching gases."

Now for all these agreements and the very few disagreements between us, the one essential detail, viz., the agitation, which I omitted, is to blame.

I was struck with Professor Dewar's way of stating that point. He thought that the rapid rotation removed the hypochlorite from the anode and thus saved it from being converted into chlorate. My subsequent experiments do not bear this view out. It appears that the removal of the chlorates, already formed by the rapid rotation, gives rise to the formation of fresh quantities of chlorate.

I made a great number of experiments, first to learn to obtain constant results in two consecutive cells. Having learnt that, I made experiments with and without rapid rotation in two cells in series. My stirrer, of the form of a ship's propeller, rotating at 400 revolutions per minute, kept the solution in one of the two cells in very brisk agitation. I was unable to make by the means indicated by Messrs. Cross and Bevan a gas-tight joint, and could not therefore produce satisfactory analyses of the gases at the same time.

The mean results of seven experiments with stirrer and seven without are given below :—

—	Current efficiency.	
	Available Cl.	Total Cl.
With stirrer	57·8	74·7
Without „	55·0	61·8

I will only refer in a few words to Professor Dewar's explanation of the electrolysis of magnesium chloride, which Mr. Bevan hailed with great satisfaction, and of which he asserted for himself and partner that they had long held that view.

This explanation, from which Mr. Mond dissented, but which the Professor held to be quite as rational as mine, is the following.

The current decomposes, not the magnesium chloride, but the water in which it is dissolved, hydrogen appearing at the cathode and oxygen at the anode. Part of this oxygen escapes, but the rest is absorbed by the magnesium chloride and forms the magnesium hypochlorite.

If the learned Professor had explained the production at the cathode of magnesium hydrate in this very rational and simple way I would be satisfied. But as he is not likely to have heard of hydrogen precipitating magnesia, but (I am sure) must have heard of magnesium evolving hydrogen, I am afraid we shall lose some of the simplicity and rationality of his explanation. For the present I prefer my own, it fits more of the facts than his.

The antiquated theory of the decomposition of water by the current is, however, long since exploded. Water is so bad a conductor that it is very questionable indeed whether it can be considered an electrolyte at all. But I cannot go further into this question, it would lead me into a lecture on electrolysis.

Nor can I oblige my friends by an explanation of the fact that the oxygen evolved during various periods does remain nearly constant. They think this ought not to be so if my explanation of the electrolysis were correct, but I assure them that is not so.

The assertion of Messrs. Cross and Bevan that an operator can at will make the current to electrolyse either the water or the salt dissolved therein is of course equally rational a doctrine as the decomposition of water itself.

Difficult as Professor Dewar would find it to explain the precipitation of magnesia from its solution by hydrogen gas, still more difficult he would find it to explain the precipitation of a peroxidised magnesium compound at the cathode. I have been challenged to find this substance at the cathode. I need not say that there is no great probability of its ever being found at the cathode by any one. I certainly found nothing but magnesium hydrate combined with magnesium chloride as a scaly deposit.

As to the greater efficiency of the electrolysed solutions as compared with bleaching powder. I had made some experiments, though I did not mention them.

It is curious to learn from Messrs. Cross and Bevan's report that when bleaching powder is assisted by carbonic acid, as in the Mather-Thompson process, the electrolytic bleaching solution is "not sensibly superior." What I found in my few experiments was, that between an acidified solution of ordinary bleaching powder and this electrolytic solution there was no essential difference.

With these remarks I close a discussion to which I cannot devote any further time and attention.

Newcastle Section.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the Durham College of Science,
Thursday, November 8th, 1888.

MR. T. W. STUART IN THE CHAIR.

INFORMAL COMMUNICATIONS.

Professor Bedson gave a short account of some experiments on the gases occluded in coal, a paper on which subject he had read before the North of England Institute of Mining and Mechanical Engineers. He stated that some time ago a member of the Institute drew his attention to the remarkable behaviour of a particular class of coal dust at one of the collieries under his superintendence, and suggested that it would be desirable to ascertain whether this particular coal dust contained gases enclosed in it, as coal itself does. The author said that the investigations of Herr von Meyer in Germany, and of Mr. W. J. Thomas in this country, have demonstrated that coal holds varying amounts of gases enclosed in it, the gases consisting of mixtures of carbon dioxide, nitrogen, oxygen, and marsh gas (CH_4), and in some few instances other hydrocarbons related to marsh gas and olefiant gas (C_2H_4) have been found in the gases obtained from the coal. The gases enclosed in the coal were obtained by placing it in suitable vessels and exhausting them by a Sprengel pump, and at the same time heating the coal at 100° C. (212° Fahr.), drawing off the released gases by the continual flow of mercury. An account was then given by the author of the results obtained by submitting coal dust collected fresh from the screens to a similar process. The coal dust was found to contain, like coal itself, gases occluded or enclosed in it, and in considerable volume. The analyses of these gases indicated a general resemblance in composition to those obtained by von Meyer and Thomas, and further that the combustible portion of the gases consisted in all probability in part of hydrocarbons related to olefiant gas (C_2H_4), and of members of the series to which marsh gas belongs, similar to those forming the natural gas issuing from petroleum wells. A portion of the dust had been examined by exhausting it successively at temperatures of 50°, 70°, and 100°, at each of which temperatures gas was given off which was separately collected and analysed. The results tended to show a kind of fractionation of the paraffin hydrocarbons contained in the dust, the value of n in the formula C_nH_{2n+2} being greater at the higher temperature. He added that, as a coal dust from one source only had been examined, it would be premature to draw any general conclusions from the results obtained, and it is the author's intention to submit coal dusts and coals from different sources to a similar examination. Should further investigations confirm the results obtained, the existence of gases enclosed in coal dust, together with the nature of the combustible portions of these gases, will, it is thought, aid in some measure to explain the influence of coal dust in colliery explosions.

Mr. Pattinson and Mr. Gatheral suggested that the loss of occluded gas by keeping might account for the lessened inflammability and the deterioration of coal kept for some time.

Dr. Bedson said that this change was chiefly due to oxidation of the coal, and that the amount of occluded gases was too small to affect the quality of the coal noticeably by their loss.

Mr. John Watson drew attention to an error in his paper read at the April meeting.

ANALYSIS OF WATER FROM THE ROUNDWOOD COLLIERY, PARKGATE, NEAR ROTHERHAM.

BY J. F. CLEEVES AND JOHN C. PLATTS, FIRTH COLLEGE, SHEFFIELD.

This water issued from "slips" in the roof, and was very plentiful. The sample was taken from an accumulation at a depth of 500 yards from the surface, and at a distance of 1,800 yards from the bottom of the shaft. The temperature was found to be 19° C. or 77° F.

A careful qualitative analysis of the residue left on evaporating showed it to contain silica, iron, aluminium, calcium, magnesium, barium and sodium, with chlorine and bromine—a spectroscopic examination did not reveal a trace of lithium. It will be seen that in many respects, notably in the quantity of the chlorides of barium, magnesium, calcium, and sodium, this water resembles that from the Redheugh Colliery examined by Dr. Bedson (*see* the November, 1887, number of the J. Soc. Chem. Ind.). On the other hand, however, it differs from it in containing a quantity of bromine, but no lithium.

Concerning the method of analysis, it may be interesting to note that the bromine was estimated by F. Mohr's method, which consists in precipitating the whole of the bromine and part of the chlorine with a known weight of silver nitrate. This precipitate of bromide and chloride of silver is carefully dried and weighed in the usual manner, and from the difference between this weight and the weight of the silver chloride corresponding to the silver nitrate employed, we have the necessary data from which to calculate the quantity of bromine. The results obtained were satisfactory. The other constituents were determined by the ordinary methods.

From a complete analysis which was made, we get the following as the amount of salts in the water :—

—	Grains per Gallon.	Grams per Litre.
Silica	9·06	·129
Alumina and ferric oxide	1·32	·019
Barium chloride	20·45	·292
Magnesium bromide	28·93*	·413*
Magnesium chloride	356·13	5·087
Calcium chloride	1,599·51	22·850
Sodium chloride	4,714·59	67·351
	6,729·49	96·141
Chlorine required	4,157·24	59·35
Do. found	4,165·09	59·50

Specific gravity = 1·0622.

* This is equivalent to 23·43 grains per gall. or ·333 grms. per litre of bromine.

It was intended to investigate the nature and quantity of the gases in solution, but as a sample could be got which probably only contained a small proportion of the gases really dissolved in the water, no analysis was made. The reason that any volume of water collected could not be considered to give accurate results concerning the amount of gas is, that in falling from the roof into the workings in small drops there is a great tendency to liberate a large quantity, and in fact actual experience supports this. The water does undoubtedly contain a considerable volume of gases, prominent among them being marsh gas. The dropping water was allowed to fall into an iron gutter, and then to flow away. When a lighted lamp was placed over this running stream the marsh gas burnt inside. On another occasion, when the lamp was suspended just above the surface of a large quantity of the water which had been allowed to collect, the characteristic "blue-cap" was observed in the flame, which was almost immediately extinguished. These experiments, besides demonstrating the presence of marsh gas, show how readily the water parts with the gas.

ERRATUM

Journal—April 1888, *p.* 306, *line* 17 *from bottom— Col. I.*

For "1 cc. = ·020 gram, Na_2O = ·0258 gram S." *read* "1 cc. = ·020 gram, Na_2O = ·0103 gram S."

Glasgow and Scottish Section.

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G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The First Meeting of the Session was held in the Societies' Rooms, 207, *Bath Street, Glasgow, on Monday, November* 12*th*, 1888.

PROFESSOR DITTMAR IN THE CHAIR.

ON THE BEHAVIOUR OF THE HYDRATES AND THE CARBONATES OF BARIUM AND OF THE ALKALI-METALS AT HIGH TEMPERATURES, AND ON THE PROPERTIES OF ANHYDROUS AND HYDRATE OF LITHIA.

BY W. DITTMAR, LL.D., F.R.S.

THE paper which I propose to read to-night joins on to one, "on Alkali-proof Vessels," which I laid before the Section some years ago. In that paper, as some of you may remember, I showed that the corrosive action which caustic alkalis and similar bodies exhibit when kept in a state of fiery fusion in platinum vessels, is a function not of these but of the peroxides formed from them by the action of atmospheric oxygen, and consequently can be prevented by operating in an atmosphere of hydrogen or nitrogen. It does not follow that the alkalis themselves, under the circumstances, suffer no chemical change. This side of the question lay outside my programme at the time, but I found, incidentally, that carbonate of lithia, if kept at a red heat in an atmosphere of hydrogen, loses almost the whole, if not the whole, of its carbonic acid. The observation is interesting in this sense, amongst others, that it shows the way towards preparing that substance, Li_2O, of which our handbooks give us little more than the name and the formula. It is from this standpoint that I, some time ago, resumed the experiment, and thus came to drift into the present investigation, in which, let me acknowledge it at once, I was most ably supported by my excellent private assistant, Mr. Robert Anderson.

The substance used as carbonate of lithia in the present case was part of a supply of "lithium carbonicum purissimum," from Trommsdorff, of Erfurt, which an analysis by Mr. Robson had proved to be contaminated with only 0·2 per cent. of foreign bases, and 0·09 per cent. of SO_3, and consequently was accepted as a sufficient apology for the ideal compound. As the preparation is very bulky, we began by fusing up successive portions in a platinum crucible in an atmosphere of hydrogen, to produce some 26 grms. of an anhydrous and partly causticised compact substance. In this operation, as in all subsequent similar experiments, we used the same platinum crucible which had served in the previous research—an ordinarily shaped crucible of about 30 cc. capacity, provided with a closely-fitting lid overlapping the sides, and provided with two autogynically soldered-in platinum tubes. The inlet-tube projects into the crucible to the extent of about a centimetre, the outlet-tube commences at the lid. 15·4 grms. of the fused carbonate were placed in the crucible, and in it kept at a red heat in a current of carefully purified hydrogen for, in all, 37 hours. During the greater part of the operation a powerful Bunsen—at the latter stages a gas blowpipe—served as the source of heat. The ultimate residue formed a stone-like, very hard mass, which, when broken up into fragments and heated again, only sintered but did not fuse, nor did it show any appreciable degree of volatility. It exhibited a slight tinge of blue, which was probably owing to the presence of a trace of sulphide of lithium, because it disappeared when a sample was heated in air. As the mean result of three analyses, it contained, in 100 parts, 0·6 of CO_2 and 99·57 of Li_2O (determined as Li_2SO_4). Sum = 100·17, showing that it was a approximation to pure lithium monoxide. In regard to the properties of this oxide, I have nothing to add to what I stated incidentally, except that it acts only very sluggishly on cold water, with only slight elevation of temperature. This does not prove that the heat-evolution is small. An exact determination of the latter by means of Bunsen's calorimeter is in contemplation.

Hydrate of Lithia.

Hydrate of lithia might have been obtained from the oxide by treatment with water, and this, indeed, is what I originally intended to do; but the preparation of the oxide having proved so very wasteful of time, I fell back upon the old known method of decomposing the sulphate by means of its exact equivalent of baryta, which was found to work very satisfactorily. Reserving all details for the complete memoir, I will only say that we had no difficulty in obtaining a pure and clear solution of the hydrate without the use of filters, and that this solution was evaporated, first in a large nickeled iron basin (as made in Iserlohn for culinary purposes), and then in a large platinum basin, to a small volume. The concentrated ley deposited on cooling colourless crystals, which were dried on a plate of unglazed granite-ware over caustic soda, and preserved as dry, when they ceased to stain filter-paper when pressed against it. From duplicate determinations of the lithia, the carbonic acid and the baryta, I calculated that the crystals contained—

Lithia, Li_2O, as hydrate	33·48*
Lithia as carbonate	0·62
Carbonic acid in the carbonate	0·91
Baryt, BaO	0·08
Water, by difference	64·91*
	100·00

* Corresponding to the formula $Li_2O + 3·2347\ H_2O$, *i.e.*, $LiOH + H_2O + 0·1173\ H_2O$ of surplus water.

The greater part of the preparation was utilised for an extensive series of determinations of the solubility in water at four different temperatures, which were finally summed up in the interpolation-formula—

$$y = 6·6750 - 0·00346\ t + 0·0003\ t^2$$

where y stands for the percentage of Li_2O in the solution saturated at $t°$ C.

For t =	0°.	19·4°.	50·0°.	100·0°.
y by calculation.	6·675	6·721	7·282	9·327
y by experiments	6·667	6·758	7·240	9·330

These results show that lithia in its rate of solubility in water comes nearer to baryta than it does to caustic soda or potash.

The crystals, when heated in a current of pure dry hydrogen to 100°, lost all their crystal-water, and the residual LiOH remained undecomposed up to 320°. When heated to redness in hydrogen within the gas crucible for four hours they suffered complete reduction to Li_2O. To make quite sure of this important result, the Li_2O in the residue was determined as sulphate and found equal to 99·96 and 99·80, mean 99·88 per cent.

This result surprised me very much, as even hydrate of baryta is generally supposed to retain its water at a red heat. But is this really true? As Mr. Anderson had his hands full, I caused Mr. Andrew Hodge to prepare some CO_2-free baryta-crystals, and examine them in regard to their behaviour at a red heat in hydrogen. The residue became constant in weight after about four hours, and was found to be pure BaO. (A determination of the baryta as $BaSO_4$ gave 100·35 per cent.)

After these results with baryta and lithia I was quite prepared to see even caustic soda becoming anhydrous when heated to redness in hydrogen, and caused Mr. Hodge to make some experiments in this direction. These experiments, however, proved considerably more difficult than I had expected. Nobody, of course, would expect caustic soda to lose its water below redness, and at a red heat the preparation volatilises very largely and, besides, creeps to an exasperating extent, so that after half-an-hour's heating (of some 2—3 grms. of substance) the crucible contained only a very little of a residue, which had to be scraped out, because the crucible, being smeared over outside with alkali, was unweighable. We tried to overcome this difficulty by burying the caustic alkali in a large quantity of spongy platinum, but failed to obtain satisfactory results even in this way. Taking my analyses as they stand they seem to prove that in the heating process the bulk of the NaOH simply volatilised, while the rest remained behind along with the carbonate which had been present in the original preparation as an impurity.

Not feeling inclined at the time to waste any more time over this branch of the inquiry, I put it aside and devoted my attention to the carbonates of the alkalis and of barium. The general order of operations was this:—The respective carbonate was in the first instance studied, in regard to its behaviour, at a red heat, in pure hydrogen, which in all cases (excepting that of lithia) led to the formation of a mixture of carbonate and hydrate ROH. The formation of hydrate from carbonate under the circumstances is easily explained by assuming that the hydrogen reduces the CO_2 of the carbonate to CO, with formation of steam; but this does not exclude the possibility of some of the carbonate being reduced to oxide by mere dissociation. I therefore, in general, proceeded to resume the heating of the carbonate in an atmosphere of nitrogen. When I tried this for the first time with carbonate of soda, I made the singular observation that the product, in addition to Na_2O, contained a considerable admixture of hydrate NaOH! Where did the hydrogen come from? Well, the answer, after Graham's famous experiments on the occlusion of gases by metals, is easy. Red-hot platinum is permeable by hydrogen, and what of this gas has once got into the crucible through its walls will, of course, exert its reducing action on the carbonate. It is as well to note that this reduction could not be very much minimised by accelerating the current of nitrogen, because the carbonate is there in the fused state, and that part of the hydrogen which diffuses directly into the fused salt will not be interfered with by the nitrogen in the empty part of the crucible. After the fact referred to had been established the nitrogen experiments were carried out in the following manner:—The carbonate to be operated upon was put into a platinum boat, the latter slid into a porcelain tube, and the tube then heated in a muffle, care being taken to so arrange matters that the boat was in the hottest part of the muffle. The nitrogen was passed in through the outer end of the tube and allowed to pass into the furnace.

All that now remains for me to do is to give a summary of my results.

Baryta.

3·427 grms. of pure anhydrous carbonate of baryta were placed in gas-crucible and in it heated in hydrogen, first by means of a Bunsen for two hours, then by means of the gas blowpipe. The weight of the residue became approximately constant after seven hours, at 2·667 grms. It contained only 0·1 per cent. of CO_2, and 99·03 per cent. of BaO; total = 99·13; the deficit of 0·87 per cent. was probably water taken up while the substance was on its way to the balance, because it is abundantly proved that hydrate of baryta loses its water at a red heat. In any case the substance was practically free of carbonic acid, and this is the main thing.

2·2168 grms. of carbonate were heated in nitrogen within a muffle as above explained, the process after attainment of the highest temperature being continued for one hour. The loss of weight amounted to only 1·9 milligram, showing that the dissociation tension of carbonate of baryta at the temperature is nil. To make sure of this result the product was analysed. It contained 22·249 per cent. of CO_2 and 77·638 of BaO; total = 99·887. The calculated percentage of CO_2 in $BaCO_3$ is 22·312.

Lithia.

In hydrogen at a bright red heat carbonate of lithia loses its CO_2 completely, as we have seen, but the last remnants go away very slowly. That the change is at least partially due to mere dissociation is proved by the following nitrogen experiments:—

—	Experiment I.	Experiment II.
Highest temperature maintained for	1 hour	10 hours
Percentage of Li_2O in residue ...	7·77	30·37

In Experiment II. the loss of weight after five hours and the additional loss after other five hours was nearly the same. The percentage of Li_2O given under II. corresspponds to the formula $Li_2O + 0·4818\ CO_2$.

This formula indicates the existence of a relatively stable basic carbonate $Li_2O.Li_2CO_3$, but I prefer to assume that probably the whole of the carbonic acid would have gone off had we continued the experiment for, say, 100 hours instead of 10.

Presuming that the dissociation-tension of carbonate of lithia lies below one atmosphere, I heated a quantity of ordinary carbonate to redness in the gas-crucible in an atmosphere of pure carbonic acid, and examined the product for caustic lithia by means of a method which I had elaborated for the detection and determination of traces of R_2O beside R_2CO_3, and which consists essentially in this, that the carbonate is decomposed by chloride of barium and the ROH left in solution determined by titration with very dilute standard acid. The product did contain a small quantity of caustic lithia.

The experiment was now repeated at the lowest temperature sufficient to keep the substance in a state of fusion. Free Li_2O was again present. In a third experiment the substance was kept as near as possible to, but below, its fusing point. The product this time was free of caustic lithia. Seeing that at that degree of "red heat" at which carbonate of lithia fuses readily, the dissociation tension is above, but probably not much above 30 inches of mercury, I placed a quantity of previously dehydrated carbonate of lithia in a silver-alloy boat,† put it into a porcelain tube lying in a combustion furnace, and then raised the tube to a red heat while a current of carbonic acid was passing through the tube, the tension of which was raised to predetermined value above 30 inches by forcing the out-going gas through a layer of mercury of properly adjusted depth. The total pressure of the gas was 31·78 inches. The percentage of CO_2 in the product was 59·594. The chloride of barium test revealed no trace of caustic lithia. The percentage of CO_2 in pure Li_2CO_3 is 59·427, calculating from Li = 7·02 and O = 16 The carbonate of lithia for this as for all the following analogous experiments. had been made specially from Erfurt "purissimum" by dissolving this in carbonic acid water, filtering off the residue and reprecipitating part of the dissolved carbonate by gentle evaporation. This preparation was bound to be very pure, but it could not be presumed to be absolutely free from magnesia and ordinary alkalis, and yet we obtained more than the calculated percentage of CO_2. This seemed to me to indicate that the true atomic weight of lithium is less than Stas' number 7·02 But then our preparation must be presumed to have contained at least a trace of physically absorbed CO_2. Hoping thereby to obtain the data for the calculation of this portion of CO_2, I carried out a series of experiments under pressures varying from a little over 30 to about 60 inches of mercury. Excluding a number of cases in which the substance did not present itself in the form of a glass but as a glittering coarse powder, the results were as follows:—

—	Pressure in Inches of Mercury.	Percentage of CO_2 in Product.
(1).............	30·2	59·611
(2).............	31·7	59·605
(3).............	31·8	59·608*
(4).............	44·2	59·610
(5).............	59·73	59·529
(6).............	59·95	59·665
(7).............	60·05	60·066

---

* Mean of three analyses, which gave (59+), ·640, ·529, ·655 respectively.

† Meaning the alloy of 91 of Ag, 7 of Au, and 2 of Ni, which I recommend as an improvement upon silver in my paper on "Alkali-proof Vessels." The platinum boat was being used for another experiment.

In experiments 4 to 7 the carbonic acid, before reaching the porcelain tube, had to pass through one of two bulbs communicating through an india-rubber tube and containing mercury. The one bulb which I just referred to was stationary, the other (which I will call the reservoir) could be placed at any desired height. The *modus operandi* was as follows: The previously dehydrated carbonate was in the first instance heated in carbonic acid of about 32 in. pressure until it could be presumed to have fused the level of the mercury in the working bulb being so arranged that it was very high up at first but as far as possible down at the end. The outlet-end of the porcelain tube was now closed and the communication between the bulb and the carbonic acid supply stopped likewise, and the reservoir raised so as to produce the desired amount of extra-pressure. The CO_2 determinations were carried out in general with about 5 grms. of substance, and every conceivable precaution taken to ensure the attainment of high precision.

I had hoped that the numbers would enable me to express the relation between total pressure p and weight of CO_2 per unit weight of Li_2O by an equation of the form $y = A + B\,p$ and thus to ascertain the quantity A corresponding to $p = 0$, *i.e.*, no physically absorbed CO_2, but a glance at the results shows that they could not reasonably be thus discounted, not even if we drop No. (7), where the analysis indeed was carried out with a relatively small weight of substance. Assuming Nos. (1), (2), and (3) to represent normal carbonate, the weight of lithium monoxide per 44 parts of carbonic acid is—

—	(1.)	(2.)	(3.)
"Li_2O" = ...	29·8181	29·8193	29·8153

Mean = 29·8177, or Li = 6·909.

I am engaged in further experiments on the question of "Li". The results, as far as they go, confirm that Li is less than 7; O = 16.

Soda.

Carbonate of soda, if heated to redness in a platinum crucible in *hydrogen*, loses CO_2 largely with formation of a mixture of carbonate and hydrate NaOH. In the four experiments which I made the percentage of NaOH in the product varied from 11·9 to 20·035, and I was not able to ascertain the cause of the great variation. In the experiment which yielded the most strongly caustic residue, 1·0068 grm. of carbonate of soda were heated along with a quantity of spongy platinum (added to prevent creeping) for four hours over the blow-pipe. The residue amounted to 0·4482 grm. Its analysis gave 20·035 per cent. of NaOH and 79·63 of Na_2CO_3: sum = 99·668. The deficit probably consisted of water taken up by the substance while being preserved for analysis.

As there is no reason for assuming the existence of a compound of hydrate and carbonate of soda which is stable at a red heat, it ought to be possible to convert the whole of a given quantum of carbonate of soda into hydrate by heating in hydrogen, and so it may be. But as caustic soda at a red heat is far more volatile than the carbonate, we cannot in general expect to obtain a *residue* consisting only of hydrate.

Suppose at a certain stage of the process the crucible contains—

x parts of R_2O as carbonate .... (k)
and y parts of R_2O as R_2O, H_2O .... (h)

in the next following small unit of time the x parts of R_2O present as carbonate will be diminished by a small quantity $k\,x$, so much having assumed the form of hydrate. On the other hand, y will gain these $k\,x$ parts, but at the same time get less by $h\,y$ parts through volatilisation, so that at the end of the small unit of time the ratio of the two quantities, *i.e.*, the weight of R_2O present as carbonate per unit weight of R_2O present as hydrate, will now be $= x' : y'$, where—

$$\frac{x'}{y'} = \frac{x - k\,x}{y - h\,y + k\,x} = \frac{x}{y}\,\frac{1 - k}{1 - h + k\frac{x}{y}} = \frac{x}{y}\,.\,\text{“}f\text{”}$$

If $k = h$, the factor f will be less than unity, and consequently the new ratio $x' : y'$ be less than the original ratio $x : y$: the ratio will get less and less until it is equal to nil, and the residue consists entirely of hydrate. The same holds, *a fortiori*, if k is greater than h.

As our residues always contained a considerable admixture of carbonate, we must conclude that h, with us, was greater than k. *Assuming now that* h *is greater than* k, then as long as $x : y$ is a very large number, *i.e.*, shortly after the starting of an operation, the factor f will be less than 1: the proportion of carbonate will diminish, until the factor f has become equal to unity, when, of course, $x : y$ assumes a constant value. This will be the case as soon as

$$1 - k = 1 - h + k\frac{x}{y}\,,\ \textit{i.e.}\text{, as soon as } \frac{x}{y} = \frac{h}{k} - 1.$$

But this fraction $\frac{h}{k}$ is a function of temperature, and although h and k increase as the temperature increases, there is no saying *a priori* which of the two increases faster than the other. From one of my experiments (not reported in this abstract) it seems as if $h : k$ became greater as the temperature rises.

Of a number of experiments made in nitrogen gas I content myself with reporting on the one which was carried out in the orthodox fashion, *i.e.*, by heating the carbonate within a porcelain tube in a muffle. (*Vide supra.*) In it 2·3407 grms. of carbonate were used, and the heat, after it had attained its maximum, maintained for two hours; the loss of weight amounted to 0·1004 grm. From the mean of two analyses I calculate that it contained—

Carbonate of soda	98·168
Sodium monoxide	1·759
	99·927

This shows that carbonate of soda is liable to slow dissociation at a red heat.

At a temperature not much above the fusing-point of the salt, this dissociation can be prevented by maintaining in the crucible an atmosphere of carbonic acid. A supply of thus fused carbonate was analysed, and gave 41·75 and 41·52; mean, 41·63 per cent. of CO_2. The formula Na_2CO_3 demands 41·47 (Na = 23·053, O = 16). The preparation clearly was normal carbonate. It differed markedly from the ordinary fused preparation. While the latter is perfectly opaque and decidedly hygroscopic, our salt presents the appearance of almost a transparent glass, and is almost devoid of hygroscopicity. It will, perhaps, find favour as a standard-substance for alkalimetry.

At the high temperature producible in a platinum crucible by means of a gas blowpipe, an atmosphere of CO_2 of the ordinary pressure of the atmosphere does not altogether prevent loss of carbonic acid: so at least it appears from an experiment I made, in which the salt was heated, first, for two hours over a large Bunsen, and then for other two hours over the blowpipe.

An analysis of the product in which the sodium was determined as sulphate gave the following results :—

Carbonate, Na_2CO_3	99·493
Hydrate, NaOH	0·337
Other water	0·170
	100·000

Unfortunately at the time the chloride of barium method had not been introduced yet, so that the actual presence of caustic alkali in the substance could not have been proved directly. Possibly there may be an error in the analysis: but assuming even it is correct, it does not follow that the salt actually suffered dissociation, because the alkali may have been produced by diffused-in hydrogen from the flame, and the action of that hydrogen may have had the better of that of the carbonic acid.

Potash.

Carbonate of potash, when heated in hydrogen or nitrogen, behaves similarly to carbon of soda, only the percentage of caustic alkali produced is less owing party to the greater stability of the potash salt, and in the case of hydrogen also to the greater volatility of the hydrate. A product obtained by heating 9·45 grms. of carbonate in hydrogen over the blowpipe for an hour and a half, contained, according to two analyses,—

Carbonate of potash, K_2CO_3	91·153
Hydrate, KOH	8·389
Water	0·458
	100·000

A product obtained by heating carbonate of potash in a muffle within a porcelain tube in *nitrogen* for two hours, contained 0·461 per cent. of K_2O and 99·663 of K_2CO_3. Total = 100·124

For the production of fused normal carbonate a quantity of carbonate of potash was heated in the gas-crucible in a current of carbonic acid, first for an hour with a small, and then for an hour and a half over a large, Bunsen. Some parts of the preparation had that glassy appearance which I had noticed in the corresponding soda salt. Two determinations of the carbonic acid gave 31·809 and 31·838, mean 31·824 per cent. The formula K_2CO_3 demands 31·821 per cent. (K = 39·136, O = 16).

Rubidium.

In my experiments on carbonate of rubidia I had to contend with a number of difficulties, one of which was that I had only very little of the salt at my disposal, while another was caused by the very great volatility of even *carbonate* of rubidia at a red heat. A third difficulty arose from the circumstance that carbonate of rubidium, when fused in a platinum crucible, even in hydrogen, attacks the metal perceptibly.

In the first hydrogen experiment 2 grms. of the carbonate were heated for one hour over the blowpipe. When the crucible was opened it was found to be empty! Seeing that carbonate of rubidia is so very volatile, I used an ordinary Bunsen in all the following experiments as a source of heat.

In experiment (2) two grms. of the salt were heated over a Bunsen in hydrogen for one hour. The aspect of the residue showed that it had been in a state of fusion. Its analysis proved complicated through the presence of platinum in the product, but the results left no doubt about the presence of caustic rubidia. The numbers fell in fairly with the formula—

$$R_2CO_3 + 0{\cdot}1455\ ROH^*$$

Experiment (3). 1·308 grm. heated in the gas-crucible in nitrogen. The residue, according to the chloride of barium test, contained 0·03 per cent. of R_2O.

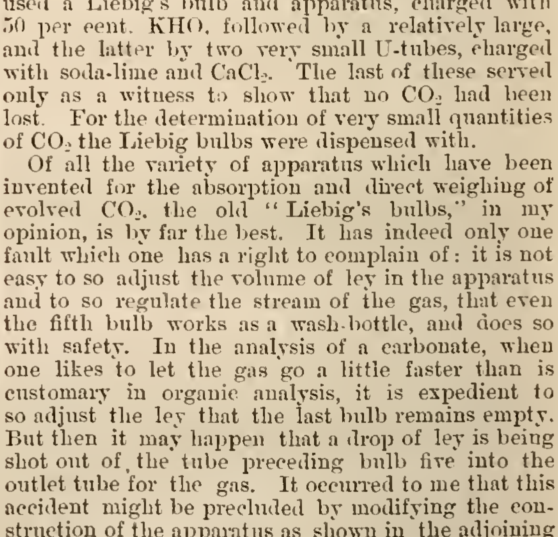
Experiment (4). A repetition of (3), but the whole of the product devoted to a chloride of barium analysis. Result :—0·156 per cent. of R_2O.

Experiment (5). 2·3 grms. of salt were fused in carbonic acid. The gravimetric analysis of the product led to the formula $R_2CO_3 + 0{\cdot}0113\ R_2O$, but as the substance contained platinum, the results cannot be expected to be very exact; besides, the chloride of barium test gave no trace of caustic rubidia. We are pretty safe in concluding that here, as in the analogous cases of the soda and potash salts, the product was normal carbonate.

APPENDIX.

The numerous determinations of CO_2 involved in this research were all carried out by the "*direct method*," an inverted condenser being inserted between the decomposition flask and the first U-tube, as recommended long ago by Classen. (See my exercises in Quantitative Analysis, page 51, and Fig. 11.) For the absorption of the CO_2, I, in general, used a Liebig's bulb and apparatus, charged with 50 per cent. KHO, followed by a relatively large, and the latter by two very small U-tubes, charged with soda-lime and $CaCl_2$. The last of these served only as a witness to show that no CO_2 had been lost. For the determination of very small quantities of CO_2 the Liebig bulbs were dispensed with.

Of all the variety of apparatus which have been invented for the absorption and direct weighing of evolved CO_2, the old "Liebig's bulbs," in my opinion, is by far the best. It has indeed only one fault which one has a right to complain of: it is not easy to so adjust the volume of ley in the apparatus and to so regulate the stream of the gas, that even the fifth bulb works as a wash-bottle, and does so with safety. In the analysis of a carbonate, when one likes to let the gas go a little faster than is customary in organic analysis, it is expedient to so adjust the ley that the last bulb remains empty. But then it may happen that a drop of ley is being shot out of the tube preceding bulb five into the outlet tube for the gas. It occurred to me that this accident might be precluded by modifying the construction of the apparatus as shown in the adjoining figure, and I caused Messrs. Baird and Tatlock to have such a modified Liebig's bulb made for me.



Plane of table.

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* I use the general symbol "R" for one equivalent of alkali-metal, because my salt was contaminated with a small proportion of cæsium, which, however, was less in the heated products than in the original carbonate.

When the apparatus came to hand I tested it very severely by filling it with water and blowing air through it in the most irregular fashion, and it stood the test well. We have since used the apparatus for a good number of CO_2 determinations and found it to work very satisfactorily. With it the gas *must* bubble in the last bulb, and, however fast the gas may go, no liquid is ever projected into the outlet tube.

A NEW PROCESS FOR OBTAINING AMMONIUM CHLORIDE FROM THE NITROGEN OF COAL, COKE, CINDERS, AND ORGANIC MATTER GENERALLY.

BY ANDREW FRENCH.

The method of producing chloride of ammonium which I have the privilege to describe to-night was a discovery made some time ago when directing the erection of some new plant at a lead smelting works on Tyne-side.

It happened at the time that a large quantity of furnace ashes (containing a considerable proportion of half-burned coal) which had been tipped into a piece of hollow ground intended to be used as a storage place for bar-lead, caught fire, and as the ashes threatened to burn back under some large piles of lead, it became necessary to extinguish them.

The handiest way to do this was to turn on some waste water which flowed in a constant stream from the fume condenser; this was accordingly done and in a few weeks the fire was overcome.

Now if it had not been for two accidental circumstances this ash-heap fire, like all conflagrations of its kind, would have been a most uninteresting and commonplace affair. The two conditions which made it note-worthy were these: *Firstly*, the cinders before being taken to the tip were usually drenched with salt water from the Tyne, and so were soaked with a solution of common salt. *Secondly*, the water from the condenser, which was also salt, contained sulphurous acid to the point of saturation; and the interesting result of these in the burning heap was the development of a very large quantity of chloride of ammonium.

It is no exaggeration to say that the surface of the heap was for the greater part covered with white sparkling sal-ammoniac, as if with snow, and at one time a ton at least of that salt might have been collected. In some places there were large cakes of it from an inch to an inch and a half thick.

Professsor Dittmar happened at that time to pay a visit to Newcastle, and I had the pleasure of showing him the heap while it was still well coated with the ammonium salt, and to him I must express my indebtedness for valuable advice in following up the investigations to discover the rationale of the phenomenon. I shared at the time, along with a great many others, the hope that a good way to make ammonia from the nitrogen of the air would some time or other be discovered, and thought that possibly this was it; but Professor Dittmar warned me to get that idea off my mind and at once search for the source of the ammonia in the residual nitrogen of the half-burned coal. Following his advice, I took a fair sample of similar ashes drenched with salt water and burned these in a Cornish assay furnace with a supply of steam, sulphurous acid, and air (the air in limited supply). I obtained in that way a profuse production of ammonium chloride. I varied this experiment in a number of ways, and found that when air, steam, sulphurous acid (or sulphur-yielding compound), and common salt were present, chloride of ammonium was always formed, but if the steam, or the sulphur, or the salt was left out, none was formed.

My next step was to examine the heap thoroughly. I let a glass tube down into one of the fumeroles and aspirated a measured quantity of the issuing vapour. The gases were made to pass through a glass cylinder containing cotton-wool to arrest the chloride of ammonium which escaped condensation in the glass tube leading from the fumerole. I found one cubic foot of the vapour contained 7·5 grains of NH_4Cl, and the gases in the aspirator consisted, to a large extent, of carbonic acid and steam mixed with atmospheric nitrogen. There was no sulphurous acid, sulphuretted hydrogen, hydrocarbons, nor bisulphide of carbon present, nor could I detect any cyanogen, although in my laboratory experiments I sometimes got cyanogen compounds formed along with the ammonium salt.

On digging into the heap after it was extinguished, I found an abundance of sodium sulphate, but scarcely any sodium chloride. It was clear, therefore, that the common salt had been changed into Glauber salt.

I was led to conclude that the reaction which takes place may be enunciated as follows:—When coal or other organic matter containing nitrogen is burned with a limited supply of air in presence of steam, sulphurous acid, and common salt, the whole of the organic or combined nitrogen is converted into chloride of ammonium, and it may be formulated thus:—

$$2\,NaCl + H_2SO_3 + 3\,H_2O + C + 2\,N = 2\,NH_4Cl + Na_2SO_4 + CO_2.$$

I beg leave to claim that this formula presents an explanation for the occurrence of chloride of ammonium about the mouths of coal mines which have caught fire. For instance, we read in Dumas' Chemistry (French edition, 1828), vol. I., page 617, as follows:—"A remarkable phenomenon is presented in a burning mine (coal mine) about three-quarters of a mile from Saint-Etienne; this is the production of a pretty large quantity of chloride of ammonium. The distillation of coals always gives ammonia, therefore its presence is not difficult to conceive of in a parallel case. It is not the same with hydrochloric acid, because we have seen that M. Karsten has searched in vain for that acid in the different varieties of coals. It may perhaps be presumed, nevertheless, that the ammonia has been able to borrow the acid from the earthy chlorides which the waters that ooze through the rock-strata of that locality always contain. Be that as it may, however (Dumas goes on to say), the fumeroles established by the fire continually emit vapour of chloride of ammonium, besides the ordinary products of the combustion of coal. This salt is condensed on the bodies lying in the neighbourhood as a crystalline deposit which is spoiled and dissolved by rain in wet weather (and he continues to say): It would not be impossible to obtain a profit from this product; it would be sufficient to place a covering or shed of boards over the fumeroles; the deposited salt on the walls could be gathered from time to time."

And we read still further back in the 1820 edition of Jameson's Mineralogy, 3rd vol., 13th page, that "sal-ammoniac occurs in the vicinity of burning beds of coal both in Scotland and England."

Of course it is well known that coals always contain sulphur, less or more; and also that the waters of collieries frequently contain a notable and sometimes a considerable quantity of chloride of sodium. A fire taking place in a coal mine under these conditions would certainly produce sal-ammoniac if the reaction I have explained is correct.

I may say that laboratory experiments have been made on coal, coal-cinders, shales, sewage-sludge cake, sea-weed, and a number of other things, and in every case the nitrogen of these bodies has come off combined as NH_4Cl.

The method employed was this:—The nitrogenous substance was made up into a little brick with clay free from nitrogen, adding a little common salt and ground iron pyrites. This was burned in a porcelain tube heated by a Bunsen burner, passing at the same time a current of air and steam over the substance, the current was drawn through an ordinary bulbed condenser.

The following are some of the results obtained in these trials with coals:—

	Lbs.		
Black's Slamannan coal	129·6	NH_4Cl	per ton.
Clyde Company's Ell coal ..	101·2	,,	,,
,, Jewelcoal	158·8	,,	,,
Coal cinders (coke)	96·8	,,	,,

Experiments with Spent Shale.

At an early stage in my experiments it was suggested that experiments on the spent shale from mineral oil works might lead to a useful result; arrangements were therefore made for a trial on a small tentative scale at the Broxburn Oil Works on one of Mr. Henderson's retorts. Before beginning the experiment I distinctly explained that the most satisfactory course would be to drench the spent shale while still hot in water containing a little common salt, then tip it into a chamber kiln or heap, rekindle it and allow it to burn in an atmosphere charged with sulphurous acid and steam, but it was thought by those at whose wish the experiment was made that the trouble of quenching and re-lighting the shale would be too great as a practical operation, and that it would be better to try to treat the charge in the combustion chamber beneath the retort. Steam was accordingly led under the fire-bars of the retort, and when the red-hot charge was being dropped out of the retort into the chamber beneath a quantity of common salt was thrown in amongst it. The result was an absolute failure. Due forethought would indeed have shown it to be not worth trying, for the shale when discharged from the retort is still giving off volatile matters and continues to do so during the whole time it is in the combustion chamber. It is therefore impossible that the salt which is vapourised by the heat could, along with steam, penetrate to the interior of the masses of shale and react upon the nitrogen.

A subsequent experiment made with spent shale from the same works which had been properly quenched in salt water yielded, in a small kiln built in Glasgow, a very satisfactory return of chloride of ammonium, and I believe it could be made to pay in that way.

I may mention that the spent shale samples when analysed by this method yielded from 40 to 42 lbs. chloride of ammonium per ton.

Experiments were made in the furnaces of steam boilers with varying results, but all of them showing an important yield of chloride of ammonium.

The coal to begin was wetted with strong brine, and about 5 per cent. of coal "brasses" or iron pyrites mixed through it so as to yield sulphurous acid, then steam was led under the fire-bars and the smoke drawn by a fan through a condenser.

In one experiment the consumption of about five cwts. of coal gave 12 lbs. of chloride of ammonium, or about 48 lbs. NH_4Cl per ton; but as considerable part of the ammonium salt condensed in the tubes and flues, 12 lbs. does not represent the whole quantity which was formed.

In another trial of the same kind some five tons of coal were burned, but only a part of the smoke therefrom was washed. The water contained at the end of the experiment 72 lbs. of NH_4Cl; but the flue tubes were thickly coated with soot, which, when tested, contained in several samples from 27 to 35 per cent. of NH_4Cl. In fact the soot had quite a crisp feel and granular appearance, owing to the amount of sal ammoniac it contained.

These experiments with coal under a steam boiler were made partly under the same disadvantage as the spent shale in the Broxburn combustion chamber, and the salt and sulphurous acid could not get properly at the nitrogen.

The next experiment was with town ashes, and the results obtained from these were perfectly satisfactory, so far as yield was concerned, but great difficulty was experienced in getting the stuff to burn.

One ton of the wet ashes yielded some 80 lbs. of chloride of ammonium, but there was a certain amount of old leather shoes and stuff of that kind which, no doubt, would help to make up the quantity.

A laboratory experiment with sewage-sludge cake (moist) gave 44·8 lbs. NH_4Cl per ton.

The question will, no doubt, be put, is this a process of any industrial utility? My reply is that at present it is not yet brought to a manufacturing stage, but I believe the time is not far distant when it will become one of the most important sources of ammonia; presenting, as it does, that substance in the best form for the manufacture of liquid and carbonate of ammonia.

The question of amount of steam required has been a difficulty where the obtainment of free ammonia is attempted from fuel containing nitrogen, but in this case the chloride of ammonium condenses rapidly on the walls of the flues before the steam condenses. It is easy, therefore, to separate the ammonium salt in a dry state, and run the condensed water back to the burning heap to be used over again continuously.

Historical.

Wm. Hunt, 1862.—Proposed to pass HCl or Cl, along with steam and air, or the *uncombined nitrogen* of blast furnaces (these are his words), through burning coke, coal, or other fuel. He said the carbon would decompose the steam and set free nascent hydrogen, to combine with the free nitrogen to form ammonia, which would combine with the chlorine of the HCl to form NH_4Cl.

Chlorides of certain of the metals may be used in place of HCl.

Ernest Solvay, 1875.—Proposed to pass vapour of HCl, steam, and *atmospheric air or nitrogen* through incandescent fuel in a limekiln by means of an artificial draught. In place of HCl, he might use chlorides of various metals.

Messrs. Clark and Smith, 1878.—Ammonia from nitrogen of the air.

Mr. Tucker, 1879.—Ammonia from nitrogen of the air.

Messrs. Rickman and Thomson.—Ammonia from nitrogen of the air.

In the early part of 1880 decade Messrs. Young and Beilby made their famous experiments, which are so well known to the most of you, I need not attempt to describe.

Then following them, Ludwig Mond, the present President of the Society, in 1883, burned coal, with a limited supply of air, using steam or a spray of water, and thus got all the nitrogen of the coal as free ammonia, which he condensed in a solution of calcium chloride, magnesium chloride, or H_2SO_4.

And in 1884 I discovered the method which I have just had the pleasure of describing; and now I will conclude by thanking you for the very attentive hearing you have given me, and I trust you will accept as my excuse for taking up so much time, the importance of the subject, than which there is none greater, when it is considered that of the 150,000,000 tons of coal raised in Britain every year, nearly the whole of the combined nitrogen goes to waste: and that represents to our dear little island home a loss of over 8,000,000 tons NH_4Cl, which, taken at an agricultural value of, say, 10*l.* per ton, is equal to 80,000,000*l.* sterling.

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SESSION 1888-89.

Prospective Arrangements.

Papers to be read by—

Dec 12th.—Mr. J. M. C. Paton. "On Methods and Machinery for Drying." At Bingham's Rooms, Long Row. Chair to be taken at 8 p.m.

Jan. 23rd.—Mr. E. Francis, F.C.S. "On the Teaching of Chemistry in Elementary and Higher Grade Schools." At University College. Chair to be taken at 8 p.m.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

ELECTRIC BLEACHING.

On Friday evening, November 9th, M. Hermite lectured on his process of bleaching by the electrolysis of magnesium chloride solution before the members of the Nottingham Section and others. The process was described and illustrated by experiments and models, as well as by lantern photographs of a plant recently erected for carrying out the process on a very large scale. After the usual vote of thanks to M. Hermite, an informal discussion of certain points elicited further information from the lecturer.

Obituary.

WILLIAM WALLACE, Ph.D., F.R.S.E., F.I.C., F.C.S.

City Analyst of Glasgow.

The Scottish Section has sustained a severe loss in the death of Dr. Wallace, which took place on the morning of the 5th November. For two years past Dr. Wallace had been in rather feeble health, and during the last month he was entirely confined to the house. While his death, therefore, has not come quite unexpectedly, it will be none the less regretted by his numerous friends throughout the country, by whom he was highly respected and esteemed, both on professional and personal grounds.

Dr. Wallace was fifty-six years of age, and the greater part of his life has been devoted to chemistry. He began his professional career in Glasgow, as assistant to the late Dr. Penny, in Anderson's College, an appointment which he held for several years. He was next appointed lecturer on chemistry in the Mechanics' Institute (now the College of Science and Arts), and he occupied this position also for a number of years. In 1870 he entered into partnership with Mr. Tatlock and Dr. Clark, and for many years a large and important business as analytical chemists was carried on by the firm. In 1874 the office of public analyst for the city of Glasgow was conferred upon Dr. Wallace by the Town Council, and he held a number of similar offices, in all of which, by his professional skill and agreeable and courteous manner, he extended his reputation and gained the esteem of a wide circle of friends. He was also gas analyst for the city, and in this connexion it should be mentioned that he was the author of a work dealing with the analysis of nearly all the gas-yielding coals in Scotland.

Dr. Wallace was for many years an active member of the Philosophical Society of Glasgow, of which some years ago he was elected to the position of President, an office which he filled with conspicuous ability. He was one of the original promoters, and always took a warm interest in the affairs of the Scottish Section of our own Society. He was a member of Committee for several years, and in 1887 was elected Vice-Chairman, a position which failing health compelled him to resign ere long.

Besides the work mentioned above, Dr. Wallace, in conjunction with Dr. Russell, the medical officer of health for the city, published in 1879 a series of papers dealing with the subjects of "The Prevention and Control of Infectious Diseases," and "Air, Water Supply, Sewage Disposal, and Food." He was also the author of a very large number of pamphlets and reports, and of papers contributed to various societies on a great variety of scientific subjects, several of which enrich the Society's Journal.

G. G. H.

Journal and Patent* Literature.

II.—FUEL, GAS, AND LIGHT.

Report on the Chemical Constitution of Natural Gas. F. C. Phillips. (From the official report, by permission of the Geolog. Survey of Pennsylvania.)

This report was made for the Geological Survey of Pennsylvania. The following tabular statement gives the results of the examination of the gases from various borings in the oil-producing region. The name of the well indicates the origin of each sample.

Constituents.	Fredonia.	Sheffield.	Kane.	Wilcox.	Speechley.	Lyon's Run, near Murrysville.	Raccoon Creek.	Baden.	Houston.
Nitrogen	9·54	9·06	9·79	9·41	4·51	2·02	9·91	12·32	15·30
Carbon dioxide	0·41	0·30	0·20	0·21	0·05	0·28	Trace	0·41	0·44
Hydrogen	0·	0·	0·	0·	0·02	0·	0·	0·	0·
Ammonia	..	0·	0·	0·	0·	0·	0·	0·	Trace
Oxygen	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace
Sulphuretted hydrogen	..	0·	0·	0·	0·	0·	Trace	0·	0·
Paraffins	90·05	90·64	90·01	90·38	95·42	97·70	90·09	87·27	84·26
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

The paraffins contained in these gas samples have the following composition *by weight*:—

	Fredonia.	Sheffield.	Kane.	Wilcox.	Speechley.	Lyon's Run, near Murrysville.	Raccoon Creek.	Baden.	Houston.
Carbon	78·14	76·69	76·77	76·52	77·11	74·96	76·42	76·48	76·68
Hydrogen	21·86	23·31	23·23	23·48	22·89	25·04	23·58	23·52	23·32
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

The samples examined may be said to consist simply of the hydrocarbons of the paraffin series, among which methane predominates. As most of the gas conveyed through pipe lines deposits little or no liquid hydrocarbons, it is evident that the higher paraffins are not present in notable quantity. Hydrocarbons of the olefine series, such as ethylene, propylene, butylene, &c., were not present. The proportion of carbon to hydrogen corresponds to nearly pure methane in one case, and to a mixture of equal volumes of methane and ethane in the gas richest in carbon, the others having an intermediate composition.

The fuel value of each gas was determined by calculation from the analytical results, and is given in the following table:—

FUEL VALUE OF NATURAL GAS.

Gas Fields.	Weight in Kilos. of Carbon per Cubic Metre of Paraffins.	Weight in Kilos. of Hydrogen per Cubic Metre of Paraffins.	Available Heat Units per Cubic Metre of Gas.	Available Heat Units per 100 cb. ft. of Gas.	Pounds of Water at Boiling Point evaporated by 100 cb. ft. of Gas.	Pounds of Pure Charcoal equal in Heating Effect to 100 cb. ft. of Gas.
Fredonia	0·80406	0·22492	11,419	32,421	133·30	8·845
Sheffield	0·65526	0·19924	10,010	28,430	116·89	7·756
Kane	0·67669	0·19866	10,354	29,319	120·54	·999
Wilcox	0·61622	0·19828	9,925	28,102	115·54	·667
Speechley	0·69857	0·20738	11,144	31,554	129·73	8·609
Lyon's Run	0·53741	0·17950	9,296	26,321	108·22	7·181
Raccoon Creek	0·62918	0·19498	9,661	27,355	112·47	7·463
Baden	0·61209	0·19677	9,515	26,941	110·77	7·350
Houston	0·64737	0·19694	9,221	26,119	107·38	7·126

1 cubic metre = 35·3166 cubic feet. 1 kilogramme = 2·20462 pounds avoirdupois. —G. H. B.

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*. .... ½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*....... 1*d*.
" 1*s*. 6*d*., " " 2*s*. 4*d*....... 1½*d*.
" 2*s*. 4*d*., " " 3*s*. 4*d*....... 2*d*.

The Examination of Fire-places for their Calorific Effect. O. Binder. Chem. Zeit. 12, 1192.

The examination of fire-places for their calorific effect is divided into three distinct operations, viz.:—1. The chemical analysis of the fuel. 2. The chemical analysis of the combustion-gases and their temperature. 3. The estimation of the ash. On the results thus obtained the calculation of the utilisation of the fuel in a fire-place is based. Many handbooks give detailed descriptions of the manner of performing these tests, and the author's principal object is to draw attention to certain points in relation to them. The chemical analysis of fuel is, of course, an elementary analysis. As all coals contain more or less sulphur, the front part of the combustion tube should contain a layer of 8—10 cm. of asbestos, well impregnated with lead chromate, as well as a further layer of 30 cm. of granulated copper oxide. The front end is bent downwards, drawn out, and connected with the calcium chloride tube by means of an india-rubber tube. The other end of the tube is in connexion with a regular supply of dry oxygen through a Löwe mercury valve. The absorption apparatus is connected with an aspirator, so that the combustion takes place in an atmosphere of oxygen below the atmospheric pressure. It is worth mentioning that coal of the same origin varies very little in its elementary composition, as shown by the following analyses.

Composition of coal (calculated as free from water and ash) from the Heinitz pit:—

—	Year of Sampling.				
	1878.	1879.	1879.	1879.	1880.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Carbon	84·41	84·07	84·48	84·23	84·44
Hydrogen....	5·63	5·43	5·68	5·29	5·43
Oxygen	9·96	10·50	9·84	10·48	10·13

The calorific value of coal is calculated according to the formula—

$$8,000 \times C + 29,000 \left(H - \frac{O}{8}\right) + 2,500\,S - 600\,W,$$

wherein it is assumed that 1 kilo. of the fuel contains C kilo. of carbon, H kilo. of hydrogen, O kilo of oxygen, S kilo. of sulphur, and W. kilo. of hygroscopic water. The greatest care should be exercised in choosing the spot where the samples of fire-gases are drawn. Whereas, on the one hand, they should be taken at a place where they are perfectly mixed, it is, on the other hand, important that they be not cooled to any extent by external influence. The ash is only determined in its totality, and loss on ignition is put down as carbon. After all, the composition of the combustion-gases is the best criterion of the combustion.—S. H.

Petroleum Deposits in Venezuela. J. Soc. Arts, 36, 1039—1040.

Consul Plumacher, United States Consul at Maracaibo, reports that part of the department of Colon, situated between the rivers Santa Anna, Zulia, and the Sierra of the Columbian frontier, is very rich in asphalt and petroleum. Near the Rio de Oro, and at the foot of the Sierra, a quantity of thick bitumen is found, and the territory bounded by the rivers Zulia, Catatumba, and Cordillera is rich in deposits and flows of asphalt and petroleum, especially towards the south, where the latter is very abundant. A little more than four miles from the confluence of the rivers Tara and Sardinete there is a mound of sand 25 to 30 feet high, and of about 8,000 square feet area, with a number of cylindrical holes on its surface from which are ejected with violence streams of petroleum and hot water. For a long distance from the site of this phenomenon the ground is covered or impregnated with petroleum. From one of these streams, it is stated, about 5,760 gallons of petroleum flow in 24 hours. This petroleum is of excellent quality, with a density of 83 degrees. In the department of Sucre, at the foot of the mountains, asphalt and coal are found, and near the mountains and not far from the river Torondoy flows of a black liquid of little density are found, and strongly impregnated with carbonic acid. It resembles a substance found in the United States among the great anthracite deposits, so that possibly this mineral may be found near. The State of Zulia, in which deposits of coal, asphalt, and petroleum are situated, is as yet free from any monopolist concession, but this, in Consul Plumacher's opinion, cannot last for ever. The Government is disposed to extend every reasonable encouragement and protection.—F. W. T. K.

Notes on the Utilisation of Heat in Chemical Operations. F. Fischer. Zeits. f. angew. Chem. 1888, 535.

Although thermo-chemistry does not explain every chemical process, the knowledge of the least quantity of heat required for a certain operation is in many cases invaluable. According to the theory of heat $dQ = dU + dW$, wherein dQ expresses the heat which becomes either liberated or absorbed, dU the change in the interior energy, and dW the external work done. If a gas be given off at any chemical operation, the gas in overcoming the atmospheric pressure does mechanical work, and this work must be taken into account if the operation be expressed thermo-chemically. At a barometric height of 760 mm. the actual pressure of the atmosphere on one square metre is 10,366 kilos. The mechanical equivalent of heat is 425 metre-kilos., and the expansion for each cubic metre therefore requires $\frac{10,336}{425} = 24 \cdot 3$ calories. The "kilogramme-molecular weight" of all gases is equal to 22·3 cbm., consequently $22 \cdot 3 \times 24 \cdot 3 = 542$ cal. are absorbed in the liberation of 1 kilogramme-molecule of any gas at 0° C.; and at $t°$ C., $542\,(1 + 0 \cdot 00367\,t)$ cal. If oxygen be liberated by heating potassium chlorate ($2\,KClO_3 = 2\,KCl + 3\,O_2$) $3 \times 542 = 1,626$ cal. are absorbed for overcoming the atmospheric pressure, if the gas escapes at 0° C., and if it escapes at 20° C., $3\,[542(1 + 0 \cdot 00367 \times 20) = 1,745$ cal. are absorbed. The specific heat of the gas is not here taken into account. This heat is again set free if the gas enters into a chemical combination, as is the case in the oxidation of Weldon mud or the manufacture of bleaching powder. If coal be gasified in the producer, the gases given off by 1 kilo. of coal, amounting to 0·3 cbm., absorb in overcoming the atmospheric pressure $0 \cdot 3 \times 24 \cdot 3 \times (1 + 0 \cdot 00367 \times 600) = 24$ cal., if they leave the producer at 600° C. The attempt to decompose sodium chloride by oxygen—

$$\begin{array}{ccccccc} 2\,NaCl & + & O & = & Na_2O & + & Cl_2 \\ -195,400 & & & & +80,400 & & \end{array}$$

appears doomed to failure owing to the enormous amount of heat required (115,000 cal.). The decomposition of sodium chloride by steam only requires 30,800 cal.—

$$\begin{array}{ccccccc} NaCl & + & H_2O & = & NaOH & + & HCl \\ -97,700 & & -57,000 & & +101,900 & & +22,000 \end{array}$$

At the present moment the decomposition of magnesium chloride by ignition in a current of air engages the attention of chemists—

$$\begin{array}{ccccccc} MgCl_2 & + & O & = & MgO & + & Cl_2. \\ -151,000 & & & & +144,000 & & \end{array}$$

The process only requires 7,000 cal. The case of the manufacture of hydrochloric acid from magnesium chloride has a less favourable appearance—

$$\begin{array}{ccccccc} MgCl_2 & + & H_2O & = & MgO & + & 2\,HCl \\ -151,000 & & -57,000 & & +144,000 & & +44,000 \end{array}$$

which process absorbs about 20,000 cal. The oxidation of hydrochloric acid in the Deacon and Kingzett process is thus:—

$$\begin{array}{ccccccc} 2\,HCl & + & O & = & H_2O & + & Cl_2 \\ -44,000 & & & & +57,000 & & \end{array}$$

For every 71 kilos. of chlorine 13,000 cal. are set free, and if the apparatus be well protected from loss of heat by radiation, this amount of heat set free should be sufficient to keep up the temperature of the reaction without any further addition. The amount of heat required for the Pechiney-Weldon process is obtained in the following manner. The composition of the Pechiney mixture, which is decomposed at 1,000° C., is thus:—

	Per Cent.
$MgCl_2$	47·5
MgO	30·0
H_2O	32·5

Suppose half of the chlorine be liberated as hydrochloric acid, 200 kilos. of the mass then yield:—

Kilos. of Cl	35·5
" of HCl	36·5
" of steam	36·0
" of MgO	100·0
	208·0

8 kilos. of oxygen are therefore required which are supplied in the shape of 200 cbm. of air.

		Cal.	
To raise these latter to 1,000° C.	200 × 0·31 × 1,000	= 62,000	are required.
" 100 kilos. MgO "	100 × 0·241 × 1,000	= 24,100	"
" 35·5 kilos. Cl "	35·5 × 0·12 × 1,000	= 4,260	"
" 36·5 kilos. HCl "	36·5 × 0·19 × 1,000	= 6,935	"
" 36·0 kilos. steam "	36 [620 + (900 × 0·48)]	= 37,872	"

For the chemical work, viz., the generation of 35·5 kilos. of chlorine and 36·5 kilos. of hydrochloric acid from magnesium chloride, 3,500 and 10,000 cal. are required respectively. In addition to it loss of heat by radiation of the brickwork must not be lost sight of. As half of the total amount of heat is necessary for the heating of the air, this part of the process must receive special attention.

If calcium chloride be decomposed into chlorine and hydrochloric acid, the process is represented thermochemically, thus:—

$$CaCl_2 + O = CaO + Cl_2$$
$$-170{,}230 \quad +131{,}360 = -38{,}870 \text{ cal.}$$

$$CaCl_2 + H_2O = CaO + 2\,HCl$$
$$-170{,}230 \quad -57{,}000 \quad +131{,}360 \quad +44{,}000 = -51{,}870 \text{ cal.}$$

Calcium chloride is therefore a far less suitable material for the generation of chlorine than magnesium chloride.

If sulphuric acid acts on sodium chloride, sodium bisulphate is formed in the first instance:—

$$NaCl + SO_4H_2 = NaHSO_4 + HCl$$
$$-97{,}700 \quad -192{,}900 \quad +267{,}800 \quad +22{,}000 = -800 \text{ cal.}$$

Scarcely any heat is required. If sodium sulphate be the product desired, the case is different:—

$$2\,NaCl + SO_4H_2 = Na_2SO_4 + 2\,HCl$$
$$-195{,}400 \quad -192{,}900 \quad +328{,}500 \quad +44{,}000 = -15{,}800 \text{ cal.}$$

This is borne out by practice.

For calculating the heat utilised in a sulphate furnace, it may be supposed that 98 kilos. of sulphuric acid, diluted with 30 kilos. of water act on 117 kilos. of sodium chloride, and that the hydrochloric acid gas escapes at a temperature of 400° C., steam at 500° C., and the finished product is heated to 600° C. The specific heat of sodium sulphate is 0·232, and therefore 142 kilos. require—

$$142 \times 0{\cdot}232 \times 600 = 19{,}766 \text{ cal.}$$

The specific heat of hydrochloric acid is 0·19, and 73 kilos. require 73 × 0·19 × 400 = 5,548 cal., and 30 kilos. of steam require 24,360 cal.

	Cal.
For heating Na_2SO_4	19,766
" " HCl	5,548
" " steam	24,360
Chemical work	15,800
Mechanical work of HCl (overcoming atmosp. pressure)	500
Total about	66,000

For the condensation of the hydrochloric acid, we have to remove by cooling—

	Cal.
Steam	24,360
HCl	5,548
Heat set free by HCl dissolving in water	15,000
Total about	45,000

The formation of Weldon mud by oxidation with air sets heat free, and the same is the case in decomposing Weldon mud with hydrochloric acid:—

$$MnO_3H_2 + 4\,HCl.aq. = MnCl_2.aq. + Cl_2 + 3\,H_2O$$
$$-116{,}300 \quad -148{,}000 \quad +128{,}000 \quad +205{,}200$$
$$= +68{,}900 \text{ cal.}$$

In practice it is well known that as soon as the temperature of reaction is attained, the liberation of chlorine proceeds easily.—S. H.

The Safety of Commercial Kerosene Oils. S. B. Newbury and W. P. Cutter. Amer. Chem. J. **10**, 356—362.

Modern lamps often heat their oil reservoirs to 110°—112° F., so that an oil of which the flashing point is *higher* than the New York State standard (viz., 100° F.) may be considerably above its flashing point during its consumption.

It does not necessarily follow that such a condition may cause a *dangerous* explosion, because the flashing point of an oil may be determined by the presence in it of inconsiderable quantities of very volatile hydrocarbons, while the bulk of its constituents may be incapable of giving off vapour sufficient to form an explosive mixture with air until a much higher temperature is reached.

The authors therefore sought to decide the following questions:—

"(1.) Will all hydrocarbons of which burning oils are composed, when diffused in air in proper proportions, yield distinctly explosive mixtures? If so, at what temperature for each?"

"(2.) What are the most volatile constituents of ordinary kerosene, and how do the proportions of each of these lighter hydrocarbons affect the flashing point of the oil?"

By mixing known quantities of various definite hydrocarbons with the volumes of air necessary for their complete combustion (by vaporising them in a well-stoppered cylinder), the results given below, in the form of a table, were obtained:—

Hydrocarbon.	Formula.	B. P.	Source.	B. P. of Sample used.	Temp. at which it explodes with Air.
Butane	C_4H_{10}	1° C.	C_2H_5I and Na.	1° C.	Ordinary
Pentane (Iso.)	C_5H_{12}	30°	Petroleum ether.	30°	"
Hexane	C_6H_{14}	68°	" "	67°—68°	"
Heptane	C_7H_{16}	98°·5	"Abietene" (*Pinus sabiniana*).	98°·5	"
Octane	C_8H_{18}	124°	Illuminating oil.	125°—130°	"
Nonane	C_9H_{20}	149°·5	" "	148°—150°	Between 150° F. and 212° F.
Decane	$C_{10}H_{22}$	161° (?)	..	160°—165°	" "

As nonane and decane appeared to be the lightest constituents likely to be present in a safe oil, experiments were made with them under conditions similar to those which obtain in a burning lamp.

A few drops were placed in a cylindrical copper vessel (300 cc.) with a loose cover having a $\frac{3}{16}$-in. hole in it, and heated gradually in a water bath until a small flame applied to the hole determined the explosion of the gaseous mixture, which was sufficiently vigorous to throw off the cover. Tested thus, nonane was found to explode at 79° F. and decane at 104° F. A sample of illuminating oil flashing at 111° F. in the New York State tester, gave a distinct explosion in the above apparatus at the same temperature, viz., 111°.

The first question is thus answered for the paraffins up to decane.

With regard to the second, a sample of "water-white" oil flashing at 108° F. was distilled in a vacuum, and the product fractionated. 2 kilos. yielded 30 grms., boiling at 110°—130° C., consisting chiefly of octane, and 100 grms. boiling at 130°—160° C., containing principally nonane and decane. Only traces of any lower members of the series were present.

The authors also tried the effect of the addition of light hydrocarbons to an oil of high flashing point, viz., "mineral sperm," flashing above 212° F.

"Mineral sperm":—

95	per cent.	+	pentane	5	per cent.	flashes at	116° F.
90	„	+	„	10	„	„	ord. temp.
95	„	+	hexane	5	„	„	110° F.
90	„	+	„	10	„	„	ord. temp.
95	„	+	heptane	5	„	„	145° F.
90	„	+	„	10	„	„	110° F.
85	„	+	„	15	„	„	95° F.
80	„	+	„	20	„	„	ord. temp.

They found, further, that an oil flashing at 108° F., when subjected to the passage of a gentle current of air through it for 24 hours, lost 2·8 per cent., and had its flashing point raised to 116° F.; and suggest that some analogous process should be used on a commercial scale to free illuminating oil from its more volatile constituents.—B. B.

PATENTS.

An Improved Standard Oil Lamp for use in Photometry. A. G. V. Harcourt, Oxford. Eng. Pat. 11,985, September 3, 1887. 8*d*.

This lamp consists of a glass vessel of the form and size of an ordinary spirit lamp, surmounted by a cap carrying an iron tube about seven inches long and a quarter of an inch in diameter. The upper portion of this is surrounded by an outer tube, about four inches long and one inch in diameter, concentric with the first tube and fastened to it by flat iron plates at the top and the bottom. The function of this second tube is to guide the air current, and keep the temperature of the inner tube, through which passes the wick, more constant. These two tubes constitute the burner, and are surrounded by a metal chimney about one and three-fifths inches in diameter, resting on a gallery projecting from the lower portion of the wick tube, and extending upwards a short distance above the burner. Here it is reduced to a diameter intermediate betweeen those of the inner and outer tubes of the burner. At a short interval is a continuation of this chimney (of the lesser diameter) carried by two curved metal bands attached to the portion below. By means of screws the space between the upper and lower portions of the chimney can be varied at will. The central part of the flame is alone visible here; the upper tip can be seen through two small slots placed for that purpose on opposite sides of the upper portion of the chimney. The connecting bands above-mentioned are half the width of the tube that surrounds the flame. When the lamp is vertical so that these bands are in a plane perpendicular to the horizontal bar of the photometer, a point midway between their edges and at the height of the centre of the flame-aperture is taken as that from which distances are to be measured. This arrangement of lamp allows unmixed pentane vapour to be burnt without charring the wick, so as to produce a uniform standard light, and any desired height of flame.

—A. R. D.

Improvements in the Manufacture of Naphthalene into Forms suitable for use in Illumination and in Apparatus employed therein. H. J. Fenner and G. H. F. Fenner, London. Eng. Pat. 14,085, October 17, 1887. 11*d*.

Instead of moulding naphthalene into cylindrical sticks or into cakes which are broken up for use in the carburetting vessels, the patentees form the naphthalene into small spheres or ovals of a convenient size to suit the carburetting vessels. For details of the moulding apparatus the specification must be consulted.—O. H.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

PATENTS.

An Improved Process for the Cleaning or Separation of Ammoniacal Liquor and other Matters from Tar. J. C. Kräyenbühl, H. C. Petersen, and C. C. Burmeister, Copenhagen, Denmark. Eng. Pat. 15,067, November 4, 1887. 8*d*.

The mixed tar and ammoniacal liquors are first partially separated by traversing a box provided with two partitions, the current passing under the first and over the second. In this vessel the temperature is raised to about 45° C. by means of a steam-pipe, and two apertures at different levels provide separate means of egress for the two fluids. The tar is now transferred to a centrifugal machine or separator, which may be of the ordinary type, or on an improved plan, as shown in the drawings attached to the specification. The efficiency of the separator depends upon the fact that in the revolving drum the lighter ammoniacal liquor arranges itself in the centre, within an outer annular column of tar, and the two can be drawn off by separate pipes. Various other (heavier) impurities will be found in a zone next the wall of the drum, and these, too, can be drawn off by themselves, or, if desired, means can be adopted for making them pass off continuously with the tar. If preferred, a washing with clean water may precede or follow the treatment in the separator, a suitable form of washing apparatus being shown in the drawings.

—A. R. D.

Improvements in and connected with the Manufacture of Illuminating Gas from Coal. J. R. H. Dinsmore, Liverpool. Eng. Pat. 15,852, November 18, 1887. 8*d*.

In order to obtain all the volatile constituents of the coal in the form of a permanent gas, it is proposed to subject the products of distillation to alternate heatings and coolings. This is effected by passing the gases, leaving the retort proper, through a number of other retorts or ducts, the ends of which project beyond the setting, and are artificially cooled. These ducts all slope upwards in the direction of the gaseous current, so that any liquid matter depositing in the cooled ends runs back, and encounters the heated surface of the duct next below.—A. R. D.

Improvements in the Mixture and Treatment of Materials for Enriching Coal Gas, and in Removing or Preventing Stoppages in Ascension Pipes. W. H. Bennett, London. Eng. Pat. 17,558, December 21, 1887. 6*d*.

The inventor intimately mixes shale, lignite, brown coal, or cannel with shale or other oil by grinding in a pan under heavy edge-runners. From 30 to 40 gallons of oil per ton of shale will give a mixture very suitable for adding to ordinary coals under distillation, when the object is to improve the quality of the gas. When it is desired to clean out the ascension pipes, a passage must first be made through these, and the retorts charged with the shale-and oil mixture alone. The carbonaceous matter in the ascension pipe melts under the influence of the rich gases evolved and falls down into the mouth-piece of the retort, whence it is easily removed. For this use the mixture should contain from 50 to 60 gallons of oil per ton of shale. —A. R. D.

IV.—COLOURING MATTERS AND DYES.

The Eurhodines. O. N. Witt. Ber. **21**, 2418—2421.

Eurhodines are those dyestuffs which are derived from azines by substituting an atom of hydrogen by an amido-group, safranines are those compounds which contain two amido-groups and are azonium bases. The author proposes to apply the name of "Eurhodines" to all amido derivatives of the azine class, and to term safranines amido derivatives of the azonium bases.

It is a remarkable fact that both these compounds have a close connexion with the indamines; in many instances the indamines are obtained as intermediate products. The following experiments have been undertaken to find out whether the formation of this intermediate indamine is always necessary, or whether the azines and azonium bases can be formed directly. To prepare an indamine, a compound has to be used in which the para-position to the amido-group is free, whilst azines and azonium bases require only a free ortho-position to the amido-group. The metaxylyiene diamine, prepared by Fittig, Ahrens, and Mattheides—

$$C_6H_2(CH_3)_2(NH_2)_2 \quad [CH_3:CH_3:NH_2:NH_2 = 1:3:4:5]$$

could not yield an indamine, but it was quite feasible, that by the action of nitrosodimethylaniline, for instance, on it, a eurhodine might be formed. The result of experiment has, however, decided against this hypothesis. If one molecule of this metaxylylene diamine be treated with one molecule of sodium acetate and one molecule of nitrosodimethylaniline a violent reaction takes place, but no eurhodine was formed. No better result was obtained when di-imidochloroquinone was caused to act upon the solution of the diamine acetate.

Nitrous acid does not produce in the solution of this diamine a brown colouration, neither does diazobenzene sulphonic acid when added to it form a body of the properties of chrysoidine. All these reactions, characteristic for meta diamines, do not take place because the para-position is already occupied.

But this metaxylylene diamine can be diazotised and forms dyestuffs when combined with phenols or amines. The combination with metatoluylene diamine forms a brown dyestuff, with α_1, α_2, alpha-naphthol sulphonic acid a red, and with Brönner's beta-naphthylamine sulphonic acid a reddish-brown colouring-matter.—A. L.

On a New Chromogenous grouping of Atoms. V. v. Richter. Ber. **21**, 2470—2475.

In preparing dinitrophenylaceto-acetic ether—

$$C_6H_3(NO_2)_2.CH(COCH_3)(CO.OC_2H_5),$$

by the action of *o-p*-dinitrobromobenzene on sodium aceto-acetic ether, the author obtained a by-product melting at 153°—154° C., dissolving in caustic potash or soda with a dark blue colour. The same body had already been prepared by Wislicenus and Heckmann, and they believed its formula to be $C_{21}H_{18}N_6O_{15}$, and the formula of the potash salt $C_{24}H_{16}K_2N_6O_{15}$. This compound is, however, the ethyl ether of the bi-dinitrophenylacetic acid—

$$[C_6H_3(NO_2)_2]_2CH(CO_2.C_2H_5).$$

If the hydrogen in the CH group be replaced by the alkali metals, compounds are formed, dissolving in water with a dark blue colour. The constitution of the body was determined in the following way. It was observed that this compound was formed more abundantly when an excess of dinitrobromobenzene was used. An effort to get better yields was therefore made, and the action with dinitrobromobenzene on dinitrophenylaceto-acetic ether proved successful.

$$C_6H_3(NO_2)_2Br + C_6H_3(NO_2)_2CNa(CO.CH_3)(CO_2.C_2H_5) =$$
$$[C_6H_3(NO_2)_2]_2C(CO.CH_3)(CO_2.C_2H_5)$$

$$[C_6H(NO_2)_4]_2C(CO.CH_3)(CO_2.C_2H_5) + H_2O =$$
$$[C_6H_3(NO_2)_2]_2CH(CO_2.C_2H_5) + CH_3.CO_2H.$$

Such decompositions have been observed several times. Jones showed that diacetyl-acetic ether loses one acetyl-group through the action of sodium ethylate or even through that of water. Japp and Klingemann again proved that on acting with diazobenzenechloride on sodium methylaceto-acetic ether the acetyl-group is separated.

That the above theory is correct was proved by using malonic ether instead of aceto-acetic ether, in which case a carboxyl-group is separated.

The formation of the body from malonic ether is similar to that above described; it is also in this case better to let the reaction pass through two phases. On acting with one molecule of dinitrobromobenzene on sodium-malonic ether in alcoholic solution until the alkaline reaction has disappeared, an oil is obtained from which crystals separate after standing for some time. These principally consist of dinitrophenylmalonic ether, and contain mostly a small amount of the new compound. The greatest part of the dinitrophenylmalonic ether remains, however, in the oil, and is separated from it by treatment with an excess of concentrated sodium hydrate. The sodium compound of the ether is insoluble in concentrated alkalis, and is separated by filtration through glass wool from the saponified malonic ether. It is soluble in water with a reddish-brown colour, and is thus freed from dinitrobromobenzene. On passing carbonic acid through the solution the ether is precipitated quite pure. $C_6H_3(NO_2)_2CH(CO_2.C_2H_5)_2$ is soluble in hot alcohol and ether, and melts at 51° C.

By acting with dinitrobromobenzene on the sodium compound of the dinitrophenylmalonic ether in alcoholic solution the same blue body is obtained, as with dinitrophenylaceto-acetic ether.

$$C_6H_3(NO_2)_2Br + C_6H_3(NO_2)_2C(Na)(CO_2.C_2H_5)_2 + H_2O =$$
$$[C_6H_3(NO_2)_2]_2CH(CO_2.C_2H_5) + CO_2 + NaBr + C_2H_5.OH.$$

The blue aqueous solution of this sodium compound becomes gradually colourless on exposure, the carbonic acid of the air decomposing it.—A. L.

Action of Nitrous Acid on Tetramethyldiamidobenzophenone. E. Bischoff. Ber. **21**, 2452—2455.

On treating tetramethyldiamidobenzophenone with hydrochloric acid and sodium nitrite, a nitroso derivative is obtained, $C_{17}H_{19}N_3O$, melting at 158°—159°. This substance dissolves in dilute hydrochloric acid, but is reprecipitated on adding water. On reducing, the original substance is obtained, the nitroso-group being expelled as ammonia.

The object of this research was to ascertain primarily whether the above ketone would be attacked by nitrous acid as the para-position to the amido-groups is already occupied, and this would seem to preclude any reaction taking place, judging from the case that dimethylparatoluidine is not attacked by nitrous acid. The body obtained was certainly a nitroso body, but no constitutional formula can as yet be assigned to it.—A. R.

On Chromogenous Carbines. V. v. Richter. Ber. **21**, 2475—2478.

The author prepares synthetically bi-dinitrophenylacetic ether from the sodium compound of *o-p*-dinitrophenylacetic ether and *o-p*-dinitrobromobenzene—

$$C_6H_3(NO_2)_2.CH(Na)(CO_2.C_2H_5) + C_6H_3(NO_2)_2Br =$$
$$[C_6H_3(NO_2)_2]_2:CH.CO_2C_2H_5 + NaBr.$$

Dinitrophenylacetic ether was prepared by passing hydrochloric acid through an alcoholic solution of dinitrophenylacetic acid. It melts at 35° C.

The ether is then treated on the water-bath with an equivalent quantity of sodium ethylate and *o*- *p*-dinitrobromobenzene, until the alkaline reaction has disappeared. The final product, recrystallised from chloroform, melts at 154° C.

The author proposes to study the action of *o*- *p*-chloro- or bromodinitrobenzene on benzoylacetic ether and on benzoylacetone; he intends further to use the isomeric chloro- and bromodinitrobenzenes and picrylchloride, $C_6H_2(NO_2)_3Cl$.

The fact that the alkali compounds of certain bodies are blue, is not due solely to the presence of two dinitrobenzene-groups which are joined to a carbine-group; experiments have shown that the same effect can be produced by substitution of several mononitro-groups.

Trinitrophenylcarbine, $[C_6H_4NO_2]_3 : CH$ (trinitrotriphenylmethane), dissolves in alcoholic caustic, potash, or soda with an intense violet colour, and trinitrotriphenylcarbinol, $[C_6H_4NO_2]_3C.OH$, does the same.

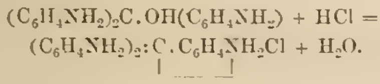
Paranitrobenzylcyanide dissolves in alcoholic caustic potash, or soda with a red colour; orthonitrobenzylcyanide with a deep violet blue.

If the alcoholic solution of paranitrobenzylcyanide be treated with an equivalent quantity of sodium ethylate and one molecule of *o*- *p*-dinitrobromobenzene, *p*-nitrophenyl, *o*- *p*-dinitrophenylcarbine cyanide—

$$(C_6H_4NO_2)[C_6H_3(NO_2)_2] : CH.CN$$

is probably formed.

Constitution of the Rosaniline Salts.—E. and O. Fischer believe the constitution of the rosaniline salts to be represented as follows :—



$$(C_6H_4NH_2)_2C.OH(C_6H_4NH_2) + HCl =$$
$$(C_6H_4NH_2)_2:C.C_6H_4NH_2Cl + H_2O.$$

The hexamethylrosaniline and malachite green have to be considered as quarternary ammonium salts, according to Fischer's views.

The author believes, however, that the rosaniline salts have a similar constitution to the compounds above described. Both classes of compounds he calls carbine dyestuffs; and as carbines he regards all derivatives of CH_4, in which two or three hydrogen atoms are replaced by negative or positive radicals, and in which the remaining hydrogen atoms can be easily replaced by radicals of a different character. Thus, we have—

Trinitrophenylcarbine, $(C_6H_4NO_2)_3CH$, and

Triamidophenylcarbine, $(C_6H_4NH_2)_3CH$.

Trinitrophenylcarbine sodium, $(C_6H_4NO_2)_3CNa$, and

Triamidophenylcarbine chloride or rosanilinehydrochloride, $(C_6H_4NH_2)_3CCl$.

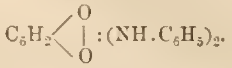
Further experiments will be made with the view of eliciting further support for this theory.—A. L.

Preparation of Pure Flavopurpurin. G. Jellinek. Ber 21, 2524—2526.

The author recommends the solution of commercial flavopurpurin in alkali, and the precipitation of the colouring-matter as a lead salt, by the addition of lead acetate. The precipitate is well washed with hot water, and decomposed with sulphuric acid in the presence of alcohol. The colouring-matter is then obtained from the alcoholic solution by fractional crystallisation. By adopting this method, the author states he has isolated about 30 per cent. of non-tinctorial matter, chiefly anthraflavic acid, from commercial flavopurpurins supplied to him by various German alizarin makers as pure articles.—D. B.

On Azophenine and the Indulines. O. Fischer and E. Hepp. Ber. 21, 2617–2624. (This Journal, 1888, 316, and 1887, 724.)

The authors believe azophenine to be a derivative of *Quinone-dianilide*, and express its constitution by means of the formula $C_6H_2(NC_6H_5)_2(NH.C_6H_5)_2$. Sulphuric acid and alcohol decompose azophenine, and a well-crystallised substance is formed, viz., *Quinone-dianilide*—



$$C_6H_2\left<\begin{array}{l}O\\ |\\ O\end{array}\right. :(NH.C_6H_5)_2.$$

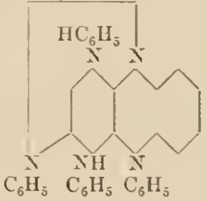
To prepare this body, 400 grms. of azophenine are to be heated to boiling for 10 hours with 40 litres of alcohol and 2 kilos. of concentrated sulphuric acid (60° B.); 195 grms. of pure quinone-dianilide are thus obtained; from the blue mother-liquors 20 grms. of induline can be recovered; besides these products only aniline was formed—

$$C_6H_2(NC_6H_5)_2(NH.C_6H_5)_2 + 2\ H_2O =$$
$$C_6H_2(O_2)''(NHC_6H_5)_2 + 2\ (C_6H_5NH_2).$$

Indulines.—The constitution of azophenine being known, it is possible to form an idea of the constitution of the indulines, as the latter can be prepared from azophenine, or directly from nitroso-bases. It is probable that the indulines have a close relationship to the safranines.

The best characterised induline, $C_{36}H_{27}N_5$, is prepared from azophenine by replacing hydrogen by aniline—

$$C_6H_2(NC_6H_5)_2NH.C_6H_5)_2 + C_6H_5NH_2 =$$



The authors describe further some indulines derived from nitroso-bodies.

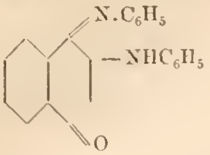
Action of nitrosodiphenylamine on aniline hydrochloride. 10 grms. of nitrosodiphenylamine are heated for two hours on the water-bath with a solution of 12 grms. of aniline-hydrochloride in 1 litre of water. The hot solution is then filtered—it contains phenosafranine. The residue consists of induline, soluble in alcohol, and aniline black, insoluble in alcohol.

The phenosafranine was purified by repeated precipitation with ammonium carbonate and phenolsafranine carbonate was analysed. Its formula is $C_{24}H_{18}N_4H_2CO_3 + H_2O$. This compound has the same colour as Perkin's mauve, and is identical with Perkin's pseudomauveine.

Rose-induline.—Azophenine heated with aniline and aniline hydrochloride produces the difficultly soluble induline. The azophenine of the naphthalene series is anilidonaphthoquinone-anil. A great number of nitroso- and azo-derivatives, containing a naphthalene ring, yield this body, if the reaction is carried out under 100° C. But there is always also a red dyestuff and a white body formed; the former, which the authors call rose-induline, has to be classed with the indulines; the constitution of the latter is not yet known. If the temperature be increased, the yield of the red substance is increased.

If one part of nitrosoethyl-*α*-naphthylamine or nitrosophenyl-*α*-naphthylamine be added to a mixture of 1 part of "aniline salt" in 3—4 parts of aniline, which are heated to 90° C., or if the hydrochlorides of the nitroso-bases are added to a solution of 1 part of aniline in 4 parts of glacial acetic acid, heated to 90° C., a dark red melt is obtained, which is at first treated with water and dilute hydrochloric acid. The residue left is boiled with alcohol, and after dilution and filtration from some resinous substances, the base is precipitated from the filtrate by ammonia.

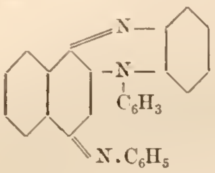
After several recrystallisations from benzene alcohol, it melts at 235 C., is nearly insoluble in water, difficultly soluble in alcohol, but more easily in benzene. Its formula is $C_{28}H_{19}N_3$. Its formation is explained by the following equation—

2 

(Anilidonaphthoquinone-anil) +

$$3\ (C_6H_5.NH_2) =$$

$C_{22}H_{18}N_2O$ (Anilidohydronaphthoquinone-anil) +



(Rose-induline).

The rose-induline forms red neutral and green acid salts, the latter of very unstable character. The author prepared and analysed the platinum double salt, the hydrochloride, acid sulphate, nitrate, and picrate.

If rose-induline be treated in acid or alkaline solution with zinc, a leuco-base is formed, which is, however, easily oxidised to the original colour by air. If, however, the hydrochloric acid solution of the base be boiled for some time with tin or zinc, a colourless solution is obtained, which cannot be oxidised to the original product, which contains aniline and which yields, on distillation with steam, naphthalene.

On heating rose-induline with 10 parts of hydriodic acid (1·96) and a little phosphorus, aniline is formed and a yellowish red base $C_{22}H_{18}N_2$, which is a rose-induline, in which aniline has been replaced by hydrogen. On heating rose-induline with fuming hydriodic acid, aniline hydroiodide and a neutral body are formed; the latter contains no nitrogen, and probably consists of a mixture of di- and tetrahydronaphthalene.—A. L.

Industrial Society of Mulhouse. Report of Meeting, July 11, 1888.

Noelting discusses some observations which were made in the course of research on the derivatives of rosaniline. Orthoxylidine [$NH_2 : CH_3 : CH_3 = 1:2:3$] and *p*-xylidine (1:4:3) which are ortho-substituted homologues of *m*-toluidine, yield no rosaniline if they are oxidised with arsenic acid in presence of *p*-toluidine. It thus appears that no rosaniline exists in which the meta-positions to the amido group in two phenyl nuclei are occupied by methyl. On the other hand, tetramethyldiamidodiphenylcarbinol, $OH.CH[C_6H_4N(CH_3)_2]_2$, condenses easily with the following meta-substituted bases:—*m*-toluidine, symmetrical *m*-xylidine, *o*-xylidine, *p*-xylidine, *m*-bromaniline, *m*-iodaniline, as also with the dimethyl or diethyl derivatives of several of these bases. The leuco-bases thus obtained yield blue or violet colouring-matters on oxidation. The meta positions can therefore be filled up in one of the phenyl-groups without preventing the formation of rosaniline. This is in accordance with the experiments of Hofmann, who obtained rosaniline by oxidising bases containing two aniline molecules in the meta- and para-positions, such as crystallised cumidine, isoduridine, and pentamethylamidobenzene. Noelting has observed that a rosaniline is obtained with aniline and crystallised orthoxylidine (1:3:4), which belongs to the same category.

Noelting reports further on observations which were made during experiments on the sulphonating of α-naphthylamine. Besides the naphthionic acids of Piria and Witt there always occurs in the mother-liquors a very soluble acid which is found to be an isomeric monosulphonic acid, and not, as might be expected, a disulphonic acid. The α-naphthylamine of commerce (which almost always contains a small quantity of the β-compound) yields a mother-liquor containing a complex mixture of sulphonic acids, from which it is not possible to isolate a homogeneous substance. But even with absolutely pure α-naphthylamine the new easily soluble acid is obtained along with the acids of Piria and Witt. This acid gives, with tetrazodiphenylchloride, a Congo colour, which is very sensitive to acids. By diazotising and heating, only traces of dinitronaphthol are formed, and the chief product is a dinitronaphtholsulphonic acid, a yellow colouring-matter soluble in water and insoluble in ether. By oxidation with nitric acid traces of phthalic acid are obtained along with a very soluble acid containing sulphur, which is fluorescent and is doubtless a sulphophthalic acid. A soluble acid, probably identical with the above-mentioned, is also formed, as well as a little amidonaphthyldisulphonic acid, if the naphthionic acid be heated for several hours to 115° with 2½ times its weight of ordinary sulphuric acid. The new amidonaphthylsulphonic acid does not appear to be of technical importance.—G. H. B.

Delicate Reactions for Aromatic Amines. New Coal Tar Colours capable of being formed on the Fibre. A. Ihl. Chem. Zeit. 12, 1243.

For the formation of the coloured condensation products which result from the oxidation of aromatic amines, the author used manganese dioxide alone (as being the cheapest oxidising agent), and in presence of mineral acids, without success; organic acids, however, such as acetic, oxalic, and tartaric, gave good results.

The acid used has an influence on the product in respect of colour, so that, apparently, it, or some oxidation product of it, takes part in the reaction.

As examples of the colours obtained, the following may be mentioned:—*o*-toluidine oxalate oxidised in very dilute solution by manganese dioxide (either the ore or the hydrated peroxide) or lead dioxide, becomes red; on warming, green; on boiling, red again; and, finally, a black substance separates, which is soluble in alcohol to a red solution. Xylidine acetate similarly treated gives a beautiful red-violet colour, becoming darker on standing.

If wool be present while these reactions are being carried out, it is dyed with the resulting colour, which is fairly fast to light and soap.—B. B.

Acid Sulphates of Dimethylaniline and Diphenylamine. A General Reaction of the Acid Sulphates of certain Aromatic Bases. L. Vignon. Compt. Rend. 107, 263—266.

It is generally understood that the salts of dimethylaniline are uncrystallisable and not stable, and that those of diphenylamine are still more unstable, even decomposed by water. The author has obtained, by the action of sulphuric acid on both amines, well crystallised acid sulphates. On gradually mixing sulphuric acid with pure anhydrous dimethylaniline, an acid sulphate is formed, with evolution of heat, and on cooling crystallises out. The neutral sulphate could not be obtained. The acid sulphate, after washing with benzene, has the composition, $C_6H_5.N:(CH_3)_2.H_2SO_4$, and melts at 80°. It is soluble in water, insoluble in ether and benzene. By heating for two hours at 180°—190°, water is eliminated, and a monosulphonic acid formed, $(CH_3)_2:N.C_6H_4.SO_2.OH$. On evaporating a solution of the barium salt, crystals are obtained with 3 and 5 mols. of water respectively.

Diphenylamine also unites directly with sulphuric acid to form an acid sulphate, $(C_6H_5)_2:NH.H_2SO_4$. No neutral sulphate could be obtained. Dried at the ordinary temperature the former consists of light-brown needles, insoluble in ether and benzene, and melting at 123°—125°. Mixed with water, diphenylamine separates out. Heated for two hours at 180°—190° it loses water and forms diphenylamine monosulphonic acid, $C_6H_5.NH.C_6H_4.SO_2.OH$; its barium salt is anhydrous.

The formation of a monosulphonic acid by heating the acid sulphate of the base for two hours at 180°—190° appears to be general with aniline and substituted amines derived from the latter. For example, acid aniline sulphate gives, as is well known, under these conditions an almost quantitative yield of sulphanilic acid (1:4).

—O. H.

Action of Micro-Organisms on Colouring-Matters.

J. Raulin. Compt. Rend. **107**, 445–447.

The following colouring-matters partially separate themselves from a fermenting liquid which has been coloured by them and attach themselves to the layer of yeast:—Magenta, Nicholson's blue, Imperial violet, Safranine, Poirrier's orange No. 2, Cochineal, Campeachy, Orchil. A seeding of *Aspergillus niger* develops well in a nutritive solution containing nitrogen as a salt of ammonia, but refuses to grow when aniline, rosaniline, or indigo carmine is substituted for the ammonia. Slightly acid liquids, such as yeast water, beer wort, sugar solution, tinted by indigo carmine, lose their colour by oxidation when exposed to air, in the absence of all organisms. Ærobic organisms, such as *Aspergillus niger*, *Mycoderma vini*, *M. aceti*, hinder this decolouration by preventing access of oxygen. Beer yeast has a similar effect, but after some time a decolouration by reduction takes place, and is accompanied by the appearance of organisms similar to the lactic ferment. If yeast water be left to itself for some days it acquires the power of very rapidly decolourising indigo carmine and many other colours. The decolouration is due to the direct action of the organisms, and not to any chemical substance produced by their development, for whereas heat, antiseptics, and filtration destroy the decolourising power, it is not affected by simply aërating the unfiltered liquid.—J. M. H. M.

PATENTS.

Production of Colouring-Matters for Dyeing and Printing.

J. H. Johnson, London. From H. Caro, Mannheim, Germany. Eng. Pat. 786, February 25, 1878. 6*d.* (Fourth Edition).

This is the fourth edition of one of the first patents relating to the production of azo-colours taken out in this country. The first part of the specification describes the production of hydroxyazo-naphthalenes by the action of diazotised naphthylamine upon α- and β-naphthol, and the conversion of these hydroxyazo-compounds into sulphonic acids. The following example illustrates the method of carrying out this process:—10 lbs. of naphthylamine are dissolved in about two gallons of muriatic acid, diluted with 100 gallons of cold water, and diazotised with the necessary quantity of sodium nitrite (4·8 lbs.). The solution of the diazo-chloride is then added to an alkaline solution of 10 lbs. of α- or β-naphthol, and the precipitate filtered off, washed, and dried. The hydroxyazo-naphthalenes are sulphonated by dissolving in twice their weight of sulphuric acid, containing "about 80 per cent. of anhydrous sulphuric acid," and heating to 100° C. for two hours. The product is limed, and the calcium salt converted into the sodium salt in the usual way. In the second process the naphthylamine is diazotised as before, and combined with the sulphonic acids of α- or β-naphthol, the latter being prepared by heating the naphthols with excess of sulphuric acid at about 100° C. The following example is given:—10 lbs. of naphthylamine are diazotised, as in the last example, and added to an alkaline solution containing the sodium salt of the sulphonic acid, resulting from the treatment of 10 lbs. of naphthol with 20 or 30 lbs. of sulphuric acid. The colouring-matter is salted out, collected, washed, pressed, and dried. In the third process the sulphonic acids of naphthylamine are diazotised and combined with the naphthols in alkaline solution; α-naphthol gives a brown, and β-naphthol a red under these conditions. The inventor next describes the production of the sulphonic acids of naphthylamine according to the three methods of (1) the direct sulphonation of naphthylamine, (2) the action of ammonium sulphite on nitronaphthalene, (3) the reduction of the nitrosulphonic acids of naphthalene. The following examples are given:—One part of nitronaphthalene is mixed with two parts of "rectified" sulphuric acid, and one part of fuming acid containing 80 per cent. of anhydrous acid, the mixture being heated to 100° C. till a sample is completely soluble in alkali. The product is diluted with water, reduced by iron, limed, and the solution of the calcium salt concentrated and acidified by muriatic acid, when the more insoluble amidonaphthalene sulphonic acids are precipitated and can be filtered off. In order to form a sulphonic acid by direct sulphonation one part of naphthylamine is mixed with three parts of fuming sulphuric acid "containing about 80 per cent. of anhydrous sulphuric acid," and the mixture heated to 70°—80° C. till a sample is soluble in alkali with the formation of a clear solution. The product is diluted with about 20 parts of water, and the difficultly soluble sulphonic acids thus separated from the more soluble modifications. In the fourth process the sulphonic acids of naphthylamine, obtained in the manner described, are diazotised and combined with one molecule of any of the sulphonic acids of α- or β-naphthol in alkaline solution; the products are in this case red colouring-matters. In carrying out this invention according to the specification the inventor points out that the sulphonic acids of dihydroxynaphthalene may be used instead of the naphthols.—R. M.

Improvements relating to the Production of Iodised Sulpho-Acids of Phenol, Cresol, and Thymol.

E. Ostermayer, Erfurt, Germany. Eng. Pat. 14,820, October 31, 1887. 6*d.*

The inventor treats the phenolsulphonic acids with iodine in the presence of oxidising agents. The following example illustrates the working of the process:—16·5 kilos. of potassium iodide are dissolved in 10 kilos. of water, 52 kilos. of hydrochloric acid added, and 7 kilos. of sodium nitrite gradually introduced. This solution is then mixed with a solution of 21 kilos. of potassium phenol-*p*-sulphonate in 60 kilos. of water. The acid potassium salt of the iodised sulphonic acid soon commences to separate; the latter is converted into the slightly soluble barium salt, from which the free iodosulphonic acid can be separated by decomposition with the theoretical quantity of sulphuric acid. After the removal of the acid potassium salt the mother-liquor yields, on evaporation, the potassium salt of a more soluble iodosulphonic acid, which crystallises from alcohol in colourless needles. Iodo-orthosulphonic acids of phenol are prepared in the same way, and the process can also be applied to the sulphonic acids of cresol and thymol.—R. M.

Improvements in the Manufacture or Production of Red Colouring-Matters suitable for Dyeing and Printing.

J. Y. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen-on-Rhine, Germany. Eng. Pat. 15,374, November 10, 1887. 6*d.*

The colouring-matters referred to belong to a new group of phthaleins, for which the inventors propose the name of "Rhodamines." The dyestuffs are alkylised rhodamines, produced by the condensation of one molecule of phthalic anhydride with two molecules of dimethyl or diethyl-*m*-amidophenol. The latter alkyl-derivatives are prepared by heating the hydrochloride of the amidophenol with methyl alcohol in a digester to about 170° C. for eight hours. The excess of methyl alcohol is distilled off, the methylated amidophenol basified by sodium carbonate, extracted by ether, and purified by crystallisation from light petroleum. The pure substance is a white crystalline, solid, melting at 86° C. The diethyl-derivative is prepared by substituting ethylic for methylic alcohol, and heating to 170° C. for ten hours. After extracting the diethyl-derivative with ether and distilling off the solvent, the crude product is purified by distillation in a current of carbon dioxide, and then by fractional precipitation with sodium carbonate from a dilute acetic acid solution; the impurities are first precipitated and then the base. By finally crystallising from a mixture of carbon disulphide and petroleum, the compound is obtained in the form of white crystals fusing at 74° C. The next part of the specification deals with the process of condensing the dimethylamidophenol with phthalic anhydride. Ten parts of the dimethyl-derivative are heated with twelve parts of the anhydride for 4—5 hours at 175° C., the operation being conducted in an enamelled-iron vessel heated in an oil-bath, access of air being prevented as much as possible. The product, when cold, is powdered and crystallised from alcohol, the phthalate of the new colouring-matter being thus obtained. The latter salt, being insoluble in water, is converted into the more soluble hydrochloride by agitating the finely-powdered crude product with weak ammonia for some hours, and then extracting the free base with benzene. The benzene solution of the base is then shaken up with hot dilute hydrochloric acid, and the aqueous solution separated—the latter depositing the hydrochloride, on cooling, in the form of small glittering crystals The free base, tetramethylrhodamine, dried at 100°, has the formula $C_{20}H_{10}O_3N_2Me_4$, and has the characters of an amine. The base gives a red fluorescent solution in alcohol. The hydrochloride contains one molecule of HCl, and is readily soluble in water with an intense crimson colour, with an orange fluorescence. The addition of hydrochloric acid to the strong aqueous solution throws down the crystalline salt, which appears blue by transmitted light; excess of acid changes the colour to red or orange. The colouring-matter dissolves in strong sulphuric acid with a yellow colour. The aqueous solutions of the salts are decolourised in the cold by ammonia and zinc dust, but the colour is restored by potassium ferricyanide. The colouring-matter imparts pure tints of red to silk or wool from a neutral or slightly acid bath without the aid of a mordant. For cotton a tannin mordant is employed. The shades on animal fibre rival the bluest of the eosins, but are much faster to light. The properties of tetraethylrhodamine are very similar to the foregoing, but the free base is soluble in water, and more soluble in benzene. The solutions of the salts are also bluer, and dye fabrics of a bluer shade than the lower homologue.—R. M.

Improvements in the Manufacture of Colouring-Matters. H. H. Lake, London. From Wirth and Co., Frankfort-on-Main, for K. Oehler, Offenbach, Germany. Eng. Pat. 9614, July 2, 1888. 6*d.*

These are basic yellow colouring-matters which it is proposed to name "Benzoflavines." They are derivatives of triphenylmethane produced by condensing one molecule of benzaldehyde with one molecule of a meta-diamine, and then with a molecule of the hydrochloride or sulphate of the same base. The new tetramines on treatment with substances capable of separating ammonia give hydrodiamidophenylacridines, which can be oxidised to diamidophenylacridines or benzoflavines. The course of the reactions is given in the following stages, illustrating the production of the colouring-matter from benzaldehyde and metatoluylene diamine:—(1.) Equal weights of the diamine and aldehyde are made into a paste with water; the mixture becomes warm and the product (monobenzylidene-metatoluylene-diamine) separates as a viscid resin which solidifies on standing. (2.) 75 lbs. of the dried and powdered product from the last operation are heated with 85 lbs. of the sulphate of the meta-diamine, in 500 lbs. of water, to a temperature of 60°—70° C. till the whole has dissolved. The leuco-base (tetramido-ditolylphenylmethane) is precipitated by alkali. Three examples are given showing how the leuco-base can be obtained in one operation without first isolating the benzylidine-product.—(*a.*) 48 lbs. of the diamine sulphate are mixed with 20 lbs. of soda lye (40 per cent.) and 30 lbs. of water. To the paste 10·6 lbs. of benzaldehyde, dissolved in 24 lbs. of alcohol of 95° Tw., are added, and the mixture kept at 60° till everything has dissolved. The leuco-base is separated as before. (*b.*) 61 lbs. of the diamine and 98 lbs. of the hydrochloride are dissolved in 200 lbs. of alcohol and 53 lbs. benzaldehyde poured in. The mixture is kept at 70°—80° C. until the precipitation of the hydrochloride of the leuco-base is complete. The crystalline salt, when pure, has the formula $C_{21}H_{24}N_4$, 2 HCl. (*c.*) A mixture of 100 lbs. of the sulphate of the diamine and 200 lbs. of 50 per cent. alcohol is heated with 25 lbs. of benzaldehyde for several hours, in an apparatus provided with a condenser. The sulphate of the leuco-base gradually separates as a crystalline deposit. (3.) The next operation is the production of the hydro-base (hydrodiamido-dimethylphenylacridine), which is accomplished by heating the hydrochloride or sulphate of the leuco-base with hydrochloric, sulphuric, or other acid in an autoclave for several hours at 160°. The salt of the hydro-base separates out; the free base has the formula $C_{21}H_{21}N_3$. (4.) The hydro-base is oxidised by atmospheric oxygen, but it is found better to use ferric chloride; the necessary quantity of the latter is added to the ice-cold solution of the hydrochloride of the base, when the colouring-matter is immediately precipitated. If zinc chloride is present a double zinco-chloride is formed. Metaphenylenediamine can be used in the foregoing operations, and substituted benzaldehydes instead of benzaldehyde. Thus nitrobenzaldehyde gives nitrotetramido-bases from which nitrobenzoflavines and amidobenzoflavines can be obtained. The nitrotetramines can be also obtained by the direct nitrification of the triphenylmethane derivative by means of nitric and sulphuric acids. In the specification the details of the process are given for preparing such a nitrotetramine, reducing to the corresponding amido-compound, converting the latter into the acridine base and then by oxidation into para-amidobenzoflavin. These colouring-matters dye mordanted cotton of a yellow colour; they dissolve with difficulty in cold water, more readily in hot water. Dilute acids precipitate them from their aqueous solution. They dissolve in strong sulphuric acid with a yellow colour, the solution having a greenish fluorescence. The alcoholic solutions have also a strong greenish-yellow fluorescence, which is destroyed by dilute acids. The free bases are colourless and insoluble in water.—R. M.

Corrigenda.

October Number, page 669, Col. 1.

Article "*Azo-colours from Ortho-diamidostilbene.*"

Line 4 from formula, for "and" *read* "which." *Line 2 above the formula, insert comma after* "α-naphthylamine "sulphonic acid" *and also the following* "again tetrazotised "and combined with two further molecules of α-naphthyl-"amine sulphonic acid."

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

PATENTS.

Improvements in Apparatus or Machinery for Washing, Scouring, and Bleaching of Fibres, Fibrous Materials, and Textile Fabrics. M. Ashworth, Rochdale, and R. Wild, Littleborough. Eng. Pat. 12,283, September 10, 1887. 8*d.*

The apparatus consists of a series of open vessels, or one vessel divided into several compartments, for containing the washing, scouring, and bleaching liquors. Over each vessel or compartment are mounted press-bowls, rollers, or pulleys, for conveying forward the fibre or fabric. Loose fibrous material is carried through the vats by endless travelling-lath creepers provided with metallic teeth; or by endless double belts or aprons. In the case of spun or woven textile fabrics, flanged or grooved pulleys are substituted for the creepers or aprons, the fabric being treated in the rope form.—W. E. K.

Improvements in the use of Chromium Compounds in Dyeing and Printing. C. D. Abel, London. From R. Koepp and Co., Oestrich, Germany. Eng. Pat. 17,586, December 21, 1887. 6*d.*

In place of the acetate, nitrate, &c. of chromium, and of the alkaline bichromates and chromic acid used in calico-printing and in wool-dyeing, the use is claimed of chromium fluoride, chromium oxyfluoride, and the double salts of chromium fluoride with the fluorides, chlorides, nitrates, and sulphites of potassium, sodium, or ammonium. The advantage obtained by the use of chromium fluoride in dyeing and printing arises from the fact that chromium oxide is very easily separated from a solution of this salt on heating, which consequently is well adapted for conveying chromium oxide to animal and vegetable fibres. In this respect it resembles the more costly chromium acetate. The hydrofluoric acid given off during the separation of the chromic oxide has no prejudicial effect upon the tint to be produced or upon the fibre.—W. E. K.

An Improved Process for Dyeing Furs or Skins. A., M., and E. Herrmann, Berlin, Germany. Eng. Pat. 1913, February 8, 1888. 4*d.*

The hairs of the skins to be coloured are first scoured by means of a hot solution of soda ash, applied on the hair side of the skins by means of a brush. After drying, the skins are washed with warm water to remove the superfluous soda and then brushed over with a weak solution of acetic acid. To dye the skins grey, a solution is first applied of sulphate of iron and pyrogallic acid, followed, after 12 hours, by solution of pyrolignite of iron. After standing further 12 hours, they are washed and dried. To give white ends to skins thus dyed, a solution of permanganate of potash is laid over the surface of the hair side by means of a sponge, the permanganate being subsequently removed by sulphurous acid. For light colours the skins are brushed with solutions of aniline colours, left for 20 minutes, washed and dried. To whiten the ends of hairs thus dyed, concentrated sulphurous acid is made use of. For dark shades the aniline colour solutions are mixed with pyrolignite of iron. —W. E. K.

Improvements in the Production of Fast Black Colour in Dyeing or Printing Fibres and Fabrics. J. C. Mewburn, London. From La Société Jeannolle et Compagnie, Paris, France. Eng. Pat 11,501, August 9, 1888. 4*d.*

This invention consists in the production of a fast or permanent black colour from toluidine, aniline, or other like coal-tar derivative by the reaction of oxidising and metallic salts in concentrated baths.

The following recipe is given for dyeing 100 kilos. of cotton:—

SOLUTION A.

Chlorate of potassium or sodium......	2 to 3 kilos.
Chloride of ammonium	1 to 2 „
Sulphate of copper......................	½ to 1 „
Sulphate of iron	½ to 2 „
Vanadate of ammonium	1 to 2 grms.
Glycerin..................................	1 to 2 kilos.
Hot water................................	55 litres.

SOLUTION B.

Toluidine (or other coal-tar derivative)	10 kilos.
Hydrochloric acid	9 „
Tartaric acid	½ to 1 kilo.
Water (added after solution)	30—35 litres.

SOLUTION C.

Bichromate of potassium or sodium ...	3 to 6 kilos.
Hot water	100 litres.

The fibres or fabrics are placed in a bath composed of equal parts of solutions A and B, and this is agitated whilst the dyeing is in progress. The fibre is then squeezed or wrung out and dried at the usual temperature. It is then passed into solution C, 1 litre to each kilo. of material being employed, and finally washed in cold water. In this way firmer blacks are obtained than from aniline oxidised by the ordinary processes in dilute baths. The colour does not change by the action of reducing bodies, nor does it discharge or become soiled by rubbing or friction. For printing, the fabrics can be submitted to the bichromate solution either before or after being printed with a mixture of solutions of A and B suitably thickened.—W. E. K.

An Improved Composition for Cleaning Fabrics and the like and Preserving the Colour thereof; also applicable to Cleansing Purposes generally. L. Grave, London. Eng. Pat. 12,045, August 21, 1888. 4*d.*

To an infusion of the bark of the soap-berry tree (*Sapindus*) is added a fifth part of ammonia solution and "sufficient borax to soften it and augment its cleansing properties."

When required for use it is diluted with about 100 parts of water, and the articles to be cleaned immersed in it for a few minutes, no rubbing being necessary. They are then taken out, rinsed, and dried.

The composition is applicable to the cleansing of such materials as cretonne, chintz, satin, crewel work, and tapestry.—B. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Notes on the Theory of the Sulphuric Acid Process. F. Raschig. Annalen, **248**, 123—140.

In connexion with a previous investigation on the action of sulphurous acid on nitrous acid (Annalen, **241**, 161, this Journal, 1887, 820, also 1888, 210), the author modified Berzelius' theory of the sulphuric acid process. While still adhering to the principle of that theory, he altered his views on the intermediary stages, so that the chamber process is now expressed by the following equations:—

I.

$$N(OH)_3 + SO_3H_2 = H_2O + \underset{\text{dihydroxylamine sulphonic acid.}}{(OH)_2.N.SO_2.OH}$$

II.

$$(OH)_2.N.SO_2.OH + N(OH)_3 = 2\,NO + SO_4H_2 + 2\,H_2O$$

III.

$$2\,NO + O + 3\,H_2O = 2\,N(OH)_3.$$

The nitrous acid still plays the principal part of oxygen carrier, in opposition to Lunge's theory, wherein this part is assigned to nitrosulphonic acid. Lunge recently adversely criticised these views of Raschig (this Journal, 1888, 208), and the present paper forms a reply to Lunge's objections as well as an attack on Lunge's own theory. Lunge objects to equation I., because there is no proof that dihydroxylamine sulphonic acid is formed under the conditions existing in ordinary vitriol chambers. According to Raschig, this is not at all necessary, as it is an intermediary product, which is at once decomposed by nitrous acid. Raschig remarks, parenthetically, that Lunge gives no proof that nitrosulphonic acid is a component of the gases of a chamber working under normal conditions. Equation II. is also attacked by Lunge, who states that nitrous acid is not always present in every part of the chamber system in sufficient quantity, and consequently considerable amounts of nitrous oxide would be formed. Raschig accepts Lunge's objection as a support for his theory, and mentions that nothing is better known in practice than the fact that the vitriol process takes place so much easier in the presence of a large excess of oxygen and nitrous acid; the absence of that excess accounts for the loss of "nitre" by the reduction of nitric oxide to nitrous oxide. But if there be nitrous acid present the nitrogen of the dihydroxylamine sulphonic acid is at once oxidised to nitric oxide. Berzelius' old theory gives no explanation for the large excess of nitrous gases required, and Lunge's explanation for the disturbance of the chamber process by the absence of an excess of nitrous gases is considered very unsatisfactory. Equation III., which may also be written thus,— $2\,NO + O = N_2O_3$, is, according to Lunge, incorrect, as nitric oxide, oxygen in excess, and water form nitric acid, and in the absence of water, nitrogen peroxide. If that were indeed the case, Berzelius' and Raschig's theory would be wrong, as it would not account for the regeneration of the nitrous acid. However, it is pointed out that nitric oxide, even in the presence of water, does not form nitric acid instantaneously, but only very gradually. If nitric oxide be kept over water and oxygen admitted, the conversion to nitric acid is very gradual, as is proved by the presence of red-brown gases, which also show that the process goes on through intermediary stages, which finally end in the formation of nitric acid. But Lunge's apparent mistake does not end here: he always presupposes the presence of large amounts of steam in all the parts of the chamber, whereas, in fact, the atmosphere of the chamber is relatively dry. If gases be withdrawn from the chamber and kept in a dry bottle they remain red for many days, but become colourless in a short time if a few drops of water are introduced into the bottle. If chamber gases were saturated with steam they would not long retain their red colour. It is therefore the want of water which in vitriol chambers prevents the formation of nitric acid, although there is plenty of oxygen present. The question of the formation of nitric acid is thus decided by the author against Lunge, and it now remains to be proved that he is mistaken in his statement that nitric oxide in the absence of water is converted into nitrogen peroxide. Lunge, in proving this assertion, quotes the results of three laboratory experiments, in which he brought together measured volumes of nitric oxide and pure oxygen, both dried by concentrated sulphuric acid. The resulting red gas was analysed and proved to be nitrogen peroxide. Although oxygen was present in large excess, nitrous acid was only formed in traces. So far, Lunge is undoubtedly right, but in applying these results to the vitriol chamber his conclusions are at fault. Firstly, the gaseous mixture in the chambers is not dried by concentrated sulphuric acid, but still contains as much water as corresponds to the vapour density of the condensing-chamber acid, and secondly, there is not an excess of pure oxygen in the chambers, but an excess of oxygen diluted with chemically indifferent nitrogen. If Lunge had repeated his experiments with air instead of with pure oxygen, he would have found that nitric oxide is chiefly converted into nitrous acid, even in spite of a large excess of air. Some years ago Lunge declared his desertion of Berzelius' theory to be due to the fact that he could no longer support Berzelius' view on the regeneration of the nitrous acid. With the results of the last experiments, all the arguments against that part of Berzelius' theory fall to the ground. There still remains the question whether Lunge's nitrosulphonic acid is essential to the formation of sulphuric acid. Pure nitrous acid, sulphurous acid, and steam passed through a glass tube, give rise to a copious and regular formation of sulphuric acid, while colourless nitric oxide escapes at the other end of the tube, whereas oxygen is absolutely necessary for Lunge's equation—

$$2\ SO_2 + N_2O_3 + H_2O + O_2 = 2\ SO_2(OH)(NO_2).$$

This experiment is certainly not a confirmation of Lunge's theory. The formation of nitrosulphuric acid undoubtedly takes place in the chambers if there be too little steam present, and also in the Glover tower, but that nitrosulphonic acid is at all temporarily formed in the chambers under normal conditions is now more doubtful than ever, and as long as there is any doubt in the matter there is no reason to abandon the principle of Berzelius' theory, which still best explains all the processes going on in the sulphuric acid chambers.—S. H.

On the Alkaline Aluminates. C. J. Bayer. Chem. Zeit. **12**, 1209—1210.

THE author has investigated the spontaneous decomposition which occurs in solutions of sodium and potassium aluminates. The compound obtained by fusing alumina and soda in the proportions required by the formula $Al_2O_3.Na_2O$, and considered as the normal aluminate, forms with water a very unstable solution. The white precipitate which separates out has the composition $Al_2O_3.3\ H_2O$, and by very slow precipitation perceptible crystals resembling hydrargillite may be obtained. By occasional shaking of the solution containing the precipitate during the course of several days a solution of an aluminate is obtained, which is permanent, and the separation of aluminium hydrate ceases. Repeated experiments show that this permanent stage is reached when the molecular proportion is 1 : 6, that is, the solution contains $Al_2O_3.6\ Na_2O$. If the normal aluminate be dissolved in water containing so much sodium hydrate as will form the compound $Al_2O_3.2\ Na_2O$, the solution will be permanent for any length of time, unless the spontaneous decomposition be induced by the introduction of a little carbonic acid, or a portion of spontaneously precipitated alumina, when the action goes on until the 1 : 6 stage be reached. Glass powder, sand, or gelatinous aluminium hydrate will not set up the spontaneous decomposition. The permanent solution usually takes about three to four days in forming. The existence of four definite modifications of sodium aluminate is inferred, $Al_2O_3.Na_2O$, $Al_2O_3.2\ Na_2O$, $Al_2O_3.3\ Na_2O$, and $Al_2O_3.6\ H_2O$.

$Al_2O_3.3\ Na_2O$ is formed by roasting alumina with excess of sodium carbonate, the alumina being capable of driving out three equivalents of carbonic acid, but no more. (*See* Eng. Pat. 10,093 of 1887, this Journal, 1888, 625.)

—G. H. B.

On the Manufacture of Borax from Boronatrocalcite.

F. Witting. Zeits. f. angew. Chem., 1888, 483—487.

ALL the borax now manufactured in Germany is prepared from boronatrocalcite, commercially known as borate of lime or "tiza" ($Na_2B_4O_7 + 2\ CaB_4O_7 + 18\ H_2O$). It is found in large quantities in the north of Chili, at Maricunga, and Pedernal, and at Ascotan, which is situated about 90 miles from Antofagasta. It is also shipped from Rosario (Argentine), and in this case too is obtained from beds situated not far from Ascotan. The borate of lime from Ascotan is superior to that from Maricunga, as it contains on the average 34 per cent. of boron trioxide, as against 12—24 per cent.; it also contains much less calcium sulphate than the latter, and consequently requires much less soda for its decomposition. The borate of lime from Antofagasta goes direct to a syndicate in Hamburg, which consists of the three refineries, Hell and Sthamer, Morgenstern, Bigot, and Co., and Julius Grossman. This syndicate also sells to other refineries at a price which is regulated according to the price of borax. Since the formation of the syndicate the price of borax has remained firm at 60 to 62 marks per 100 kilos. during the last two years. The manufacture of borax from borate of lime is divided into four parts.

1. Boiling of the borate of lime with soda.
2. Working up the residual mud.
3. Fine crystallisation.
4. Working up the lyes.

1. The borate of lime is coarsely ground in a disintegrator, and 2,500 kilos. at a time of this are mixed with 4—5 times as much water. The mixture is heated directly by steam in a large vat provided with a powerful mixing apparatus. As soon as the mixture begins to boil, calcined soda is added. The quantity of the latter, which is necessary, depends on the amount of boron trioxide and calcium sulphate present in the borate of lime. The presence of too much sulphate spoils the quality of the lye. In this case much work and much steam are wasted in its removal. As a rule the soda should be added in slight excess. It is better still to use a mixture of equal parts of calcined soda and sodium bicarbonate, as in this case the boiling goes on quicker and the mixture is more fluid. The mixture should not be too alkaline, as in this case sodium metaborate ($NaBO_2 + 4\ H_2O$) is also obtained on crystallisation, and as this only contains four molecules of water the loss is considerable. The reaction is—

$$Na_2B_4O_7 + Na_2CO_3 = 4\ NaBO_2 + CO_2.$$

On the other hand, if a slight excess of carbonate be not present, crystallisation is very slow. When the soda is being added the mixture froths up violently, but this frothing can be easily overcome by shutting off the steam and adding cold water, which should be near at hand.

When the boiling is over the mixture is allowed to settle, the supernatant lye syphoned off, and the sediment passed through a filter press. The lye should have an average concentration of 30°—35° Baumé or more. The degree of concentration is regulated by the amount of sodium sulphate present. The lye is run into rectangular iron tanks of 1,000 to 1,500 litres capacity, and allowed to crystallise in a well-ventilated cool place. The crude borax, which contains about 40—50 per cent. of borax, 40 per cent. of sodium sulphate, and 10 per cent. of common salt, crystallises out on the sides and bottom of the vessels in three or four days. The lyes can be employed several times for the boiling, but when they get too concentrated it is best to evaporate them down. The crude borax then obtained contains sufficient borax to be worked up by the usual method, but the subsequent crystallisations, containing only 10 per cent. of borax, have to be specially worked up.

2. To obtain the borax still present in the filter-pressed sediment the latter is either lixiviated in the press or the cakes are removed and lixiviated with hot water. This lixiviation is necessary to obtain a good yield. The lyes thus obtained are boiled down and crystallised.

3. The crystallisation vats used in the refining process are large iron rectangular vessels capable of holding 8 to 10 cbms. They are cased in wood, and the interspace is packed with some non-conducting material, as it is very important that irregularities in cooling be avoided in order to obtain crystals of the necessary hardness and size. The crude borax is dissolved in pure water in quantity sufficient to obtain a boiling hot lye of 30° B. The fine lyes obtained can be several times employed for dissolving fresh quantities of crude borax; but as the amount of salt and sodium sulphate increases, the gravity of the solution is increased. Lyes which are too concentrated should not, however, be employed, for in this case octahedral borax containing five mols. of water crystallises out at a high temperature, and loss is thereby entailed, as commercial prismatic borax contains 10 mols. of water. To remove iron and organic matter, which colour the borax-sodium, hypochlorite is added. This is obtained by digesting bleaching powder with sodium carbonate solution, and the clear liquid is added to the borax solution until the latter is limpid and gives no reaction with potassium ferrocyanide. The crystallisation vats are all but filled with the borax solution and carefully covered up. After 10 to 14 days the temperature has sunk to 33°, and the borax crystallisation is finished. At this temperature, too, the sodium sulphate begins to crystallise, so that at 33° the liquor must be run off. The borax crust (about 20 cm. thick) is then freed from mother-liquor by sparging it with water or washing it with a sponge. It is then knocked off with a hammer, freed from adhering dirt, and dried in baskets at 30°, in a drying chamber, for 24 hours. Small imperfect crystals are then removed and the borax is finally packed into barrels lined with blue paper and capable of holding from 3 to 400 kilos.

4. A very important point is the working up of the large quantities of lye obtained in the crude and fine crystallisation. The lyes should not contain too much sodium sulphate and salt. In winter the lyes which have previously been strongly concentrated are run into crystallisation vats which are placed in the open air. The Glauber's salt then crystallises out in large quantities. In summer crystallisation is very difficult, and the sodium sulphate and salt have then to be boiled out. This, however, entails loss, as the hard crusts formed on the sides of the vessel contain 3 per cent. of borax, which is lost. The sodium sulphate thus obtained, as well as that (containing 10 per cent. of borax) obtained in the crude borax distillation, are mixed and gently heated, being stirred up and worked all the time until the sulphate just dissolves in its water of crystallisation. The liquid is at once run off and the hard pieces of borax left are worked up in the fine crystallisation. To obtain a satisfactory yield all loss by spilling should be avoided, and great care has to be exercised in the manufacture. Witting prefers iron to lead crystallisation tanks, as they are much stronger, and after some use the sides become perfectly polished. With the present cheap soda he prefers the above method to the acid method, as the plant is not so seriously attacked, and considerable loss results in the latter method from boric acid being volatile with steam. (*See also* this Journal, 1887, 515.)

—F. W. T. K.

PATENTS.

Improvements in Apparatus suitable for Preparing Oxychloride of Magnesium. W. F. R. Weldon, London. From A. R. Pechiney, Salindres, France. Eng. Pat. 14,653, October 27, 1887. 8*d*.

Improvements in Apparatus suitable for Use in the Process of Desiccating Oxychloride of Magnesium. W. F. R. Weldon, London. From A. R. Pechiney, Salindres, France. Eng. Pat. 14,654, October 27, 1887. 1*s*. 1*d*.

The description of the apparatus contained in these two patent specifications has already been published in this Journal in connexion with Professor Dewar's paper on "The Weldon-Pechiney Process for the Manufacture of Chlorine from Chloride of Magnesium." (This Journal, 1888, 775—782. Figs. 1 to 5.)—S. H.

The Treatment of Alkali Waste for Use in the Purification and Deodorisation of Sewage and Impure Waters or Matters. J. Hanson, Wakefield. Eng. Pat. 14,997, November 3, 1887. 6*d*.

See under XVIII. B., page 763.

Improvements in Apparatus for the Distillation of Ammoniacal Fluids. G. E. Davis, Manchester. Eng. Pat. 15,540, November 14, 1887. 8*d*.

The still consists of a metal cylinder fitted with a series of trays placed one above the other and perforated with a number of small holes about three-sixteenths of an inch in diameter, distributed in the proportion of one for about every square inch of tray surface. Each tray is provided with an overflow pipe dipping down into a shallow well on the tray next below. In practice, steam is admitted at the bottom of the still, and the liquor flows downward from tray to tray by the overflow pipes, the evolved gases and vapours making their way upwards through the perforations and keeping the liquor on each tray at a depth corresponding to the top of the overflow pipe. When the liquor has descended through a certain number of trays (sufficient to remove the volatile ammonia), it flows to an adjacent vessel where it is treated with lime or soda, and whence it passes by gravitation to the topmost of the remaining trays of the still to complete its passage through the series. When the quantity of liquor to be treated is irregular the patentee prefers to make the perforations in a flat cylindrical cap standing over an opening in the centre of the tray. Drawings are attached to the specification.—A. R. D.

Apparatus for Generating Carbonic Acid Gas. F. Foster, London. Eng. Pat. 16,084, November 23, 1887. 8*d*.

The object of this invention is to make the supply of carbonic acid gas more continuous by avoiding the stoppage for recharging the generator with the carbonate or the acid. By means of a slide valve the desired quantity of the carbonate is admitted into the generator, while a discharge valve at the bottom is automatically closed and opened periodically to withdraw the residue. Both valves and the acid supply are controlled by the movement of a revolving shaft, the rotation of which in one direction or the other is governed by the rise and fall of the gas-holder. The shaft is also fitted with cams which are arranged so as to open the discharge valve whenever by the failure to produce gas the gas-holder bell falls below a certain point. The discharge valve then closes again automatically, and the further descent of the gas-holder bell operates on the shaft which by its cams opens the acid inlet tap and the slide valve for admitting the carbonate.—S. H.

Improvements in the Manufacture of Carbonic Acid and Magnesia. H. Leffmann, Philadelphia, U.S.A. Eng. Pat. 8208, June 5, 1888. 6*d.*

THIS invention has reference to the manufacture of carbonic acid and extra heavy magnesia. Magnesite is crushed and heated in a gas-retort to about 750° C. Carbonic acid in a moderately pure state is given off, and after cooling and drying can be liquefied for commercial purposes, while the residue consists of magnesia, distinguished for its high specific gravity.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Researches on Glazes for Porcelain. C. Lauth and G. Dutailly. Bull. Soc. Chim. **50**, 221—251.

THE authors divide their work into two portions, the first part treating of colourless, and the second of coloured glazes.

FIRST PART.

These glazes may be considered as a combination of silicate of alumina with one or more silicates of the alkalis, alkaline earths, or metallic bases: the bases actually investigated being potash, soda, magnesia, lime, strontia, baryta, and zinc oxide. Relatively simple mixtures were in all cases made out of the great number of possible combinations, and those were especially studied which might be capable of industrial application. The mode of work was to make an exceedingly intimate mixture of the components, to suspend this in water, and apply to the porcelain in a moistened state, the pieces of porcelain being of such a composition that a temperature of about 1,350° was required to fire them. The firing was either performed rapidly in a Perrot furnace, or more slowly in the Sèvres furnace. The composition of the glazing mixture was such that the ratio between the oxygen of the silica to the oxygen of the bases was as 3 to 60, this being about the ratio which is found in the pegmatite employed as the glaze for the hard Sèvres porcelain. The mixtures were usually prepared from sand, kaolin, and either the oxide or the carbonate of the other bases. But in the case of potassium and sodium, both of whose oxides and carbonates are soluble in water, a frit containing the corresponding alkaline alumino-silicate was prepared either from pegmatite or a natural felspar, and having about the composition of either orthose or albite.

The first portion of the work was divided into three principal sub-divisions as follows:—

A. Silicates containing only one base in combination with silica and alumina.

B. Silicates containing two different bases combined with silica and alumina.

C. Silicates containing several bases in combination with silica and alumina.

In the first two series the materials were combined in simple proportions to form well-defined compounds, whilst in Series C. they were mixed together in empirical proportions.

Series A.

1. *Silicates* $m\ Al_2O_3$, $n\ K_2O$, $p\ SiO_2$.—The mixture of these silicates was made by the aid of frits containing potassium; orthose being too expensive for use on an industrial scale. The results were very bad, the glaze being difficult to apply, and on drying leaving portions of the porcelain uncovered. Moreover, it could not stand firing without the formation of bubbles.

2. *Silicates* $m\ Al_2O_3$, $n\ Na_2O$, $p\ SiO_2$.—The remarks made in the foregoing division apply here also.

3. *Silicates* $m\ Al_2O_3$, $n\ MgO$, $p\ SiO_2$.—In this case it was not found to be possible to cause the mass to thoroughly fuse, no matter how the relative proportions of the ingredients were varied.

4. *Silicates* $m\ Al_2O_3$, $n\ CaO$, $p\ SiO2$.—This mixture fuses much more readily than the one containing magnesium, and it was also noticed that the fusibility increased as the percentage of lime increased. Experiments were made with the mixtures given in the table below:—

Formula.	A : B.*	Calcined Kaolin.	Sand.	Chalk.	SiO_2.	Al_2O_3.	CaO.
$3\ Al_2O_3$, 4 CaO	3 : 60	42	53	21	72·29	15·95	11·76
$2\ Al_2O_3$, 3 CaO	3 : 60	33·85	53·71	22·34	72·20	15·30	12·50
Al_2O_3, 2 CaO	3 : 60	29·62	55·23	26·53	71·67	13·44	14·89
Al_2O_3, 3 CaO	3 : 60	24·80	57·03	32 74	70·52	11·27	15·31
Al_2O_3, 2 CaO	3 : 60	29·62	63·17	26·53	73·78	12·44	13·78

* Ratio between the oxygen of the silica and the oxygen of the bases.

Nos. 1 *and* 2 were incompletely vitrified; *No.* 3 was thoroughly fused; *No.* 4 gave a good glaze; *No.* 5, which is rather more siliceous than No. 3, behaved much as No. 2.

The exclusively calcareous glazes were not so transparent as those containing a little alkali.

5. *Silicates* $m\ Al_2O_3$, $n\ BaO$, $p\ SiO_2$.—These glazes were rather more fusible than those containing lime, but were more apt to contain bubbles.

6. *Silicates* $m\ Al_2O_3$, $n\ SrO$, $p\ SiO_2$.—In this case the results were almost identical with those obtained in the case of barium.

7. *Silicates* $m\ Al_2O_3$, $n\ ZnO$, $p\ SiO_2$.—It was found here also, as in the case of magnesium, that none of the mixtures would fuse under the required conditions.

From these experiments it appears that in each group of alkalis, alkaline earths, and earths, the higher the atomic weight of any given member the more readily fusible is the mixture prepared from it. And further, that in each mixture there is a proportion giving the maximum fusibility. Thus we have, on the one hand, the infusible calcium silicate, and, on the other, the infusible aluminium silicate; but by mixing the two together a proportion is arrived at, giving the maximum fusibility.

Series B.

In this series, mixtures containing two bases were studied. The composition of the silicates obtained on fusing the different mixtures may be expressed by the general formula—

$$m\ Al_2O_3,\ n\ B',\ p\ B'',\ q\ SiO_2,\ \text{where usually}$$

$$m = 1,\ n = 1,\ p = 1,\ \text{and}\ q = 9.$$

This series is also sub-divided according to the mixtures studied.

1. *Mixtures of alkaline bases.*—The only possible mixture in this case is between potassium and sodium. The drawbacks mentioned in Series A. under potassium and sodium exist here when frits are employed, but some mixtures have been prepared with the aid of felspar. In no case, however, was complete vitrification obtained at the required temperature—about 1,350°.

2. *Mixtures containing an alkali and an alkaline earth.*—These preparations could only be obtained by the aid of frits, and were unsatisfactory unless the frit had been very recently prepared, in which case fairly good results were obtained with combinations of potassium and sodium with calcium, barium and strontium.

3. *Mixtures containing two alkaline earths.*—These are given in the subjoined table :—

Bases taken.	Sand.	Calcined Kaolin.	Chalk.	Magnesia.	Barium Carbonate.	Strontium Carbonate.
CaO, MgO	55·23	29·62	13·27	5·31	..	..
CaO, BaO................	55·23	29·22	13·27	..	26·14	..
CaO, SrO	55·23	29·62	13·27	..	..	19·57
MgO, BaO	55·23	29·62	..	5·31	26·14	..
MgO, SrO................	55·23	24·62 (?)	..	5·31	..	19·57
BaO, SrO	55·23	29·62	..	..	26·14	19·57

The combinations, however, were not satisfactory, partly because complete fusion did not set in, and partly because there was a lack of transparency.

4. *Mixtures of an alkaline earth with zinc oxide.*—Zinc oxide was combined in turn with the oxides of barium, strontium, calcium, and magnesium, but satisfactory fusion did not take place, and the transparency also was not good.

Summing up their results for Series B., the authors point out that the fusibility of the different mixtures is about the mean of the fusibility of the silicates composing them, and they embody their views in the following table :—

—	K_2O.	Na_2O.	MgO.	CaO.	BaO.	SrO.	ZnO.
K_2O	Fused at a temperature below 1,350°.	....	....	....	....	....	....
Na_2O	Fused at a temperature below 1,350°.	Fused at a temperature below 1,350°.	....	....	....	....	....
MgO	Not completely fused.	Began to fuse.	Did not fuse.	....	....	....	....
CaO	Completely fused and a good glaze.	Completely fused and a good glaze.	Began to fuse.	Fairly well fused.	....	....	....
BaO	Almost completely fused.	Almost completely fused.	Began to fuse.	Fairly well fused.	Fairly well fused.	....	....
SrO	Almost completely fused.	Almost completely fused.	Began to fuse.	Nearly fused.	Fairly well fused.	Fairly well fused.	....
ZnO	Began to fuse.	Began to fuse.	Began to fuse.	Began to fuse.	Began to fuse.	Began to fuse.	Did not fuse.

Series C.

In the two preceding series the authors show that mixtures containing alkalis give the most transparent and completely fused glazes. Calcium oxide alone gives a good glaze, but it is always a little opaque, as though a certain amount of crystallisation had taken place. As, however, this body seemed to be the most promising, from an industrial point of view, it was specially studied in this series, in mixtures obtained by the addition of chalk and sand to pegmatite and felspar, with reference to its effect in altering the fusibility of the various mixtures. It is shown that by diminishing the silica or the alumina the fusibility increases. In one special case, in which the proportions were as follows—

Pegmatite.	Sand.	Chalk.	SiO_2.	Al_2O_3.	KNaO.	CaO.
66	29	9	75·08	12·23	7·48	5·19

it will be seen that there is about the same amount of silica as in the pegmatite used in the time of Brongniart for the glaze of hard Sèvres porcelain. But by substituting in the pegmatite about 2 per cent. of lime for 2 per cent. of alumina, the point of fusion is lowered about 150°.

Besides these siliceous glazes, others, in which a part of the silica had been replaced by borates, fluorides, or phosphates were examined. In the case of the borates, good results were obtained, a mixture of 50 parts of calcium borate with 35 of sand and 35 of kaolin giving a quite satisfactory glaze. With calcium fluoride a much higher degree of fusibility was obtained than with calcium carbonate, and it was also a valuable substance for using with coloured oxides. The use of cryolite, even in such small proportions as 2 to 3 per cent., always caused the formation of bubbles. With phosphates, the results were bad; but this material might be employed in the manufacture of "crackle" porcelain.

SECOND PART.

Coloured Glazes.

In the present methods for colouring porcelain there are very grave defects. The colouring material is either mixed with the porcelain itself, when the characteristic properties of the porcelain almost disappear, and the article seems to be made of metal or varnished wood, it not being possible to recognise the grain or transparency of the ware; or else the colours are applied to the surface of the porcelain. In this case also, the colours being opaque, spoil the lustre of the porcelain, and their own beauty is at the same time much lessened. These defects do not exist when coloured glazes are taken. The introduction of the metallic oxide, however, alters the fusibility of the glaze, and hence the composition of this latter must also be altered. Thus, in a calcereous glaze experience shows that—

8 parts of uranium nitrate diminish the chalk in the proportion of				4	parts.
5 parts of cobalt oxide	,,	,,	,,	5	,,
8 parts of colcothar	,,	,,	,,	4	,,
8 parts of manganese	,,	,,	,,	4	,,
4 parts of copper oxide	,,	,,	,,	4	,,

Of the different methods for applying the glaze, the authors find that the best results are obtained by dusting, and it is better to obtain the required thickness by successive operations rather than by one alone. The thicker the layer the better the subsequent effect, but it is then more apt to start.

The different colours are prepared as follows :—

Yellow.—By the addition of 8 per cent. of uranium nitrate to the elements of the glaze. A greater percentage is apt to give a blacker colour. Calcium fluoride gives better results than the ordinary calcareous flux.

Blue.—About 5 per cent. of cobalt oxide is sufficient, and the blue is not so violet in colour as in the Sèvres porcelain. An addition of 2 per cent. of cobalt chromate also gives a beautiful blue. In this latter case alkaline fluxes should be employed.

Rose.—When 100 grms. of tin oxide are mixed with 34 grms. of chalk moistened with a solution of 3 to 4 grms. of potassium bichromate, and the whole calcined, a pigment known as "pinck colour" is produced. About 8 per cent. of this gives to the glaze a beautiful rose colour.

Violet.—10 parts of glaze to 8 per cent. of the pinck and 1 part of glaze to 5 per cent. oxide of cobalt.

Green.—5 per cent. of oxide of copper is enough. The chalk must be diminished in the same proportion. Or 2 per cent. of chromium oxide may be used instead; with this alkaline fluxes are preferable.

Sea-green.—A mixture containing 3 per cent. oxide of copper, 5 per cent. oxide of tin, and 0·5 per cent. oxide of iron, gives a colour closely resembling the green of the Chinese.

Brown.—Many mixtures are given. A very good colour was obtained from the following mixture:—40 parts of sand, 20 parts of calcium fluoride, 32 parts of peroxide of manganese, and 8 parts of peroxide of iron. The mixture is fluxed and finely ground, and applied under the white glaze.

Black.—About 10 per cent. of uranium nitrate is taken and fritted with the ordinary colourless glaze, the chalk in which must be diminished by 5 per cent. A reducing flame must be used to develop the colour.

Turquoise-blue.—There must be no alumina whatever in the flux, which is now made up as follows : sand 54·16, dry sodium carbonate 17·50, barium carbonate 24·16, and oxide of copper 4·17 parts.

These coloured glazes can be used in many different ways. Thus, they can be employed on a white ground for ornaments, cameos, &c., the effect being much increased by enamels and engraving. Or the whole ground can be coloured, the article having been first ornamented with suitable engraving. A part of the glaze may also be removed, exposing the white porcelain beneath, and this can then be filled in with another harmonising colour, such an effect being very rich. This latter result may also be obtained by applying to the porcelain a uniform layer of the coloured glaze, upon which is laid the design in the other colour or colours, the whole being then covered with a thin layer of colourless glaze, this latter softening the tones of the whole, and rendering the surface smoother and more polished.—S. G. R.

On the Deterioration of Levels. F. Mylius. Zeits. f. Instrumentenkunde, **8**, 267.

Levels, of which the glasses are filled with ether, become useless after a time from the formation of a rough film on their inner walls. Such a film gave on analysis : Soda, 33·1 ; potash, 12·5 ; lime, alumina, and ferric oxide, 12·3 ; silica, 11·6 ; carbonic acid, water and loss, 30·5 parts per cent. respectively.

It therefore appears to be a decomposition product of the glass, due to the action of the water constantly present in commercial ether. The presence of water in a level filled with ether may be demonstrated by cooling it to 0° C., when it separates out, and is deposited on the walls of the tube in the form of dew.

The composition of the glass has much influence on its liability to attack, glasses containing much alkali being peculiarly prone thereto, while Bohemian glass offers great resistance, being surpassed, however, by glasses in which the alkali is replaced largely by lead oxide. Zinc oxide also appears to exercise a marked protective influence on the glass of which it forms part.

The stability of the lead glasses is noteworthy, since they are easily attackable by acids and alkalis. From these results it follows that levels should either be constructed of refractory glass or filled with anhydrous ether.—B. B.

X.—METALLURGY, MINING, Etc.

The Influence of Aluminium upon Cast Iron. W. J. Keep, C. F. Mabery, and L. D. Vorce. The Eng. and Min. Journ. **46**, 125—128.

The paper contains the results of a series of experiments specially carried out to ascertain in what manner the presence of small quantities of aluminium influence the properties of cast iron. Two bases were used, one a white iron and the other a grey Swedish iron, and the aluminium was added in the form of ferro-aluminium containing silicon. Each base was experimented upon separately, and at the same time a series of blank trials, without the addition of aluminium, were made in each case, the metals in the two series in other respects being subjected to exactly the same conditions. Consequently, any difference in the properties between the two metals containing the aluminium and the two metals without, is taken to represent the effect of aluminium. The subject was considered under 12 heads, with the following important results :—

1st.—*Solidity of Castings and Prevention of Blowholes.*

The aluminium castings were of a slightly finer grain and of increased solidity. With 0·1 per cent. of aluminium present, the resistance to dead weight was increased about 44 per cent., and to impact 6 per cent.

2nd.—*Does the Aluminium remain in the Iron to exert an Influence when the Iron is remelted?*

The white base, after the addition of 0·25 per cent. of aluminium was remelted six times, fresh quantities of the white base being added each time. That the aluminium remains in and improves the iron is shown by the superior and stronger castings obtained in this series, even when the percentage of aluminium had become very low, than in those cases where no aluminium was added.

3rd.—*The Effect of Aluminium on the Grain.*

Aluminium seems to enable iron to hold in solution all its carbon until just upon the point of solidification, when it is precipitated in a finely graphitic form. The advantage of this is the uniformity of the mass and the absence of pockets of graphite, which are generally produced when ordinary gray iron has been cooled slowly. Hence the homogeneity and greater strength of the aluminium castings. The rapidity of cooling makes little or no difference, as the release of the carbon seems to be instantaneous, and only at the moment of crystallisation. A very little aluminium is sufficient to precipitate graphite from white iron, 0·25 per cent. rendering it perceptibly darker in colour, 0·5 per cent. more so, whilst 0·75 per cent. renders it quite gray, with no signs of white. With increasing amounts up to 4 per cent., the maximum in all these experiments, the effect is the same, the castings becoming softer and greyer as the amount of aluminium increases. The presence of much silicon does not alter the matter, the grain being the same also in thin and rapidly cooled as in thick castings.

4th.—*Taking away the Tendency to Chill.*

Aluminium castings are not affected by chilling. As above shown, graphite is liberated whether the casting is cooled rapidly or slowly, with the result that however cooled the grain is uniform and there is no chill.

5th.—*The Thickness of Sand Scale.*

When sufficient aluminium is present to cause an extensive separation of graphite, that graphite which is near the facing of the casting forms a plumbago coating, which resists the sand and the heat, and prevents the iron burning the sand into itself.

6th.—*The Effect upon Hardness.*

The fineness of the grain of these castings causes them to be more easily cut than cast iron of coarser grain.

7th.—*Resistance to Dead Weight.*

In all the tests the presence of aluminium increases the strength to sustain a constant load, but the strength does not increase uniformly with the percentage of aluminium.

8th.—*Resistance to Impact.*

In this case the increase in the strength of the aluminium castings is much greater and more marked than in the preceding, those made with the white iron base being much more benefited than those made with the gray.

Here again, above a certain percentage of aluminium, the strength becomes less, due to the larger amount of graphite liberated.

9th.—*Elasticity.*

Aluminium improves the elasticity of cast iron.

10th.—*Permanent Set.*

The fineness and compactness of iron containing aluminium gives less permanent set than iron equally as soft when that softness is produced by silicon.

11th.—*The Effect on Shrinkage.*

The shrinkage is slightly increased with a small quantity of aluminium, due, probably, to the elimination of blowholes, but with 0·75 per cent. and more, it is much decreased, especially in the case of the white iron.

12th.—*The Fluidity of the Melted Metal.*

The fluidity in the case of the white base was much increased, but in respect to the gray base containing much silicon it is not so clear, although it is believed that the fluidity is also increased in this case.—A. W.

Solutions for Colouring Metals. B. Pensky. Zeits. f. Instrumentenkunde, **8**, 322.

Brass is covered with a thin bluish-black layer by immersing in a solution of ammoniacal copper carbonate (100 grms. of carbonate, 750 cc. of strong ammonia, and 250 cc. of water) until the desired tint is obtained. Surfaces which have been subjected to pressure, such as sheet metal, &c., are not coloured evenly, owing to the oxide deposited on them. The action of the solution depends on the interchange of copper for zinc, and only metals containing zinc can therefore be etched by the above solution.

A steel-gray colour is obtained with a solution made by dissolving 42·5 grms. of arsenic in 1 litre of HCl and 125 cc. of HNO_3, and gradually adding 42·5 grms. of iron borings. The best results are obtained when the metal to be stained is well polished with emery paper, immersed in the solution for five minutes, washed with soap and warm water, and carefully dried. The metal is then covered with a colourless varnish.—A. R.

The Reason Iron Rails when in use Rust much less rapidly than when not in Service. W. Spring. Bull. Soc. Chim. **50**, 215—218.

The above fact has long been known, and various explanations of it have been given, amongst others that the vibrations set up preserve the iron, or that currents of electricity are generated, which have the same effect, and it has even been surmised that the rails are kept constantly covered with a thin layer of grease derived from the wheels of the cars. The author shows, however, that the preservation of the rails is due to the formation of magnetic iron oxide on their upper surface, produced by the pressure of the wheels on the moist iron rust. This he proved by taking slightly moistened ferric hydrate and mixing with minute particles of iron, and then subjecting the whole to a pressure of 1,000—1,200 atmospheres. It was found that the ferric hydrate adhered strongly to the iron, which was moreover much corroded, and that for a depth of half a millimetre the hydrate had become black. Analysis of the material detached from the fragments of iron showed the presence of magnetic iron oxide. A similar analysis of the material taken from an actual iron rail proved that here also was magnetic iron oxide together with ferric oxide and a little free iron. The rails, in fact, are protected in just the same way that many other iron articles are intentionally so protected, viz., by coating them with a layer of the magnetic oxide.—S. G. R.

PATENTS.

Improvements in Apparatus for indicating the presence of Firedamp in Coal Mines or other places. J. W. Swan, Bromley. Eng. Pat. 11,928, September 2, 1887. 8*d.*

The essential feature of the apparatus lies in the combination of two wires or resistances of equal gauge in electrical circuit, and in contact respectively with atmospheric air and the atmosphere of the mine or place to be tested; and a differential thermometer, by which the difference in temperature of the two resistances is caused to give an indication of the presence of explosive gas or to signal when such gas is present to any predetermined extent. For details of the apparatus the specification and drawings must be consulted.
—O. H.

A New Process of extracting Aluminium from Minerals, and also making Aluminium Alloys therefrom. S. Pearson, Hockley; A. W. Turner, Birmingham; and W. Andrews, Aston. Eng. Pat. 12,332, September 12, 1887. 4*d.*

By heating silicate or compound silicates of alumina with calcium fluoride and sodium, or potassium carbonate, or hydrate, or all of these together, it is claimed that aluminium is produced, and if other metals are present alloys of aluminium obtained.—A. W.

Improvements in the Manufacture of Chromium and its Alloys. L. A. Groth, London. From V. and E. Kouff, Paris, France. Eng. Pat. 14,700, October 28, 1887. 6*d.*

Alkaline chromates are mixed with equivalent proportions of silica and carbon to produce the alkaline silicate and chromic oxide, which latter is reduced by the carbon. The mixture is heated in a crucible and spongy metallic chromium obtained, containing the soluble silicate which is removed by washing. Alloys can be made in the same way. Modifications are described.—A. W.

Improvements relating to the Production of Aluminium and Compounds or Alloys containing the same, and to Apparatus therefor. L. Grabau, Hanover, Germany. Eng. Pat. 15,593, November 14, 1887. 8*d.*

This patent relates to the production of aluminium from the fluoride by metallic sodium. The proportions used are those which produce the reaction—

$$2\ Al_2F_6 + 6\ Na = 2\ Al + Al_2F_6,\ 6\ NaF,$$

whereby the most fluid salt is obtained. The aluminium fluoride is heated to 600° C., at which temperature it is pulverulent, and is then poured on to the surface of melted sodium. An advantage is gained in the fact that the pulverulent material floats on, and prevents undue loss of the sodium. The reaction takes place and the temperature rises rapidly, but the containing vessel is kept cool by a current of water which solidifies a certain amount of the slag on its sides. It is claimed that this solidified layer of slag protects the vessel, and consequently pure and uncontaminated metal is obtained, inasmuch as the reaction has taken place in a matrix from which it could obtain no impurity. The metal is poured and cast in a similarly coated mould.

—A. W.

Improvements in the Smelting of Copper and Lead Ores and arrangement of Furnaces for that purpose. H. B. Scott, London, and W. Gentles, St. Helens. Eng. Pat. 16,347, November 28, 1887. 8*d*.

The claim in this invention is the arrangement of furnaces at different levels so that the materials in the successive stages of copper smelting may be tapped and run direct along shoots from one furnace to another, thereby saving the labour of recharging, and also the cost of fuel at present used for reheating the cold pigs of material. Along the shoots are placed conical moulds to intercept any such metals as will subside into them, such as lead, silver, and gold.—A. W.

Improvements in Extracting Gold, Silver, and other Metals from their Ores and Alloys. A. Schanschieff and D. Marks, London. Eng. Pat. 16,553, December 1, 1887. 6*d*.

Instead of metallic mercury, as in the ordinary amalgamation process, a mercurial salt, preferably sulphate, is used, which on being reduced precipitates fine globules of mercury in intimate contact with the ore. A battery may be used wherein the ore can form either pole, the other being carbon. If pyrites be used it is decomposed, mercury being deposited, and the gold and silver obtained as an amalgam.—A. W.

Improvements in obtaining Chromium. J. Park, Glasgow. Eng. Pat. 377, January 10, 1888. 6*d*.

Bichromate of ammonium is ignited with sugar or starch, &c., whereby an intimate and finely divided mixture of chromic oxide and carbon is obtained. This is packed into a plumbago crucible, covered up, and maintained at a white heat for an hour or more. A mass of spongy chromium is thus obtained, which on powdering and reheating can be made solid and compact.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Electro-Metallurgy. H. Steinach. Chem. Zeit. Rep. **12**, 228.

The author, in the first place, opposes the view that a metallurgical process is only profitable when dynamos are employed. For example, in the silvering of articles by means of a battery, the precipitate which is slowly deposited is seen under the microscope to be dense and crystalline, while that rapidly deposited with the dynamo has a felt-like appearance. The latter, therefore, has not the same durability as the former. The same applies to many other precipitates, as tin, iron, and copper. As the only practical and approved element the author recommends Bunsen's. Binding screws, which are rapidly corroded by the acid vapours, are entirely avoided by using mercury contacts for every cell (glass cups let into wood), into which the wires from zinc and carbon dip. The author further describes an arrangement of several elements, to have the usual E.M.F., for other work, coppering lead, gilding, &c. It works with an initial current of six ampères at 1·8 volts, and after four weeks, 10 hours daily, uninterrupted use, still gives a current of two ampères. For the baths themselves enamelled cast-iron vessels are employed. For acid baths wooden vats neatly coated with thin lead are best, the soldering to be done either with lead chloride or tin and stearin as flux. As continual movement of the liquid is necessary, a handy water supply or a small suspended reservoir is employed for this purpose.

The suspension of the anodes (diaphragms in acid-copper baths) and the articles are also treated of, including numerous notes on the art of silvering, &c.

The copper bath consists of a solution of pure copper sulphate (free from iron) of 18° Bé., to which is added sufficient sulphuric acid to raise it to 20° Bé. In the State printing office in Vienna, 20 per cent. of copper sulphate and 3 per cent. of acid are taken. In the cyanide bath the potassium cyanide is converted into carbonate by contact with air which would finally cause the non-attachment of the silver, but this is prevented by the addition of baryta.

To rapidly determine the amount of potassium carbonate in the bath, the author, at G. Buchner's suggestion, employs a solution of barium chloride, containing 17·6 grms. per litre, so that 1 cc. corresponds to 0·01 grm. of K_2CO_3. From the number of cc. of this solution required to completely precipitate 10 cc. of the silver bath the amount of carbonate present in the latter is readily ascertained.—O. H.

PATENTS.

Improvements in Galvanic Batteries. P. Skrivanow, Paris, France. Eng. Pat. 15,063, November 4, 1887. 4*d*.

A battery is made up of an attackable electrode, as iron, tin, or zinc, and of an electrode of carbon, lead, or other material, which is not attacked when immersed in the working solution of "hydrate of potash or soda." The negative plates are coated with red lead or minium, which is held in place by parchment. In one arrangement, two negative electrodes and a zinc plate between them, fit grooves in a cell, the red lead and parchment being retained by doubling over the edges of the lead plates upon them.

—E. T.

Improvements in the Electrolytes of Secondary Voltaic Batteries. W. J. S. Barber-Starkey, Bridgnorth. Eng. Pat. 15,754, November 17, 1887. 6*d*.

The inventor uses as the electrolyte of an accumulator, a solution of sulphate or bisulphate of potassium, or sulphate of magnesium, alone or in combination, the object being to obtain an electrolyte that will remove such insoluble sulphates as those of lead, and prevent their formation on the plates. The solution may be formed by adding to the sulphuric acid, carbonate of potassium, magnesium, or ammonium, or the bicarbonate of potassium in small quantities until the sulphate is removed.—E. T.

An Improvement in Plates for Secondary Voltaic Batteries. B. M. Drake and J. M. Gorham, London. Eng. Pat. 3986, March 14, 1888. 8*d*.

The inventors cast grids, perforated in the usual way, but with the ribs deeper than they are to be in the finished plate. The edges are then burred over, so that the perforations are smaller at the mouth than inside. This may be effected by passing the plate under a blunt tool, or by percussion. Or it may be passed under a series of square plates with rounded corners, clamped on a revolving spindle, so that each consecutive plate has a slight angular advance on the one preceding it. The corners of the squares beating on the plates accomplish the burring.—E. T.

Improvements in Storage Battery Plates. W. P. Thompson, Liverpool. From C. D. P. Gibson, New York, U.S.A. Eng. Pat. 12,706, September 3, 1888. *6d.*

A grid is employed with square perforations separated by thin webs. Into each perforation is dropped a lead piece somewhat resembling a collar stud, it having two lozenge-shaped plates connected by a short thin neck. While the ends of the stud-shaped pieces are level with the faces of the plate the latter is pasted and ultimately "trained."
—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Note on Distilled Stearin. R. Benedikt. Zeits. f. angew. Chem. 1888, 491—492.

In his investigation on turkey-red oil (Zeits. f. angew. Chem. 1887, 150 and 325), Benedikt repeatedly tested distilled stearin for hydroxy acids and always found them absent. Recently Geitel has expressed it as his opinion (J. Prakt. Chem. **37**, 53) that the larger quantity of solid fatty acids obtained in the sulphuric acid saponification than is obtained in the lime saponification is due to the formation of oxystearic acid. The following are the results of experiments on the subject which Benedikt and Grüssner have carried out. The sample employed was one prepared by the sulphuric acid saponification method, and had been distilled after saponification and pressed twice; melting point 52·1°. In testing for the oxyacids the acetyl value was determined. The saponification value of the non-acetylised fatty acid was 206·4° of the acetylised fatty acid 207·5°, the acetyl value was therefore 1·1, which would indicate the presence of 0·5 per cent. of oxystearic acid. But as the value obtained is still within the experimental error of the method, the presence of hydroxy fatty acids does not seem proved. The sample contained no oleic acid as on preparation of the lead salt none was taken up by ether. In spite of the absence of oleic acid the sample absorbed 13·94 per cent. of iodine from a v. Hübl's iodine solution. Another unsaturated acid is therefore present.

Now M. C. and S. Saytzeff have found (J. Prakt. Chem. **37**, 269) that on distillation oxystearic acid is converted into iso-oleic acid which melts at 43°—45°. It is possible therefore that in the commercial distillation with superheated steam, oxystearic acid is converted into iso-oleic acid, and that commercial stearin obtained by the sulphuric acid saponification method is a mixture of stearic, palmitic, and iso-oleic acids. The reactions are probably as follows:—On saponification with sulphuric acid we get—

$$C_{18}H_{34}O_2 \text{ (oleic acid) } + H_2SO_4 = C_{18}H_{35}(OSO_3H)O_2.$$

On boiling the product of this reaction with water we get—

$$C_{18}H_{35}(OSO_3H)O_2 + H_2O = C_{18}H_{35}(OH)O_2 + H_2SO_4.$$

And finally on distillation we obtain iso-oleic acid thus—

$$\underset{\text{(oxystearic acid)}}{C_{18}H_{35}(OH)O_2} = \underset{\text{(iso-oleic acid).}}{C_{18}H_{34}O_2} + H_2O$$

Calculating the percentage of iso-oleic acid from the iodine value obtained above, we should find 15·5 per cent. in the stearin from Gonda. Benedikt and Grüssner are trying to prepare iso-oleic acid from distillation stearin in quantity.—F. W. T. K.

Ricinoleic Acid. F. Krafft. Ber. **21**, 2730—2737.

This acid is best obtained from castor oil, by quickly saponifying with strong potash and decomposing the soap by heating for a very short time with concentrated hydrochloric acid. After repeatedly washing with water, afterwards cooling to 0°, a crystalline mass is obtained. This is gradually pressed at temperatures not higher than 12°, when all the impurities are removed and the pure acid remains. It is white, odourless, melts at 16°—17°, and cannot be distilled without decomposition, even under diminished pressure. The barium salt prepared from the crude acid is readily soluble in warm alcohol; and the lead salt in ether, leaving but a slight residue, which proves that the crude acid does not contain more than traces of solid fatty acids. Castor oil which has been kept for a considerable time at low temperatures shows crystalline deposits, which consist of the glycerides of ricinoleic and stearic acids. These may be separated by treating their barium salts with alcohol, when the stearate only is dissolved. The formula of ricinoleic acid is probably—

$$CH_3\ (CH_2)_5CHOH.CH{=}CH.(CH_2)_8COOH,$$

which would account for the ready formation of secondary caprylic alcohol and sebacic acid when it is treated with KOH, also the breaking up of a part of the acid into oenanthol and undecylic acid, as well as the formation of ordinary stearic acid by reduction. On oxidising with nitric acid not only dibasic acids, such as azelaic and oxalic acids, are formed, but also normal heptylic acid. The safest method of oxidising, *i.e.*, in order to ensure the non-formation of secondary oxidation products, is to slowly introduce 1 part of the substance into 1—3 parts of nitric acid (sp. gr. 1·5), and after the first stage of the reaction seems over to heat very slowly to 50°.

Ricinelaidic Acid is best obtained by passing nitrous acid into a mixture of ricinoleic acid with a little nitric acid. After pressing and crystalling from ether a lustrous mass of crystals resembling asbestos is obtained, melting at 52°—53°. This acid cannot be distilled even at a pressure of 15 mm. without decomposition. Oxidised with nitric acid, normal heptylic acid is formed.

Ricinic Acid.—On heating the barium salt of ricinoleic acid in vacuo, a volatile oil distils over, which, after rectifying, distils at 172°—173°, and is almost pure methylhexylketone. The residue in the retort is treated with HCl, and the acids which separate are distilled at a reduced pressure of 15 mm. At 250° a substance distils over which solidifies in the receiver, and after crystallising from weak alcohol melts at 81°. It may be distilled almost without decomposition. The analysis shows this new acid to be isomeric with ricinoleic and ricinelaidic acids. It is readily oxidised by nitric acid; normal heptylic acid and an acid melting at 100°—107°, which is not volatile with aqueous vapour, are amongst the products of the reactions. In other respects the new acid behaves very similarly to its two isomerides.—A. R.

On the Densities and Refractive Indices of Certain Oils. J. H. Long. Amer. Chem. J. **10**, 392—405.

The sp. gr. was determined by the use of a 50-grm. specific gravity bottle immersed in water, of which the temperature was known to 0·1° C. The weights used were corrected to their value in vacuo, and water at 4° C. was taken as the unit of sp. gr. The index of refraction was determined by the method of minimum deviation, using a Meyerstein spectrometer; a bead of sodium carbonate in a Bunsen flame served as a source of light. A large number of results of various oils at different temperatures were obtained, and by means of carefully-drawn curves, values for intermediate temperatures were interpolated for each oil. The following table shows the range of variation for each kind of oil at 20° C:—

Kind of Oil.	Sp. Gr. (D.)	Refractive Index (N.)	"Specific Refractive Energy." $\left(\frac{N-1}{D}\right)$
Olive (4 samples)	·9126—·9136	1·4695—1·4711	·5143—·5162
Cotton seed (6 samples)	·9186—·9210	1·4722—1·4741	·5127—·5161
Sesamé (3 samples) .. .	·9181—·9199	1·4735—1·4748	·5150—·5161
Mustard (3 samples)...	·9116—·9127	1·4740—1·4746	·5198—·5201
Castor (1 sample)......	·9589	1·4791	·4996
Pea nut (1 sample)	·9173	1·4717	·5142
Lard (1 sample)	·9122	1·4686	·5137

The olive oils were cold-pressed, and sufficiently free from palmitin to remain clear at 0° C. The cotton-seed oils included both crude dark specimens and others that were highly refined. It will be noted that the sp. gr. is lower than that usually given; this is probably due to the smaller quantity of palmitin present.

The decrease in sp. gr. for a rise in temperature of 1° C. was nearly the same for all the oils, viz., about ·00068. A similar uniformity prevailed in the case of the refractive index, the value being ·0004. The author deduces from his results that the composition of the olive, sesamé, and cotton-seed oils examined, is approximately 4 parts of tri-olein to 1 part of tri-palmitin, in the following way: Their mean molecular weight (as determined by saponification) is about 870; this gives the "molecular refractive energy," $M\left(\frac{N-1}{D}\right)$, the value of 448; now, taking the "atomic refractive energies" of C, H, and O, as 4·85, 1·50, and 3 respectively, an oil consisting solely of tri-olein would have a "molecular refractive energy" of 450·4, while for one containing nothing but tri-palmitin, the number would be slightly smaller:* a mixture of 4 parts of tri-olein and 1 of tri-palmitin would give 447·2,† which corresponds closely with that found by experiment, viz., 448.
—B. B.

PATENTS.

Improvements in the Treatment and Distillation of Fatty Matters or Crude Fatty Acids, so as to separate the Fatty Acids from the Glycerin, and in Apparatus therefor. W. P. Thompson, Liverpool. From La Société Industrielle des Glycerin et Acides Gras, Paris, France. Eng. Pat. 13,085, September 27, 1887. 11*d*.

The improvements consist in the saponification of fats by means of superheated steam at a carefully regulated temperature, so that the fats themselves do not distil over, but only their products, viz., fatty acids and glycerin, while the formation of tarry matters is avoided. The process is conducted in a boiler through which pass a number of tubes connected to each other by elbows at each end of and outside the boiler; these elbows, being on the outside of the boiler, are exposed to the gases from the furnace beneath it. Steam is passed into these tubes, becomes superheated by means of the elbows, and thus serves to raise the contents of the boiler to the requisite temperature; it then passes into the boiler, and is distributed by means of a pipe (provided with perforations) running the whole length of the boiler, its admission being controlled by a cock, while a waste-pipe serves for the disposal of any surplus. The fat to be treated is fed into the boiler from a tank placed about 6 ft. above it, being kept fused by a steam coil in the tank; on its way to the boiler the fat passes through a U-tube, the upper ends of which are about 6 ft. above the level of the liquid in the tank, while the lower end is exposed to the furnace gases; this arrangement serves to dry the grease. From the U-tube it passes into a worm placed inside the boiler, and finally is distributed by a perforated pipe. The steam and fat being thus intimately mixed, and their proportions and temperature easily controlled, react, and their products are led away to any suitable condensers. In order to obtain as regular a temperature as possible in the boiler, the furnace beneath it has its bed sloped from back to front, being 16 ins. from the boiler in front and only 8 in. at the back, and is suitably provided with dampers. The temperature in the boiler is ascertained by a thermometer at each end, and the height of the contents by a float. The process is continuous, and it is claimed that the yield of fatty acids is 94 per cent. of the fat used.—B. B.

Method of Manufacturing Soap free from Water. H. Wiesinger and L. Rissmüller, Hanover. Eng. Pat. 15,314, November 9, 1887. 6*d*.

Soap, prepared in the ordinary manner, is cut into bars, and then sliced into thin shavings by means of a planing machine. The shavings are spread in thin layers on galvanised wire netting stretched on wooden frames, which are arranged one above the other, with a space of about 2 ins. between them. The frames are placed in a drying-room, heated to about 40° C., for six hours (the low temperature being adopted to prevent the soap fusing in its own water), after which the temperature is raised to 70°—80° C., and the drying completed. The dry shavings are powdered, subjected to a pressure of 200 or 300 atmospheres in suitable moulds, during which process they shrink to about one-third of their previous bulk and then form a solid horn-like cake of anhydrous soap.

The grinding process is not absolutely necessary, but if dispensed with a much higher pressure is needed to agglomerate the dry shavings.

It is stated that the use of such soap free from water—which is often present in excessive quantities in ordinary soap—would be of great advantage to the consumer.—B. B.

Improved Apparatus for Expressing Oil from Substances. J. W. Lord, London. Eng. Pat. 15,490, November 12, 1887. 6*d*.

The patentee surrounds the press, which may be of any kind, with a jacket through which steam, superheated steam, or hot air, is passed.

A door is provided for the introduction of the material to be pressed, and a pipe at the lowest part leads away the oil.—B. B.

Improvements in the Treatment of Oils for their Purification. J. W. Lord, London. Eng. Pat. 15,491, November 12, 1887. 8*d*.

Oils possessed of strong and unpleasant odours, such as fish oils and cocoa-nut oil, are deodorised and purified by being driven through a worm tube, provided with perforated diaphragms at intervals, in company with hot water, in quantity preferably greater than that of the oil, and thence into a tank provided with an agitating screw. If time allow, water alone is used, but the settling is hastened by the addition of 1 per cent. of caustic soda and 0·5 per cent. of alum, together or separately, the oil being separated from the water in a settling tank, and thence run into a boiling vat, where it is heated to a temperature of at least 250° (*sic*), and finally into another settling tank, from which it is drawn off as required for use.

To raise the boiling point sufficiently, oil that has been previously boiled may be added.—B. B.

Improvements in or relating to Treating Crude Cotton-Seed Oil and to the Separation of Colouring-Matter therefrom. G. Tall, Chester, and W. P. Thompson, Liverpool. Eng. Pat. 15,647, November 15, 1887. 6*d*.

At present it is customary to remove the colouring-matter from crude cotton-seed oil by agitation with caustic soda; this reagent, however, causes the loss of 3 to 7·5 per cent. of oil which is retained in the mucilage. The patentees substitute normal sodium carbonate for the caustic soda, that being without action on the oil itself, though capable of extracting the colouring-matter. When the bulk of the colouring-matter has been dissolved out by this means, any remaining traces, together with a disagreeable taste which is apt to cling to the oil, are removed by treatment with Fuller's earth at 300°—350° F. The colouring-matter can afterwards be used as a dye either in the alkaline solution or after precipitation, preferably, with hydrochloric acid and re-solution in an alkaline menstruum. When exhausted the Fuller's earth can be regenerated by boiling with sodium carbonate, washing and drying at about 300°—400° F.
—B. B.

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* Actual value, 412·3.

† Recalculation gives 442·8.

XV.—AGRICULTURE, MANURES, Etc.

Relation of Atmospheric Nitrogen to Arable Soil. T. Schlösing, Berthelot, A. Gautier, and R. Drouin. Bied. Centr. **17**, 578—584.

Hitherto the question of the absorption of atmospheric nitrogen by soil has been decided by the difference in the quantity of nitrogen found in a soil before and after a certain period. Schlösing has now attacked this question in a different manner, using eudiometric methods of analysis (Compt. Rend. **106**, 805—809, 898—902). In these experiments the soil is placed in a flask, which is then completely filled with a measured quantity of air, free from ammonia and in which the nitrogen has been accurately determined; the open end of the flask is closed by means of mercury. From time to time pure oxygen is admitted to replace that used up by the oxidation of the organic matter in the soil, and arrangements are made for absorbing the carbonic acid produced. At the close of the experiments the volume of nitrogen is again accurately determined; the disappearance of nitrogen is, however, in all cases insignificant and scarcely exceeds experimental error. The greatest variation observed corresponded to an absorption of 1·6 kilo. of nitrogen per 4,000 tonnes of soil, or one hectare, to a depth of 0·3 m. during a period of 14 months; a quantity scarcely within the range of the ponderables of practice. Two poor and one rich sandy clay, a soil rich in lime, a very sandy soil, and kaolin were subjected to experiment. The quantity of oxygen used up in each case shows that the combustion of the organic matter takes place to a different degree in each soil; it is accompanied by the formation of nitric acid and the disappearance of ammonia. In order to set aside any objection which might be made to the use of mercury, Schlösing repeated his experiments with numerous soils in a modified apparatus from which mercury was excluded (Compt. Rend. **106**, 982—987), but with the same result. Therefore the absorption of nitrogen by soil cannot be detected by the most refined method of analysis. Berthelot (Compt. Rend. **106**, 1049—1055), on the basis of the conditions observed by him to be necessary for the absorption of nitrogen by the soil, takes exception to the following points in the above work:—The pressing together of the soil, the excessive moistening and warming of the soil to expel the air, as it must kill organism present in the soil. He moreover questions whether material, consisting mainly of coarse fragments of sand and chalk, can be considered a soil, and doubts the extreme accuracy of the gasometric method in this particular case. With regard to Boussingault's experiments referred to by Schlösing, he considers them quite out of the question, as they refer to rich soils experimented on with quite a different object in view. Finally Berthelot remarks that Schlösing does not absolutely deny the possibility of this fixation of nitrogen, but simply shows that his experiments do not support the view. As, however, the modes of experiment are not sufficiently in accord with those of Berthelot's, the latter continues to hold to his views in the matter, but brings forth no fresh evidence in support of them.

A. Gautier and R. Drouin made experiments with an artificial soil composed of 60 parts of sand washed with acids and water, and mixed with 5 per cent. of gelatinous silica; 30 parts of pure precipitated calcium carbonate; 10 parts of kaolin containing 0·007 per cent. of ferric oxide; and 3 parts of neutral potassium phosphate. This was manured with a nitrogenous compound. When this mixture was simply exposed from August 14 to October 31 a slight loss of nitrogen was observed, even when ferric oxide had been added; but where organic matter, consisting of washed charcoal and ulmin substances from cane sugar, was supplied, distinct fixing of nitrogen ensued. The results with and without vegetation (hog beans) are given in the table.

About a kilogramme of soil was used in these experiments. The authors also demonstrate that ammoniacal nitrogen is constantly being converted into organic nitrogen through the agency of lower organisms. They conclude that bare soil withdraws nitrogen from the air in considerable quantities, but organic matter is absolutely essential. Ferric oxide accelerates matters, and, moreover, the soil must have a good tilth and be permeable. In the above experiments the bare soil absorbed about 10 times more nitrogen than was obtained by Schlösing with his acidified water; hence it would appear that some other form of nitrogen besides ammonia is fixed by the soil (and also plants) from the atmosphere.

—D. A. L.

Character and Condition of Soil.		Total Nitrogen in Soil and Plants.	Nitrogen fixed by the Plants in Soil and Plants.
		Grm.	
The mixture	Bare soil.......	−0·0086	+0·1892
	Soil with plants	+0·1860	
With iron............	Bare soil.......	−0·0234	+0·1909
	Soil with plants	+0·1675	
With organic matter .	Bare soil.......	+0·1005	+0·1067
	Soil with plants	+0·2072	
With iron and organic matter.............	Bare soil.......	+0·1089	+0·1393
	Soil with plants	+0·2482	

Experimental Cultivation of Maize and Peas in Aqueous Nutritive Solutions. E. Heiden. Bied. Centr. **17**, 622—624.

These experiments were conducted in a greenhouse. The seeds were allowed first to germinate in distilled water or pure sand, and as soon as they had good roots and stems they were transferred to glass vessels, containing in one series Nobbe's normal nutritive solution, in the other series, nutritive solutions deficient in one of the following constituents: nitrogen, phosphorus, sulphur, chlorine, potash, soda, lime, magnesia, and iron; the object being to show the relative importance of the individual substances for the development of the plant. Five plants were placed in each vessel on the 20th of June. Some of the observed results were as follows:—

Character of Solution.	Peas.		Maize.	
	Extent of Vegetation.	Mean Height of Plant.	Extent of Vegetation.	Mean Height.
Normal solution.	Blossomed, &c.	cm. 97	.. .. ..	cm. 100
Without—				
Lime	July 21	21	July 21	18·9
Magnesia	August 15.....	44	Aug. 27, Sept. 9 and 20.	30
Nitrogen	Aug. 8 and 15 .	51	End of Sept...	32
Potash........	End of August to beginning of Sept.	45	Latter half of August.	28
Phosphoric acid	Mid. of August	63	July 21 and beginning of Sept.	24
Iron	End of Aug. (colour pale).	..	End of August (colour pale).	..

From these results lime appears to be the most necessary constituent for both plants. Lupins could not be cultivated in this manner.—D. A. L.

On the Occurrence of Solid Hydrocarbons in Plants. H. C. S. Abbot and H. Trimble. Ber. **21**, 2598—2599.

If certain plants be extracted with petroleum-naphtha, the extracts yield crystalline compounds about which very little is known. *Cascara Amarga* extract gave a substance which proved to be a mixture of several compounds. After the removal of fats and colouring-matter the substance was recrystallised from boiling absolute alcohol. By means of fractional crystallisation three compounds were obtained, one of which was examined closely. It fused at 196·2°—196·4° C., and at a higher temperature was decomposed, giving off a smell resembling sandal-wood. It dissolved in most solvents, from which it readily crystallised in long silky needles. An elementary analysis showed C = 87·89 per cent., H = 11·90 per cent. *Phlox Carolina*, treated in the same manner, yielded a crystalline matter, containing C = 87·90 per cent., H = 12·02 per cent. The composition of the two hydrocarbons well agrees with the formula $(C_{11}H_{18})x$.—S. H.

Treatment of Black Rot in Vines. Prillieux. Compt. Rend. **107**, 355—357.

The most effectual application of several that were tried in the vineyard of M. Despeyroux, at Aiguillon, proved to be the "*bouillie bordelaise*," made by adding six parts of copper sulphate and six parts of lime to 100 parts of water. This was applied four times, viz., on May 22nd, June 22nd, July 2nd, and July 19th. In the untreated rows almost all the grapes were destroyed by the black rot, whereas in the rows treated with the above application 75—86 per cent. remained sound. The other substances tried were "*eau céleste*," copper sulphate solution, sulphosteatite powder, powdered copper sulphate, and "*Carrère*" powder. None of these produced more than slight effects.—J. M. H. M.

The Fixation of Atmospheric Nitrogen by Leguminous Plants whose Roots bear Nodosities. E. Bréal. Compt. Rend. **107**, 397—399.

The author has inoculated various leguminous plants with the juice of the crushed tubercules of Lucerne grass, with the result that the inoculated plant in every case bore tubercules on its roots. This juice when examined under the microscope was found to contain in suspension a number of rounded, highly-refracting grains, mixed with moving filaments resembling some species of bacteria.

Peas grown in water containing potassium chloride, calcium phosphate, and some of the juice above mentioned, were dried and analysed after the fiftieth day of their growth. They contained :—

——	Dry Substance.	Nitrogen.	Nitrogen per 100 parts Dry Matter.
	Grms.	Grms.	Per Cent.
Tubercules and adhering rootlets	0·990	0·0266	2·68
Roots	0·725	0·0150	2·07
Stalks and leaves	2·475	0·0540	2·20
Entire plant	4·190	0·0956	..
Original pea	1·255	0·0460	3·70
Gain	2·935	0·0396	..

In the case of lupins grown in sand, the inoculated plant after 45 days' growth contained $2\frac{1}{2}$ times as much nitrogen as the original seed, while the plant not inoculated was stationary as regards the percentage of nitrogen. Inoculated peas grown for 50 days in sand multiplied their dry matter 38 times and their nitrogen 25 times.—H. T. P.

The Treatment of the Potato Disease. Prillieux. Compt. Rend. **107**, 447—449.

Nine plants sprayed with the "*bouillie bordelaise*" (sulphate of copper 6 parts, lime 6 parts, water 100) on August 5, gave 115 sound potatoes and no diseased ones. Six adjacent plants not treated gave 53 sound and 17 diseased tubers.—J. M. H. M.

The Vine in France. A. Chatin. Compt. Rend. **107**, 488—490.

The author calls attention to the vineyard of M. Desbois, of Meyzieux (Isère), the vines in which have acquired vigour enough to withstand successfully the depredations of phylloxera, mildew (*Peronospora viticola*), and black rot in even the exceptionally bad season of 1887. The system pursued comprises triennial pruning of the long wood, with previous pinching out or disbudding, and the use of powerful manures supplying phosphoric acid, nitrogen, potash and lime.—J. M. H. M.

The Manurial Value and the Rational Employment of Thomas-slag as compared with Superphosphate, Bone-Meal, Raw Peru Guano, and Coprolite Meal. P. Wagner. Chem. Zeit. Rep. **12**, 222.

The author finds, as regards clayey soil, that in the case of Thomas-phosphate meal, the phosphoric acid is approximately of half the value of water soluble phosphoric acid. It is therefore profitable to buy P_2O_5 in the form of Thomas slag when it can be obtained at somewhat less than half the price of P_2O_5 in superphosphate. Experiments have shown also, that, when using equal quantities of phosphoric acid, during the first two years after manuring, for every 100 parts of Thomas-phosphoric acid, only about 60 parts of the P_2O_5 in raw Peruvian guano, and only 40 parts of the P_2O_5 in bone-meal were assimilated by the plants. It follows from this, that if the P_2O_5 of bone-meal and of raw Peruvian guano be *dearer* than Thomas-phosphoric acid, it is not rational to prefer them to Thomas-phosphate meal.

On the Influence which the Sterilising of the Soil exerts on Plant Development. Frank. Chem. Zeit. **12**, 1340.

In order to settle the question of the relation of the lower organisms to certain properties and action of the soil, *e.g.*, the nitrification of the ammonia or fruitfulness with regard to the development of plants, different investigators have employed the method of sterilisation of the soil, believing that the special effects following this treatment with steam at 100°, whereby the lower organisms are killed, as compared with those with untreated soil, will elucidate the question of the part played by the lower organisms. Laurent and Hellriegel have observed a weaker plant-development in sterilised soil. The author tried to discover if different kinds of soil in sterilised and unsterilised condition exhibit similar differences in their action on plant life. In perfectly similar cultures with sterilised and unsterilised soils it was found, to begin with, that those rich in humus always showed greater fruitfulness in the sterilised state. Those soils almost devoid of humus, on the contrary, showed other results. Whilst such soil in the normal condition was tolerably fruitful for lupins, after sterilising it suffered considerable reduction in this quality; but no special change in this condition was wrought by inoculating with unsterilised sand or garden soil. Oats showed more vigorous development in the sterilised sandy soil, and in their case an inoculation with unsterilised soil produced no perceptible difference. These observations go to show, it is argued, that the differences specified are not the result of micro-organisms. But it is admitted as doubtful if steaming at 100° does really effect destruction of the organisms, but that other properties are acquired, is proved by the surprising fact that almost uniformly, on sterilised soils, especially on those of humus character, and when freely exposed to the air, a peculiar fungus, *Pyronema Marianum Carus* (*Peziza confluens Pers*), appears in the form of a bright red excrescence, never showing itself, however, on the neighbouring unsterilised soil. This growth flourishes only on places formerly covered by Meilers and similar arrangements, in which fires have been burnt. The spores of this fungus are destroyed by boiling, consequently they could not have *remained* in the sterilised soil, but must have been carried there from the atmosphere, and only have found in the sterilised soil the special conditions suitable for their development and growth. It was discovered, further, that the sterilising action of steam achieved chemical alterations in the soil, such as the alteration of otherwise insoluble matters, in such wise that, on treatment with water, the sterilised soil yielded more dissolved constituents than the unsterilised. Both organic and inorganic matters were thus rendered more soluble. Hence we have here an action distinctly more favourable to plant growth in the sterilised soil; and the argument as to difference of action being solely attributable to destruction of the germs of micro-organisms must fall to the ground.—W. S.

On the Nitrogenous Algæ of Arable Soil. Frank. Chem. Zeit. 12, 1341.

The author has shown that free nitrogen becomes combined nitrogen not only in the cultivation of leguminous plants, but also in that of other species, although not in so considerable a degree. He also confirms Berthelot's observation of the enrichment with nitrogen of soils devoid of humus, these soils being exposed, though bare of vegetation, to the action of air and light. The explanation was afforded after a microscopic examination of the soil, when it was discovered that the advent and increase of nitrogen were due to the action of a freshly-introduced microscopic form of algæ, and not fungoid growth, as at first surmised. These algæ are of a kind the cells of which contain plasmic matter very rich in nitrogen.

The inquiry next advanced and examined was whether such algæ are peculiar to a special case or cases or are universal, and the latter supposition was confirmed as fact.

Immediately after tilling the soil, the surface layer does not exhibit at first any of these cryptogams, but after remaining at rest a sufficiently long time a lively growth of algæ takes place in the upper layer exposed to the light, which increases further the longer the soil remains at rest. The algæ discovered in the soil coincided with those forms which the author had found in the case of his experiments on the small scale in land devoid of vegetation. They are in part Phycochromaceæ, and especially different forms of Oscillaria, partly Chlorophyllaceæ. The germs of these algæ contained in soil are easily discovered when small quantities of the earth moistened with pure water are brought into a flask stoppered with a plug of cotton-wool, and thus let stand a week or two exposed to the light. The algæ then appear in the form of green or dirty-green specks, gradually joining one another to form a connected layer. By inoculation the algæ can be transferred, and obtained pure. Similar cultivations with sterilised soil yielded no development of algæ, and no development ensued when the non-sterilised soil was kept in the dark. From a basis of such experiments and reasoning, it is easy to understand, the author concludes, that what was first sterile rock in some now colonised parts of the earth of insular character, gradually became luxuriant with vegetation.—W. S.

The Occurrence and Distribution of Tannin in Plants. E. Wagner. Chem. Centr. 1888, 252.

In the plants investigated (*Crassulaceæ*), tannin was only found dissolved in the parenchymatous tissue cells. The principal tissues yielding tannin are the epidermis and the ground and other tissues in its immediate proximity. The cells containing tannin are pale in colour, which is frequently quite transitory; they store up little or no starch, and in most cases the chlorophyll granules and calcium oxalate crystals in them are smaller in size and fewer in number than in the cells destitute of tannin. These experiments have not yet elucidated the function of tannin and its distribution within the plant.—D. A. L.

Cultivation, Treatment, and Composition of Japanese Tobacco. M. Fesca and H. Imai. Landw. Jahrbücher, 1888, 329—372.

The present inquiry relates more especially to the district Oyamada, in Tochigi-Ken. The soils there are tertiary and paleozoic, the former being more suitable for tobacco growth; the best soil for the purpose in the district contained 16·3 per cent. of stones, 10·9 per cent. of coarse earth, and 72·8 per cent. of fine mould. The fine mould dried at 105° had the following percentage composition:—Hygroscopic water, 3·83; loss on ignition, 6·55; humus carbon, 5·92; insoluble in hydrochloric acid, 62·99; soluble silica, 15·92; alumina, 9·56; Fe_2O_3, 3·86; Mn_2O_3, 0·10; CaO, 0·20; MgO, 1·25; K_2O, 0·14; Na_2O, 0·17; P_2O_5, 0·04; SO_3, 0·01. Porosity and a certain amount of humus are more important than a high percentage of nutritive matter in the soils for tobacco culture. In Japan the manner of cultivation and manuring is peculiar, and details are given in the paper. The seeds, mixed with wood ashes, are sown broadcast in a specially prepared bed, dressed with human excrement and wood ashes, harrowed in, and covered with twigs to protect from cold; when the plants have four or five leaves they are thinned, and in wet weather dressed with horse urine, but in dry weather with water from baths containing 1 per cent. of human urine; later on they are transplanted into ridges in a field, about 4,000 plants being allowed per hectare. In 10 days they receive a dressing of a mixture of stable manure, sewage, and straw ash, and in another 10 days a smaller dressing of a somewhat similar mixture, the manure in each case being mixed in with the soil, and followed by the application of water from baths containing sewage. The plant goes through other operations of cultivation, and ultimately the various leaves are gathered at different periods, according to their position on the stem, which also determines their quality, the middle leaves being the best. The authors calculate that the manure applied amounts to 64·8 of N, 115 of K_2O, 97·5 of CaO, 41·2 of P_2O_5, and 37·5 of Cl, respectively, in kilos. per hectare; and that a harvest of 1,000 kilos. of tobacco per hectare removes from the soil 16·7 kilos. of N, 47·3 of K_2O, 56·7 of CaO, and 6·8 of P_2O_5. The residual nutrition in the soil serves for the grain crop, which follows the tobacco in Japan.

The results of the analyses of various tobaccos cultivated in this manner are given in the table on page 760, in percentages of the dry substance free from sand.

The following points should be remembered when examining tobaccos:—The quantity of nicotine may be considered as bearing the same relation to tobacco as the percentage of alcohol does to spirituous liquors; but as yet a high percentage of nicotine has not been shown to be an indication of the good quality of tobacco. Nitric acid should not be found in well-fermented tobaccos. Ammonia determinations are frequently too high as they include some amido-nitrogen. A tenth per cent. or so of ammonia does not seem to lower the quality of the tobacco. The quantity of albuminoids present in a tobacco affords no indication of quality unless the proportion of amides is simultaneously considered. The amido-nitrogen represents for the most part harmless or perhaps even beneficial nitrogenous compounds in tobaccos. It is possible that a further study of these bodies and their decompositions will reveal the presence of bodies exercising a direct influence on the quality of tobacco. Anyway the conversion of albuminoids into amides is one of the most important results of the fermentation. Ordinary fat determinations, or rather extracts, are of no use in tobacco analysis. Carbohydrates should not be present in well-fermented tobacco, but a study of the changes they undergo would doubtless be of great value in connexion with tobacco. Only considerable differences in the amount of the various constituents of tobacco can give any conclusive indication of the quality of a tobacco. Very bad tobaccos always contain much albuminoid matter, sulphuric acid, chlorine, and especially large quantities of mineral acids with small proportion of amido-nitrogen, potash, &c. It is not safe to judge a tobacco from one constituent or group of constituents; as a rule the alkali-character of the composition should be ascertained to be favourable or otherwise. By the present methods of analysis it is easier to recognise a bad tobacco than one of good quality. In connexion with the influence of botanical character the authors have only observed that

——	Havanna (*N. macrophylla*).	Oyamada (*N. rustica*) Ordinary.	Oyamada (*N. rustica*) Curly-leafed.	Oyamada (*N. rustica*) Long-stalked.	Kentucky (*N. tabacum*).	Florida (*N. tabacum*).	Connecticut (*N. tabacum*).	Russian (*N. macrophylla*).
Total nitrogen	1·473	1·573	1·689	1·459	1·296	1·306	1·412	1·348
Nicotine	2 632	3·653	2·958	4·090	3·496	2·902	2·914	2 678
Albuminoids	2·690	2·430	3·210	0·689	2·040	3·040	3·620	2·940
Amido nitrogen	0·588	0·553	0·674	0·602	0·346	0·317	0·329	0·415
Crude fat	12·320	14·440	11·740	12·580	10·340	12·000	11·760	11·800
Crude fibre	13·250	13·710	13 890	13·930	15·500	14·750	14·630	13·170
Total carbonic anhydride	4·067	4·721	3·721	3·717	3·998	3·688	3·622	4·279
Soluble carbonic anhydride	0·393	0·528	0·522	0·358	0·434	0·345	0·569	0·347
Insoluble carbonic anhydride	3·674	4·193	3·199	3·359	3·564	3·343	3·053	3·932
Pure ash..............	13·831	12·662	10·677	12·382	11·091	14·935	12·323	14·636
Potash.................	3·917	3·866	3·682	3·140	3·263	4·730	4·715	4·425
Soda	0·310	0·186	0·154	0·232	0·130	0·157	0·077	0·379
Lime	6·147	5·364	3·706	4·959	4·626	5·675	4·769	0·554
Magnesia	1·523	1·230	0·964	1·379	1·143	1·433	1·176	1·408
Ferric oxide	0·356	0·293	0·296	0·183	0·332	0·375	0·235	0·304
Phosphoric acid	0·678	0·531	0·411	0·255	0·444	0·559	0·383	0·601
Sulphuric acid	0·307	0·649	0·687	0·885	0·268	1·028	0·319	1·120
Silica	0·389	0·514	0·455	0·362	0·454	0·367	0·387	0·457
Chlorine	0·635	0·134	0·378	0·940	0·527	0·309	0·491	0·326
Per cent., air-dried tobacco:—								
Sand................	1·51	1·91	1·74	1·02	1·25	1·40	1·76	1·30
Hygroscopic water..	11·64	11·17	12·21	11·52	8·39	11·28	8·79	8·73
Per cent., total nitrogen:—								
As nicotine nitrogen	30·9	40·1	29·7	48·6	46·8	38·6	35·8	34·3
As amido nitrogen ..	39·9	35·2	39·9	41·3	26·8	24·3	23·2	30·8
As albuminoid nitrogen	29·2	24·7	30·3	9·6	26·2	37·3	40·0	36·1

the variety *Nicotiana tabacum* has a lower percentage of total leaf surface and a higher percentage of crude fibre than the other varieties of tobacco examined.

The authors have made a detailed investigation into the distribution of individual bases and inorganic acids in the different tobaccos, and have come to the following conclusions. Bases, particularly potash and lime, in medium quantity, are favourable to the good quality, and especially the combustibility of tobacco. An excess of either of these bases over a liberal mean percentage is neither a sign of good quality nor combustibility, and only an exceptionally low percentage of either of them can be regarded with certainty as a bad sign. Very high magnesia is prejudicial to the combustibility. Mineral acids in large quantities indicate both bad combustibility and quality; but only a very high proportion of an individual acid can be safely considered a decidedly bad indication. The combustibility is influenced to the greatest extent by the quantity of sulphuric acid present, and in a diminishing degree by the percentages of chlorine, phosphoric acid and silica in the tobacco. The percentage of soluble carbonates appears to have no important influence on the quality and combustibility of tobacco; the influence of the total quantity of carbonates in the ash is much greater, but even in this there is a maximum beyond which the percentage of carbonic anhydride in the ash cannot be regarded as indicating increase of combustibility. The relation of carbonates to the mineral acids is a much more important factor, a large preponderance of the former being a favourable sign. High basicity of ash is an excellent indication of good combustibility, especially when not due either entirely, or to a great extent, to magnesia or iron.—D. A. L.

The Nitrification of Ammonia Salts in Soils. H. Landolt.

Deutsche Landw. Presse **15**, 135—136.

With a view to refuting statements made by Frank in connexion with H. Plath's experiments on the nitrification of ammonia and its salts, the author, in conjunction with Plath, has repeated the experiments, including in the inquiry the following points:—The proof of the existence of nitrates and nitric acids in the air; of the complete removal of these impurities by passing the air through concentrated sulphuric acid and caustic soda; of the inability to produce even traces of nitrogen oxides by passing air, purified in this manner, over sterilised calcium carbonate, even when the latter was in contact with ammonium sulphate; of the nitrification of added ammonia salts in non-sterilised samples of clay-marls and loam-marls, and the absence of such nitrification in the same soils sterilised, or ignited and neutralised with either an aqueous solution of carbonic acid or phosphoric acid free from nitric acid. These points have all been confirmed, and, therefore, one thing is certain, that the inorganic constituents of a soil do not produce nitrification, and consequently it must originate from some other source.
—D. A. L.

PATENT.

Improvements in the Manufacture of Manure. B. Piffard, Hemel Hempstead. Eng. Pat. 9750, July 4, 1888. 4*d.*

Flints, or other siliceous materials, are finely pulverised and mixed with lime, the hydrate, chloride, or carbonate of lime, or other alkaline carbonates or sulphates, preferably in the proportion of three of siliceous material to one of the other material. Two per cent. of lamp black is added to serve as an indicator, by colouring the whole a uniform grey when mixture is perfect.—A. G. B.

XVI.—SUGAR, STARCH, GUM, Etc.

The Estimation of Saccharose, Invert Sugar, and Raffinose by the Copper Method. Preuss. Zeits. f. Zuckerind. 1888, 722.

The cane sugar used was inverted by dissolving 9·5 grms. in 700 cc. of hot water, digesting for half-hour with 100 cc. of $\frac{N}{5}$ HCl, neutralising with $NaHCO_3$, cooling to 20° C., and diluting to 1 litre. In performing the gravimetric Fehling test, the mixture was boiled for 15 minutes.

The following relation was found to exist between the copper found and the invert sugar taken for analysis:—

$$Y = 8{\cdot}368537 + 0{\cdot}55346\,X + 0{\cdot}00003216\,X^2;$$

Where X = copper found (mgrms.), Y = invert sugar taken.

When the time of boiling was reduced to three minutes, the following results were obtained:—

X	40	50	60	70	80	90	100
Y	79·7	99·3	119·5	139·3	158·9	178·2	197·3
X	110	120	130	140	150	160	170
Y	216·1	234·6	252·9	279·9	288·8	306·1	323·3

X = Cane sugar taken (mgrms.). Y = Copper found (mgrms.).

When estimating invert in presence of cane sugar, a special table is necessary. Ten grms. of substance to be taken for analysis and the time of boiling two minutes. The following relation exists between the invert sugar taken and copper found:—

$$Y = 23{\cdot}4212 + 2{\cdot}06954\,X - 0{\cdot}0010857\,X^2.$$

The reducing power of dry raffinose is given by the following equation (inversion in seven minutes and three minutes boil):—

$$Y = 5{\cdot}5396 + 1{\cdot}363\,X + 0{\cdot}00005137\,X^2.$$

Where Y = mgrms. of copper; X = mgrms. of raffinose.

—H. T. P.

The Estimation of Cane Sugar in Presence of Invert Sugar or Raffinose. Dammüller. Zeits. f. Zuckerind. 1888, 742.

One half the normal weight of sugar is dissolved in 75 cc. of water, 5 cc. of 38 per cent. hydrochloric acid added, and the mixture heated for $7\frac{1}{2}$ mts. in a water-bath kept at 67°—70° C., cooled, diluted to 100 cc., and observed in a 200 mm. jacketed tube at 20° C. The percentage of cane sugar may be calculated by Clerget's modified formula:—

$$Z = \frac{100\ S}{142{\cdot}66 - 0{\cdot}5\ t}$$

Z = per cent. cane sugar.

S = algebraical difference of readings before and after inversion.

t = temperature in degrees centigrade.

In presence of raffinose, the following formula must be used:—

$$Z = \frac{0{\cdot}5188\ P - J}{0{\cdot}8454};\ R = \frac{P - J}{1{\cdot}85};$$

Z = per cent. cane sugar.

R = per cent. raffinose.

P = polarimetric reading for the whole normal weight before inversion.

J = polarimetric reading for the whole normal weight after inversion.

—H. T. P.

Constituents of Sugar Cane. Winter. Zeits. f. Zuckerind. 1888, 780.

Normal ripe sugar cane contains neither levulose nor invert sugar. The leaves also contain no levulose, but glucose and saccharose. The assumption that cane sugar is formed from glucose and levulose can therefore no longer be allowed. Amongst organic acids, malic, succinic, glucinic, and apoglucinic acids were found in sugar cane; tartaric, oxalic, citric, and aconitic acids were absent. Pectin and metapectin were present, but no asparaginic or metapectic acid. The crude syrup contained considerable quantities of phosphoric acid and silicates of the alkalis. In the *masse-cuite* a gum was sometimes found, which is possibly identical with Scheibler's dextrane.

The method employed by the author for separating different kinds of sugar consists in precipitating the latter with ammoniacal lead acetate. The freshly-prepared compound is treated with water and filtered, the lead separated from the cane sugar by passing CO_2 into the solution, while the portion insoluble in water is suspended in water and also treated with CO_2. In this case only the lead-glucose compound is decomposed. The filtrate therefore contains the glucose; the residue consists of the lead levulose compound. This is washed, suspended in water, decomposed with H_2S, and the levulose is thus obtained in the filtrate.

—A. R.

Levulose. E. Jungfleisch and L. Grimbert. Compt. Rend. **107**, 390—393.

The authors have studied the influence of various experimental conditions on the specific rotary power of levulose. The rotary power of freshly-prepared solutions of levulose is greater than that of solutions which have been kept some time. For example, a solution of levulose containing 9·75 grms. per 100 cc. gave, 35 minutes after its preparation, $(\alpha)_D = -97^\circ{\cdot}33$ at 7° C; after 55 minutes, $(\alpha)_D = -96^\circ{\cdot}11$; after 1 hour 15 minutes, $(\alpha)_D = -95^\circ{\cdot}11$; and after 1 hour 45 minutes, $(\alpha)_D = -94^\circ{\cdot}77$; after which it remained constant. Solutions of levulose must be prepared at a temperature not exceeding 40° C., as appreciable traces of levulose are destroyed at higher temperatures. The specific rotary power of levulose diminishes by 0°·56 for every 1° C. increase of temperature. The specific rotary power of levulose in solution may be calculated by means of the following formula:—

$$(\alpha)_D = -101^\circ{\cdot}38 - 0{\cdot}56\,t + 0{\cdot}108\,(p - 10)$$

Where t = temperature. p = concentration.

This formula is applicable to temperatures between 0° and 40° C. with concentrations less than 40 grms. per 100 cc.

—H. T. P.

XVII.—BREWING, WINES, SPIRITS, Etc.

Influence of the Temperature of Fermentation on the Production of Higher Alcohols. M. L. Lindet. Bull. Soc. Chim. **50**, 164—167.

A number of experiments were carried out with a view to determine whether, during the fermentation of the beer wort, the temperature had any influence on the amount of higher alcohols produced thereby. A beer wort of constant composition was prepared and the same yeast employed, the only variation allowed being the difference in the temperature, which ranged from 8° to 35°.

The results tend to show a slight increase in the amount of higher alcohols produced by fermentation at the higher temperatures, but the differences are but nominal.—J. W. L.

A New Process for purifying Spirituous Liquids, especially Brandy. J. Traube. Zeits. f. Spiritusind. **11**, 201.

The method consists essentially in treating the crude spirit with a concentrated salt solution, preferably potassium carbonate, when two layers are formed, the upper one containing almost all the fusel oil and first runnings. This upper layer is run off, and, on simple distillation of the residue without a column, a very pure product is obtained. A great saving is effected in several ways by this process.

—O. H.

Improvements in the Manufacture of Spirit. Dingl. Polyt. J. **269**, 425—427.

Wepper and *Lüders* (Zeits. f. Spiritusind. **11**, 34) point out that the cadmium chloride test for the pyridine bases is very unreliable, owing to the varying composition of commercial cadmium chloride. Of two samples of cadmium chloride, one gave the reaction and the other did not, with the same sample of pyridine. Neither of the two samples had the composition represented by one of the formulæ—

$$CdCl_2 . 2\,H_2O \text{ or } CdCl_2.$$

They contained :—

(*a.*) $Cl = 37\cdot58$ per cent., $H_2O = 11\cdot32$ per cent. ; and
(*b.*) $Cl = 36\cdot63$ per cent., $H_2O = 9\cdot17$ per cent.

$CdCl_2$ contains 38·8 per cent. chlorine, while $CdCl_2.2\,H_2O$ contains 16·44 per cent. H_2O. Both samples were acid, *a* more than *b* ; otherwise they were pure. The authors recommend the use of a stronger solution of the pyridine bases when performing the test.

α-Hydroxynaphthoic acid as an Antiseptic. Experiments made by *Magerstein* (Oester. Ung. Brennerei. Zeit. **12**, 5) with sugar solutions to which yeast had been added, show that the antiseptic action of α-hydroxynaphthoic acid is about five times greater than that of salicylic acid.

Lanson has detected iso-butyleneglycol in the products of the alcoholic fermentation (La Sucrerie indigène, No. 5). The author finds that 60·8 grms. of this body are formed for every 100 kilos. of sugar fermented.—H. T. P.

The Plastering of Wine in France. Report of United States Commercial Agent at Limoges. Board of Trade J. 1888, 439.

There is now being discussed before the Academy of Medicine at Paris a question of great importance to all wine merchants and exporters, viz., whether the plastering of wine is injurious to public health or not ?

This practice of plastering wines, or adding sulphate of lime, is very ancient ; it is unknown when or where it originated, but for the last 25 years it has been a subject of dispute among the highest hygienic authorities, wine growers, and merchants in France ; at times its use has been condemned and again permitted.

Since the production of wine in the celebrated district has fallen off, through the ravages of phylloxera and cryptogenous diseases, the less noted wine of the central departments of France has been brought into greater requisition. These wines differ materially from the famous growth of Bordeaux and Burgundy districts, and as they are replacing these more renowned varieties special attention is being given to them—the merchants who buy them for home use or exportation are doing their best to make them as agreeable as possible, to take the place of their illustrious neighbours, and in order to accomplish this recourse is had to plastering.

The sulphate of lime is added after the first fermentation, or while the wine is in the vat, and it is also mixed with the grape must. This last process has for its object the rendering soluble the different elements of the wine. The general rule is to put 500 grms. to the hectolitre of wine, but the greater number of wine-makers throw it in without weighing. The advantages said to be gained by the use of sulphate of lime are these : Fermentation is increased very much ; is more rapid and complete ; the colour is brighter and more permanent ; and the wine will keep for a much longer period. For the wholesale dealer this greatly enhances the value of the wine, but the questions to be considered are these : Does the addition of sulphate of lime in any way render wine injurious to health, and what are the chemical changes caused by this plastering ? Ordinary wine in its normal condition contains a certain amount of the bitartrate of potash ; this readily acts on the sulphate of lime and forms an acid sulphate of potash, and there is precipitated an insoluble bitartrate of lime, varying according to the degree of alcohol, the wine dissolving a portion of the sulphate of lime. Natural wine contains at the maximum about 0·5 grm. of sulphate of potash per litre. This quantity is increased to from five to ten times that amount by the action of the sulphate of lime, and at the same time the proportion of the bitartrate of potash diminishes to such a degree that it may be said to be substituted by the acid sulphate of potash. Finally, in wine treated with sulphate of lime, sulphuric acid is found in a free state ; also sulphate of magnesia. Have not these serious alterations in the mineral constituents a bad effect on the health of the consumer ? Twenty-five years ago this question was propounded and is not settled yet, and at present is being discussed by the hygienic committee of the Academy of Medicine on behalf of the French Government.

It is held to be an incontestable fact that plastered wines have occasioned functional troubles and organic injuries, as all familiar with medical science know that a solution of acid sulphate of potash, in which sulphuric acid is in a free state, acts as a purgative and a caustic in certain cases ; as regards the abolition of plastering, the hygienic committee is not unanimous in its opinion. It is considered, however, that a moderate plastering is necessary for the utilisation, preservation, and transportation of a certain class of the poorer grades of wine, whose loss would be a disastrous thing for the wine-growers. But they should continue the practice so that the proportion of acid sulphate does not exceed 2 grms. per litre, this proportion being sufficient to obtain all the commercial advantages for which the wine is used. This, in effect the declaration of 1880 by the same committee, and which the said committee now recommends as its unanimous opinion, should be rigorously enforced.—J. H.

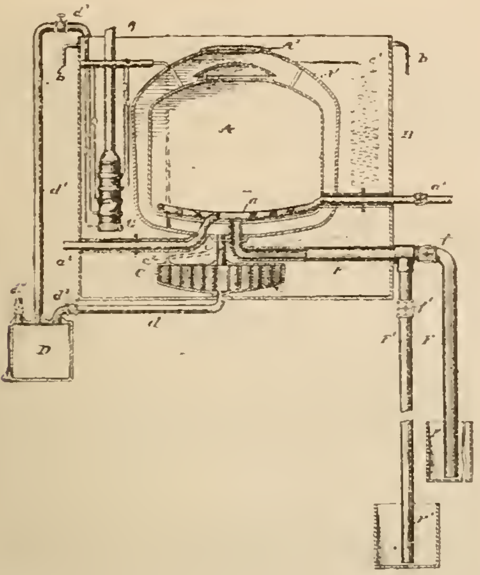
PATENTS.

New or Improved Process and Apparatus for obtaining a Continuous and Determined Quantity of Carbonic Acid or other Gas, especially applicable for making Aërated Water and for raising Liquids. L. & C. Guéret, Paris, France. Eng. Pat. 14,927, November 2, 1887. 8*d.*

The apparatus appears to be specially designed for raising beer by gas pressure. Carbonic acid is generated in the usual manner and the gas-escape pipe shut off until a certain pressure is attained in the apparatus. The latter is then connected with a beer barrel, and when a certain quantity of beer is withdrawn from the barrel the pressure in the producer sinks for a moment, but is soon established again by the acid flowing automatically on the carbonate, and thus generating a new quantity of gas.—S. H.

A Process of and Apparatus for Distilling Alcohol from Wine, Cider, or other Fermented Fruit Juices. W. L. Horne, Connecticut, U.S.A. Eng. Pat. 9658, July 3, 1888. 8*d*.

This invention relates to the distillation of alcoholic liquids in vacuo, and at such a temperature as will not kill the yeast which is present, and so as to permit the residue deprived of its alcohol to undergo a further fermentation. For this purpose a still of special construction is employed, as shown in drawing.



A, still; A′, condenser; B, tank in which both these vessels are suspended; C, receptacle to receive distillate, and containing within it a partition, c', composed of concentric rings with openings therein, forming a tortuous passage from centre to circumference; D, final distillate tank connected with C by pipe d; F, pipe supplying the still A with liquor from tank E; F′, pipe to convey residual liquor after distillation to tank E′; G, hydraulic vacuum pump; g, water inlet to pump; a is a coil of steam pipe within the still for supplying such heat as may be required, a' being inlet pipe and a^2 outlet pipe. The operation of distilling is performed as follows:—On starting, the still, condenser, and their connexions are full of air. The pump is set in operation removing the air and filling the tank B with liquid. As soon as the air has been exhausted, the cock f in the pipe F is opened, and the still supplied with the required amount of liquor to be operated upon. The cock f is then closed, and the evaporation begins, the vapour rising through the opening in top of still, and coming in contact with the walls of condenser, is more or less condensed, the condensed liquor flowing down into the bottom of the condenser and into tank C, and is thence drawn by pump through the helical passage in tank C, any residual vapour by this means becoming further condensed. As soon as the evaporation of the liquid within the still has continued long enough to lower the temperature of the said liquid and still, it is raised to a normal temperature by passing a heated medium through the coil a.

The connexions with the final distillate tank with the pump g being open at the start, a vacuum will also be formed therein, and the distillate as it accumulates in the tank C will flow into the tank D, from which it is taken at any time by closing the cocks d^2, d^3, and opening the cock d^4.—J. H.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

Detection of Olive Seed Husk in Pepper. M. Gillet. Bull. Soc. Chim. **50**, 173—174.

The husk of olive seed is coloured bright yellow by alcoholic iodine, whereas pepper is coloured brown by the same reagent

The iodine solution employed is 5 per cent., of which 1 cc. is added to 1 grm. of the pepper. In applying the method, prepared mixtures of pepper and olive seed are coloured with the reagent, and the sample under investigation is compared with them after treatment in a similar manner. According to the author's experiments, 20 per cent. of the adulterant may be detected by this means.
—J. W. L.

PATENT.

Process of Preserving Meat and other Food Articles. B. Willcox, London. From H. Salzer, Baltimore, U.S.A. Eng. Pat. 7535, May 22, 1888. 6*d*.

The meat or other article is enclosed in an expansible envelope, preferably some animal membrane (previously disinfected), and then steamed for about 30 minutes, to kill organisms and to cause the article to shrink; a coating of plaster of Paris is then immediately applied, and when this has become dry and hard, the whole is immersed in a heated bath of vaselin, to which is added two or three per cent. of paraffin, in order to render the substance firm and coherent when it cools. The plaster of Paris absorbs the melted vaselin and paraffin.

The disadvantages of the older method of simple immersion in pure melted paraffin are that the pure paraffin invariably cracks on cooling, and becomes permeable; attempts to overcome this by an additional coating of gelatin mixed with glycerin failed; moreover such a mixture is the food of certain powerful species of bacilli, and certainly not a germicide or germifuge. In the above method these objections are overcome.—A. G. B.

(*B*)—SANITARY CHEMISTRY.

PATENTS.

A New System of Sewage Disposal. T. Glennie, Glasgow. Eng. Pat. 14,656, October 28, 1887. 8*d*.

This system consists of placing a portable cesspool box and filter between the house drains and the sewage conduit-pipes. The boxes are adapted for rapid removal and change, and serve to filter and purify the effluent water; they are carried to a distance, and all nuisance thus avoided when they are emptied. Charcoal or earth may be the filtering material.—A. G. B.

The Treatment of Alkali Waste for Use in the Purification and Deodorisation of Sewage and Impure Waters or Matters. J. Hanson, Wakefield. Eng. Pat. 14,997, November 3, 1887. 6*d*.

For the above purpose the alkali waste is submitted to intimate contact with oxygen, by grinding it and exposing to the action of the air; or in place of or in addition to the oxidation, it may be submitted to the action of sulphurous acid gas, produced by the action of hydrochloric acid on partially oxidised waste.—A. G. B.

Improvements in Sterilising Atmospheric Air for Use in connection with the Purification of Water and Improvements in the Purification of Water and Apparatus for those Purposes. A. Angell, Southampton, and F. Candy, Bexley. Eng. Pat. 14,999, November 3, 1887. 8*d*.

Air is sterilised by passing it through "magnetic spongy iron," Eng. Pat. 1793, 1886 (this Journal, 1886, 675), and the sterilised air collected in a chamber into which the water is subsequently forced and kept until it is surcharged with the compressed sterilised air. The water may, if desired, be also filtered through a layer of "magnetic spongy iron." For details of apparatus the specification and drawings must be consulted.—E. E. B.

A Process for Disinfecting Impure Liquids. E. Hermite, E. J. Paterson, and C. F. Cooper, Dalston. Eng. Pat. 15,384, November 10, 1887. 4*d.*

The sewage or other impure liquid is mixed with any suitable chloride, and an electric current then passed through "thin streams or sheets" of the mixture.—E. E. B.

Apparatus for Disinfecting Impure Liquids by Electrolytic Action. E. Hermite, E. J. Paterson, and C. F. Cooper, London. Eng. Pat. 15,385, November 10, 1887. 8*d.*

When impure liquids which contain such chlorides as those of magnesium, sodium, &c., are electrolysed, the chlorides are decomposed temporarily, with the result that harmful organic compounds are rendered innocuous. The invention relates to methods of applying electrodes for this purpose. The liquid may flow from a reservoir between two horizontal plates, the electrodes, mounted to form a sluice. In wells a framework of plates is supported by flexible conductors, which are wound on the barrel of a winch at the top. In shallow pools, &c., two trucks, moving together along opposite sides, have a winch barrel each on which electric cables are wound, stretching horizontally across the pool and supporting the framework of electrodes, and serving at the same time to convey the current. In sewers, &c., the liquid passes in thin sheets between a considerable number of longitudinally arranged electrodes. (*See* preceding abstract, Eng. Pat. 15,384.)—E. T.

Improvements in the Electrolytic Treatment of Sewage and Sea Water for the Production of Certain Products therefrom, and Apparatus therefor. W. Webster, jun., London. Eng. Pat. 15,760, November 17, 1887. 8*d.*

The inventor employs vessels that are separated into two distinct sets of alternating compartments by porous tiles. In one set are the positive carbon electrodes, and in the other the negative iron ones. Both compartments are filled with the liquor to be treated, that in one set of compartments being often changed, while the liquor in the other set is not removed till sufficiently saturated with chlorine, or ammonia, &c., as the case may be, when it is heated for the recovery of these bodies in other tanks. The compartments may be formed by porous partitions, running from end to end with a separate outlet and inlet to each, or by means of a continuous porous partition, made up of tiles, passing backwards and forwards, nearly from end to end of the cell, in a regular zigzag, the ends of it making water-tight joints with the ends or sides of the tanks.—E. T.

Improved Apparatus for the Electrolytic Treatment of Sewage and other Impure Liquids. W. Webster, jun., London. Eng. Pat. 15,939, November 19, 1887. 8*d.*

The liquid is caused to flow through iron conduits, each section of which is made of two, four, or more longitudinal parts bolted together, but insulated from each other. Alternate ones form one electrode, the others the other. The liquid in its flow is therefore subjected to nascent ammonia, chlorine, and oxygen, causing the solid matter to be deposited and the albuminoids to be decomposed and disinfected. On account of the chemical action upon them, the conduits must be very thick or be lined with special sheet-iron facings. The solid deposits may be removed by special branch pipes with a pump, or they may be allowed to settle in special chambers. The current may be alternating when potable waters are treated.—E. T.

(*C*)—DISINFECTANTS, &c.

PATENTS.

The Manufacture and Application of New Antiseptic and Disinfectant Substances. W. B. Giles and A. Shearer, London. Eng. Pat. 14,864, November 1, 1887. 6*d.*

Benzene or one of its homologues is treated with concentrated sulphuric acid or sulphuric anhydride. The compound thus obtained is freed from the excess of acid and can then be used as an antiseptic or disinfectant; or may be further purified before use.—E. E. B.

An Improved Manufacture or Preparation of Antiseptics. A. Boake, F. G. A. Roberts, A. Shearer, and W. B. Giles, London. Eng. Pat. 15,564, November 14, 1887. 4*d.*

The antiseptic is obtained by dissolving salicylic acid in a solution of either sulphite of sodium, potassium or ammonium, or a mixture of these sulphites.—E. E. B.

An Improved Antiseptic or Disinfectant. W. J. Cooper, Westminster. Eng. Pat. 15,668, November 15, 1887. 6*d.*

This antiseptic consists of a mixture of about one part, by weight, of anhydrous calcium chloride with two parts of sodium chloride, to which some camphor may be added.
—E. E. B.

An Improved Process for preserving Wood and other Vegetable Matters. P. L. Quarante and V. D'Escalonne Le Rivert, Paris, France. Eng. Pat. 17,814, December 27, 1887.

The material to be preserved is immersed in a solution of the following composition:—

"Acetate of alumina or soda, 6 kilos.; subacetate of lead (in solution at 1,320° density), 2 litres; pyrolignite of lead, 6 kilos.; glycerin, 5 per cent. by weight; and 1,000 litres of pure water."

This preservative is free from the objections attending the use of creosote and sulphate of copper, of which the former destroys the fibre of the wood or other material, while iron, even if galvanised, causes wood treated with sulphate of copper to decay when brought into contact with or inserted into it.

Wood preserved in this way shows no sign of decay after being sunk into damp ground for 10 years; it is also rendered imputrescible, uninflammable, and nearly incombustible.—A. G. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Essence of Eucalyptus Globulus. M. R. Voiry. Bull. Soc. Chim. **50**, 106—108.

The crude essence is greenish-yellow, and possesses a disagreeable odour. Examined with the polariscope in a 1 decim. tube, it causes a rotation of 4° 24′. Density at 0° = 0·934. When submitted to a temperature of −50° it solidifies to a crystalline mass, which melts at −10°.

By means of fractional distillation under the atmospheric pressure the author was enabled to separate butyric and valerianic aldehydes. A larger portion distilled over between 150°—160°. The analysis and rotation coefficient proved this to be dextro-terebene. The greatest portion of the essence distilled at 175°—180°, and this proved to be eucalyptol. Eucalyptol is a mobile liquid possessing an odour resembling menthol and camphor. It solidifies at 0°, and melts at + 1°. It is optically inactive, and its density = 0·940.

The author also submitted the essence to fractional distillation under a pressure of 4 c.m. of mercury. He was thus enabled to separate a terpilenol, $C_{10}H_{18}O$, besides the acetate, butyrate, and valerianate of the same body.
—J. W. L.

The Essence of Cajeput. R. Voiry. Bull. Soc. Chim. **50**, 108—109.

The odour of this essence is less disagreeable than that of eucalyptus, but more penetrating. It rotates the plane of polarisation − 2° in a 10 c.m. tube. D_0 = 0·934. It solidifies to a crystalline mass when cooled to − 50°, which does not melt again until near − 8°.

Butyric and valerianic aldehydes were separated by distillation under normal pressure. No important fraction distilled under 155°. That passing over between 155°—160° proved to be a levo-rotatory terebenthene which confers its optical property on the essence.

The principal portion distilled between 175°—180°, and consisted almost entirely of cajeputol, $C_{10}H_{18}O$, identical in all respects with the terpene obtained from the terpenol of List and that from the eucalyptus. Benzoic aldehyde was detected in the portion distilling between 170°—180°. When distilling the essence under 4 c.m. mercury pressure a disengagement of acetic acid was perceived towards the end of the operation, which proved to be owing to the decomposition of terpilenol acetate.—J. W. L.

On Anagyrine. E. Hardy and N. Gallois. Compt. Rend. **107**, 247—250.

Anagyris foetida is a plant of the family leguminosis, growing in the south of France and Algeria. It has toxic properties, and the active principle is an alkaloid, called anagyrine by the authors. It is best obtained from the seeds by the usual method employed for extracting alkaloids from plants. Anagyrine is an amorphous, yellowish substance, soluble in water, alcohol, and ether. It is delinquescent, and forms well crystallised salts with acids. Iodide of potassium and mercury give a white, a solution of iodine in KI, a brown precipitate. The hydrochloride is not delinquescent, very soluble in water and chloroform. It gives with $PtCl_4$ and $AuCl_3$ well defined salts. The action of the alkaloid on animals causes vomiting and trembling fits, the respiration is weakened, and finally death ensues.—A. R.

Comparative Toxic Action of Ouabain and Strophanthin. E. Gley. Compt. Rend. **107**, 348—351.

These two substances have closely related formulæ, that of ouabain being $C_{30}H_{46}O_{12}$, and of strophanthin $C_{31}H_{48}O_{12}$, their chemical properties are analogous, and so is their physiological action, the final stage of the latter being stoppage of the heart's action. The toxic power of ouabain is double, treble, or quadruple that of strophanthin, according to the animal operated on. With dogs, the subcutaneous injection of $\frac{1}{10}$ milligram of ouabain per kilo. of animal produces death in 20—25 minutes; under the same circumstances $\frac{3}{10}$ milligram of strophanthin kills in about an hour.—J. M. H. M.

Physiological Action of Para- and Meta-phenylene Diamine. R. Dubois and L. Vignon. Compt. Rend. **107**, 533—535.

These bodies present similar chemical properties to the leucomaines and ptomaines.

Meta-phenylenediamine, $C_6H_4(NH_2)_2$, is obtained from meta-dinitrobenzene by reduction; the para compound is obtained from para-nitraniline. Their acute physiological effects are similar. The experiments were tried upon dogs, and it was found that a dose of 0·1 grm. per kilo. of the animal, produces salivation, vomiting, diarrhœa, excessive urination, and finally death from coma. Para-phenylenediamine takes 2—3 hours, and the meta-compound 12—15 hours. The bases gradually change by becoming oxidised at the expense of the oxygen of the tissues. The products of this process give a dark colour to the blood and tissues. In some respects the physiological properties of the two substances are different.

The meta-compound induces a violent influenza, and the animal has fits of sneezing, followed by a raw cough. The animal falls from exhaustion and dies in a state of coma. The para-compound acts at the side of the eye-socket. It produces by subcutaneous injection exophthalmia, the eye starting from the socket, and discolouration and swelling round the eyeball ensuing.—J. B. C.

Physiological Action of Hedwigia Balsamifera. E. Gaucher, Combemale and Marestang. Comp. Rend. **107**, 544—547.

The bark from the stems of *Hedwigia balsamifera* yields 19 per cent. of alcoholic and 17 per cent. of aqueous extract, whilst the root-bark yields 18 per cent. of alcoholic, and 25 per cent. of aqueous extract. Subcutaneous injection of the alcoholic extracts in quantities of 0·146 grm. per kilo. of animal weight was sufficient to produce serious symptoms in a guinea-pig, and 0·161 grm. per kilo. caused death in an hour and a half; 0·298 grm. in an hour. The alcoholic extracts from both root and stem are of equal activity; but the mortal injection of aqueous stem extract is 0·53 grm. per kilo., death ensuing in 20 minutes; whilst of the aqueous root extract 0·65 grm. per kilo. is required to produce death in one hour. The various effects produced are described in detail, and lead to the conclusion that *H. balsamifera* is a nerve poison, reducing temperature and producing paralysis and convulsions. The only post-mortem evidences of its use are visceral, and more especially pulmonary congestion, which are more marked when death is slow than when it is rapid.

Special investigations showed that the active principles of these extracts were an alkaloid and a resin, which were isolated and submitted to toxological tests. In these experiments the alkaloid was found principally to cause convulsions, but also to occasion paralysis and reduction of temperature, whereas the injection of an amyl-alcohol solution of the resin is followed by the latter symptoms only, though in this respect it is very much more active than the alkaloid, and is, in fact, by far the more poisonous of the two substances. It is very slightly soluble in ether, chloroform, benzene, and methyl and ethyl alcohols, but is more soluble in amyl alcohol, which dissolves $\frac{1}{300}$th. The convulsions produced by the alkaloid resemble those produced by strychnine, whilst the paralytic symptoms of the resin recall those arising from curara poisoning.—D. A. L.

On Pyrodine, a new Antipyretic. J. Dreschfeld. Medical Chron. **9**, 89—99.

If the chemical constitution of antifebrin and phenacetin be compared, it is easy to see the possibility of producing other substances and substitution-products likely to possess temperature-reducing properties. The present subject of examination and physiological experiment is a substance prepared by Ad. Liebmann and registered by Messrs. I. Levinstein and Co. as "Pyrodine," and which as its active ingredient contains *Acetyl-phenyl-hydrazine*—

$$C_6H_5.N_2H_2.C_2H_3O.$$

It is a white tasteless substance, a crystalline powder, very sparingly soluble in cold water, possessing very littlle taste, and thus, easily administered in powder form.

The results of the investigation are briefly summed up as follows:—

(1.) Pyrodine is a powerful antipyretic.

(2.) It reduces fever temperature quickly, and maintains the temperature at a low level for some hours.

(3.) It is easily taken, and produces marked perspiration, but not nausea, vomiting, or collapse.

(4.) It is especially applicable in cases of pneumonia, scarlet fever, and typhus. Given in small doses in the latter disease it enables the patient to pass through the fever at a low temperature range without delaying the crisis, and it seems also to shorten the period of convalescence.

(5.) It is less applicable in cases of typhoid, owing to the early exhibition of toxic symptoms.

(6.) It appears to act equally well in migraine and neuralgia, but observations not extensive enough yet.

(7.) Given in often repeated doses at short intervals it easily shows toxic properties, and these depend on the action on the blood, producing hæmoglobinœmia. It should not be given (unless the temperature be very high) oftener than once in 18 or 24 hours, and it is not safe to continue its use for more than a few days.

(8.) It is found to act in cases where the other antipyretics have failed.

(9.) The dose for children is 2—4 grains; for adults, 8—12 grains.

(10.) It is a much more powerful antipyretic than either antipyrine, antifebrine, or phenacetine, but it is also much more toxic than these bodies.

This disadvantage is reduced by the fact that it is rarely necessary to give more than one dose in 12 to 18 hours, as the temperature is kept low for a longer period than if any of the other antipyretics are used.

(11.) It reduces the pulse as well as the temperature, and often causes diuresis.—W. S.

PATENT.

Improvements relating to the Production of Peptone and Maltose or Maltose Substances. A. Brünn, Wiesbaden, Germany. Eng. Pat. 14,459, October 24, 1887. 6*d*.

The object of this invention is the production of peptone preparations and the simultaneous formation of maltose or maltose substances, "by the aid of a ferment formed during the fermentation of dough, which process consists in—

"(*a*) Incorporating the albuminous (proteïn) substances, such as meat, milk, or eggs in a dough containing leaven, allowing this mixture to undergo fermentation, and lixiviating with water the peptone formed."

"(*b*.) Subjecting the said albuminous (proteïn) substances to the action of a soluble ferment which has been obtained from a dough fermented by the aid of leaven by simple extraction with a solvent, or by any other suitable process until the peptonisation of the albumen (proteïne) is completed, and then lixiviating with water the peptone thus formed."

In this manner is obtained besides peptone, also maltose or maltose substances by reason of the action of the leaven ferment upon the starchy substances of the flour contained in the dough.—J. H.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Positive Cyanotype or Blue Process. Indian Engineer, 5, 305—308 and 321—322.

A detailed account of the method of working the positive cyanotype process adopted in the Photographic Office of the Indian Survey, Calcutta.

Dishes of papier maché may be used, but in hot climates it is advantageous to employ wooden dishes thoroughly varnished with shellac or with a mixture of asphaltum (7 lbs.), beeswax (2 lbs.), linseed oil (1 pint). Before the first coat of varnish is dry the dish is lined with strong linen cloth, and three or four coats of varnish are applied afterwards.

Sensitising the paper.—The paper used must be hard and well sized. Good ordinary drawing paper, the well-known Rives or Saxe paper, and the thick photographic paper specially prepared for this purpose by Schleicher and Schüll, will give good results. Two methods of sensitising may be adopted. In the first, two solutions are made as follows:—

		Parts.
A	Best gum arabic	170
	Distilled water	650
B	Tartaric acid	40
	Distilled water	150

When the gum is completely dissolved the liquid is filtered and the tartaric acid solution added with constant stirring. After complete admixture, 100 to 120 parts of a solution of ferric chloride of sp. gr. 1·453 is added very gradually with vigorous agitation to the mixture, which is then allowed to remain in the dark for 24 hours. Distilled water is now added until the sp. gr. of the liquid does not exceed 1·100. If the solutions are mixed in any order other than that given, coagulation is liable to take place, but this is prevented by the presence of tartaric acid. The solution has an orange colour and will keep for a long time in the dark.

The second method, which is due to Pizzighelli, gives brighter prints. Three solutions are prepared, namely—(A.) Gum arabic 20 parts; water 100 parts. (B.) Ferric ammonium citrate 50 parts; water 100 parts. (C.) Ferric chloride 50 parts; water 100 parts. A. will only keep for a few days; B. and C. may be kept for several weeks in well-stoppered bottles. When the solutions are required for use they are mixed in the proportions of A. 20 parts, B. 8 parts, and C. 5 parts, and *in this order*, otherwise coagulation will occur. Free acetic acid prevents this coagulation. The mixture gradually thickens, loses its glutinous properties, and eventually becomes a thick magma. In this condition it is said to give the best results, but it cannot readily be applied to the paper. It is better, therefore, to add a small quantity of acetic acid. The mixture will not keep more than a few days.

Both sensitising solutions are applied in the same way. The paper, stretched on a board or sheet of glass, is firmly fastened at the edges or corners in order to prevent dragging, and the solution applied lightly by means of a broad, flat, soft brush or sponge, which is moved up and down and across the paper in order to secure a uniform coating. The paper is then dried rapidly in the dark, and may be preserved for a long time if protected from light and moisture. If, however, the second sensitising solution be employed, the Indian Office finds that the paper will not remain in good condition for more than a day or two.

Sensitising and development are carried on in yellow light only. During printing the paper is exposed behind the tracing, &c. in the usual way, sheets of carefully dried felt or paper being placed between the sensitised paper and the back of the frame. Printing requires in direct sunlight from 15 to 40 seconds, in the shade from 1 to 5 minutes, in rainy weather 5 to 15 minutes, in dull foggy weather 15 to 30 minutes or even more. Correct exposure is essential, and in order to avoid mistakes some lines are drawn with the same ink on the edge of the tracing, and some slips of the sensitised paper are placed under these with their ends projecting from the frame. One of these strips is withdrawn from time to time and developed. These trial strips may be exposed in a separate frame behind a piece of the same tracing paper or cloth with lines in the same ink. If the prints be rolled up and kept in a dry place, several hours, or even days, may elapse between printing and development.

Development.—A 20 per cent. solution of potassium ferrocyanide which has a sp. gr. of 1·1275 is placed in a large dish, the depth of the liquid being not less than an inch. The print is placed face downwards on a clean table, the edges are turned up all round to a depth of an inch, and the print is then floated, face downwards, on the ferrocyanide solution, care being taken to avoid the formation of air bubbles. After half a minute the paper is raised by one corner, great care being taken that no ferrocyanide solution touches the back, and the action of the ferrocyanide is allowed to continue until blue spots begin to appear on the white ground. The print is then at once washed with water, the water being allowed to flow over the back, and when all the ferrocyanide is removed, but not till then, it is placed in dilute sulphuric (3:100) or dilute hydrochloric acid (10:100) for about 15 minutes, the surface being well dabbed with a brush to loosen the mucilage. Afterwards the print is placed face upwards in an empty tray, and well rubbed with a brush to remove the blue mucilage, thoroughly washed with water, and dried.

If the ground be blue the print is under-exposed, or the action of the potassium ferrocyanide has been continued too long. If the lines be broken and feeble, but the ground be white, the print has been over-exposed or the lines of the tracing, &c. are not sufficiently opaque. If in the acid bath the lines become dark blue, but are washed off in the after treatment, the development has been too short. If the ground be also spotty, the print has been under-exposed. Blue stains may be removed by means of a 25 per cent. solution of normal potassium oxalate, which is applied locally to the dried print by means of a brush, and is dried off with blotting paper.—C. H. B.

Ortho-chromatic Photography. C. H. Bothamley. Phot. News, **32**, 508, and Brit. J. Phot. **35**, 499.

A continuation of experiments previously described (this Journal, 1887, 423). In order to obtain a standard light of constant quality, *i.e.*, consisting only of rays of certain refrangibility, the light is passed through a definite thickness of a solution, of definite strength, of some compound exerting a definite and known absorption. In order to determine the relative sensitiveness of various ortho-chromatic plates to rays of lower refrangibility than *b*, the light from a standard amylacetate lamp was passed through two centimetres of a 1 per cent. solution of picric acid. A Warnerke sensitometer screen was used for the purpose of measurement, the distance from the light to the screen being 1 metre, and the cell containing the picric acid being close to the screen. It was found that gelatino-bromide plates treated with ammoniacal solutions of the eosin dyes are much more sensitive to the less refrangible rays than plates prepared with an emulsion to which the eosin was added at the time of its formation. This result confirms the statements of Vogel and others. The dyes were applied in the form of solutions containing one part of dye in 10,000 parts of water, with or without 1 per cent. of strong ammonia solution, the plates being immersed in the liquid for two minutes and dried in the dark. The order of efficiency of the dyes commonly employed is: ammoniacal Cyanin, aqueous Erythrosin, ammoniacal Azalin, ammoniacal Rose Bengal, ammoniacal Erythrosin, the last being the most energetic sensitiser.

A series of strictly comparative exposures upon landscapes, made with ordinary plates exposed in the usual way, and with similar plates which had been treated with ammoniacal Erythrosin and exposed with a pale yellow transparent screen between the object and the lens, showed that the latter method possesses great advantages. The improvement is especially marked in the rendering of the foliage, water, distance, and sky; and the well-known defects of ordinary photographic pictures are to a great extent eliminated, the various objects being rendered much more nearly in accordance with their true relative brightness. A series of experiments with carefully constructed colour-charts and other coloured objects showed that ammoniacal Rose Bengal gives better "values," *i.e.*, more accurate representations in monochrome of the relative brightness of the different colours, than any other single dye. The best results were obtained with an ammoniacal sensitising bath containing Rose Bengal (1:10000), Cyanin (1:20000), and Erythrosin (1:20000). For landscape work an ammoniacal Erythrosin bath seems to be most suitable. No ortho-chromatic process with gelatin plates yet introduced will give really correct "values" without the interposition of a transparent yellow screen between the object and the sensitive plate, for the purpose of reducing the intensity of the blue and violet rays, to which the prepared plates are still relatively too sensitive. Plates prepared with silver erythroside, as recommended by Obernetter and Vogel, and exposed without any screen, give results which are superior to those obtained with ordinary plates, but inferior to those obtained with plates prepared with ammoniacal Erythrosin and exposed with a screen.

In order to avoid the misconceptions which have attached themselves to Vogel's term *optical sensitisers* (this Journal, 1888, 518—519), the author proposes to use the term *selective sensitisers* to denote those dyes and other compounds which make photographic plates sensitive to certain parts of the spectrum only.—C. H. B.

Photography on Wood. Phot. Corr. **25**, 347.

Eight grms. each of gelatin and white soap are dissolved in 500 cc. of water, with the addition of a little zinc white. The wood is coated with this mixture, allowed to dry, and the surface coated with an ammoniacal solution of albumen containing citric acid. When dry it is finally painted with a 10 per cent. solution of silver nitrate, and exposed in the usual way.—H. T. P.

The Ortho-chromatic Wet Collodion Process. Eder. Phot Rundshau, 1888, 249.

0·6 grm. of eosin (yellowish) and 12 grms. of cadmium bromide are dissolved in 140 cc. of alcohol, and 70 cc. of this solution are mixed with 100 cc. of plain collodion. The plates are coated with this mixture, being previously edged with a solution of india-rubber. They are then soaked, at first in a strong solution of silver nitrate, acidified with nitric acid, and then in a weaker solution of silver. A moderately long exposure must be given (without a plate of yellow glass before the lens), and the plates developed with a strong iron developer. After fixing the picture comes out clear and dense. The reddish colour may be removed by washing with dilute alcohol.—H. T. P.

Hydroquinone Developers. Phot. Mittheil, 1888, 134.

In hot weather, ready mixed hydroquinone developers spoil in 4—5 days, while in cold weather they last 2—3 weeks. Further, all gelatin films developed with alkaline developers strip off in warm weather. This may be prevented by soaking the plates in a strong solution of salt after development. Soda is the best alkali to use in hydroquinone developers.—H. T. P.

Water-glass Developer. Chem. Zeit. Rep. **12**, 244.

50 cc. of sodium water-glass of 50° Bé. are mixed with 450 cc. of water. 5 cc. of a 10 per cent. solution of hydroquinone in alcohol are mixed with 100 cc. of water, and during the development, 5—20 cc. of the water-glass solution are added.—H. T. P.

PATENTS.

Improvements relating to the Preparation and Use of Sensitising Materials and Sensitive Surfaces for Photographic Purposes. E. H. Farmer and H. K. Tompkins, London. Eng. Pat. 15,727, November 16, 1887. 6*d*.

Albumen is employed in place of gelatin, collodion, &c., for the formation of an emulsion with silver bromide or other haloid salt of silver. A soluble haloid salt is dissolved in the albumen and a solution of a silver salt added; or the haloid salt and the silver salt are dissolved separately in water and added alternately to the albumen. If the images are to be printed out the silver salt may be in excess, but if they are to be developed the haloid salt must be in excess. Various proportions may be used, but the following give good results: 128 grains of potassium bromide are dissolved in 16 ozs. of egg albumen, and 196 grains of silver nitrate in 20 ozs. of water added gradually. A small quantity of ammonia or ammonium carbonate may be added to the albumen before emulsifying. Paper or glass is coated with the emulsion and dried, the film being rendered insoluble by adding chrome alum to the emulsion, or by immersing the coated paper in alcohol. The prepared paper is exposed to daylight under a negative until all the details are visible, which requires 15 seconds to five minutes, when the image is developed by any of the developers in common use for positive papers. Good results are obtained with a solution consisting of pyrogallol 12 grains, sodium sulphite 100 grains, ammonium carbonate 24 grains, potassium chloride 20 grains, and water 20 ozs. If the image is to be formed entirely by printing out, the paper is sensitised on an 8 to 12 per cent. solution of silver citrate or other organic silver salt, which may be prepared by dissolving silver nitrate 48 grains, citric acid 20 grains, and ammonium nitrate 10 grains in 1 oz. of water. The

organic silver salt may also be emulsified with the albumen. The albumen may be mixed with hard gelatin, and in this case coagulation by alcohol or chrome alum is unnecessary.
—C. H. B.

Flexible Films for Photographic and other Purposes and Apparatus in connexion with the Manufacture thereof. J. E. Thornton, Manchester. Eng. Pat. 16,018, November 22, 1887. 11*d*.

The novelty consists in the use of transparent or translucent algin, algulose, or sodium alginate prepared from sea-weed. This dissolves in cold or hot water, but becomes insoluble when treated with mineral acids or salts of calcium, iron, silver, copper, &c. It may be bleached and may also be mixed with gelatin and other substances to modify the character of the film. A thick glutinous aqueous solution of the algin is flowed over the smooth level surface of a sheet of glass, ebonite, or other temporary support, dried, and the film rendered insoluble by treatment with a strong solution of calcium chloride. The film thus prepared may be coated on one or both sides with a layer of sensitive silver gelatino-bromide emulsion, either with or without an intervening layer of plain gelatin. For the preparation of stripping films, the composite layer of algin, gelatin, and sensitive emulsion is separated from the paper which serves as a temporary support by a layer of soluble algin or other soluble substance. Layers of algin, gelatin, and sensitive emulsion may be superposed in any number and in any order. The sensitive emulsion may be applied directly to the algin film. The use of a film of algin avoids the necessity for strengthening the film with gelatin skins, films of collodion, &c.—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements in Explosive Substances and Absorbent Materials therefor. W. D. Borland, London. Eng. Pat. 758, January 18, 1886. (Second edition.) 6*d*.

The most porous forms of charcoal at present known will not absorb more than from 5—6 times their weight of nitroglycerol, in consequence of which large proportion of charcoal in the explosive, the gases produced by explosion contain too much carbonic oxide. By this improved process, a carbonaceous material is prepared, capable of absorbing as much as 35 times its weight of nitroglycerol. The inventor carbonises small pieces of cork waste or any form of cork in a convenient and suitable manner. "When properly prepared the carbonaceous substance readily absorbs from 7—8 times its weight of nitroglycerol, giving a pulverulent mixture; from 10—12 times, giving a plastic-like mass; and is capable of absorbing even so much as from 30—35 times its weight, yielding a stiff paste of homogeneous appearance from which no nitroglycerol separates, even after many months immersion in water."

The mixture of 7—8 parts of nitroglycerol with one of the carbonaceous material is excellent for cartridges, and may be safely moulded under water. Mixed with one-fourth its weight of water it becomes absolutely uninflammable, but may be detonated. A mixture of 75 parts of nitroglycerol, 3 parts of the carbonaceous substance, 2 of alkaline carbonate, and 20 of Kieselguhr, is extremely dry to the touch, less affected by freezing and thawing than ordinary Kieselguhr dynamite, and may be immersed in water for an indefinite length of time without showing signs of exudation.—O. H.

Improvements in Matches. W. H. Percival, London. Eng. Pat. 16,083, November 23, 1887. 4*d*.

The patentee proposes to dip the ends of matches into a solution of "cyanite" or other non-inflammable preparation, so as to prevent the fingers from being burnt, the flame becoming extinguished on reaching the part so treated.
—C. N. H.

Improvements in Explosives. E. Kubin and A. Siersch, Vienna, Austria. Eng. Pat. 3759, March 10, 1888. 4*d*.

"The object of this invention is to provide an explosive which, on being detonated, will prevent danger of ignition of fire-damp or coal-dust in mines."

For this purpose chloride or sulphate of ammonia, or the two salts together, are mixed with dynamite, blasting-powder, or other explosive, in proportions varying from 20 to 50 per cent. On the detonation of the explosive the ammonia salts are decomposed into non-inflammable gases, which have the effect of reducing the temperature and rarefying the explosive gases.—C. N. H.

XXIII.—ANALYTICAL CHEMISTRY.

On the Specific Heats of Solutions. E. Mathias. Compt. Rend. **107**, 524.

Several formulæ have been proposed to represent the variation of the specific heat of a solution with the amount of solvent that it contains. That of Schüller (Pogg. Ann. 1869, **136**, 70) has been shown to be inexact by Marignac (Ann. de Chim. et de Phys. 1870, **22**, 406). The latter experimenter has substituted another expression, which although correct has the defect of being cumbersome and not susceptible of a simple theoretical interpretation. Mathias has succeeded in converting it into the following very convenient formula:—

$$\gamma_n = \frac{a + n}{b + n} c$$

where γ_n is the specific heat of the solution which contains n (where n is not less than 25) equivalents of the solvent for each equivalent of the body dissolved, a and b are constants, and c is the specific heat of the solvent. From the determinations of Marignac and Thomsen he obtains for aqueous solutions the following values of a and b:—

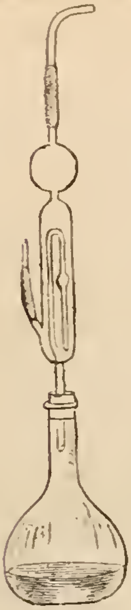
Solution.	*a.*	*b.*
$H_2SO_4 + nH_2O$	2·5	7·3
HCl " "	1·365	5·05
NaHO " "	12·012	15·715
KHO " "	6·163	11·282
NaCl " "	5·725	10·0
NH_4Cl " "	2·663	6·277
Na_2SO_4 "	18·510	28·12
$C_{12}H_{22}O_{11}$ "	8·778	19·77

The application of this theoretically interesting formula to bodies dissociated by water will be given in a later memoir.—W. W. H. G.

A Distillation Apparatus for Use in Nitrogen Estimations. J. Kjeldahl. Chem. Zeit. Rep. **12**, 238.

To prevent the carrying over of alkali mechanically by the hydrogen and steam during the distillation in the Kjeldahl process, the author advises the use of the apparatus shown in the drawing below.

Before distillation is commenced a little water is introduced into the bulb through the side tube. This water is heated to boiling by the passage of the steam, and effectually



retains all the alkali (soda) spirted over, without holding back any of the ammonia.—H. T. P.

On a Characteristic Reaction of Bismuth. M. E. Léger.

Bull. Soc. Chim. 50, 91—93.

A solution of potassium iodide (2 grms.), and cinchonine (1 grm.) in water (100 grms.) gives an orange-yellow precipitate with even very small quantities of bismuth; or this solution may be replaced by a saturated aqueous solution of cinchonine hydriodide. One part of bismuth in 500,000 may be detected by its use. The following quantities have been detected: 0·0001 grm. of Bi mixed with 1 grm. of $Pb(NO_3)_2$; 0·001 grm. of Bi in a mixture of the nitrates of Cu, Pb, Hg, and Ag; 0·001 grm. of Bi in a mixture of salts of Cu, Pb, Bi, Sn, As, and Sb.

The following method was employed for the separation of the bismuth:—precipitation of the metals as sulphides, conversion into nitrates, then into carbonates, separation of the carbonates of bismuth and lead by means of potassium cyanide, conversion of these into chlorides, and, lastly, separation of the lead chloride by means of alcohol. The alcoholic solution evaporated to dryness and the residue re-dissolved in a little nitric acid, and a few cc. of water, gives the characteristic red precipitate with the iodo-cinchonine reagent. In order to obtain the highest degree of sensitiveness it is necessary:—(1.) to employ the reagent in excess; (2.) to avoid too great an excess of nitric acid; (3.) to avoid especially the presence of hydrochloric and sulphuric acids. The precipitate obtained is soluble in alcohol, is decomposed by alkalis, and decolourised by silver nitrate.—J. W. L.

An Improved Decomposition and Absorption Apparatus. W. Thörner. Zeits. f. angew. Chem. 1888, 487—488.

In Fig. 1, *A*, is what is called a cooler-flask (Kühlerkolben), *i.e.*, a flask (capable of holding 200—1,000 cc.) provided with a neck 350 mm. long and 16 mm. wide, which is surrounded by a suitable condenser *B*. These flasks all have the same width of neck so that they all fit into the same condenser. This condenser-flask is fixed into a suitable stand and the mouth of the flask is closed with a doubly-perforated india-rubber stopper. One of these perforations is provided with a tube *C*, which ends just below the stopper, and connects the flask with the absorption apparatus *E*. *D*

Fig. 1.

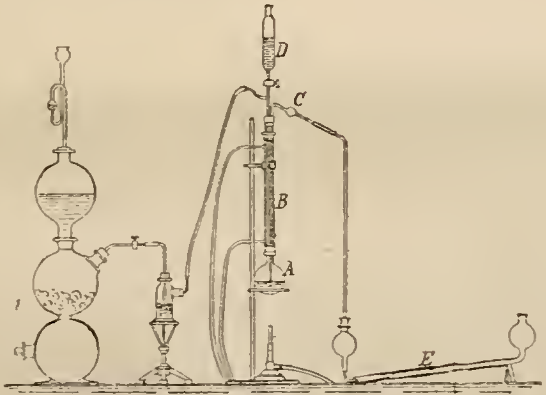
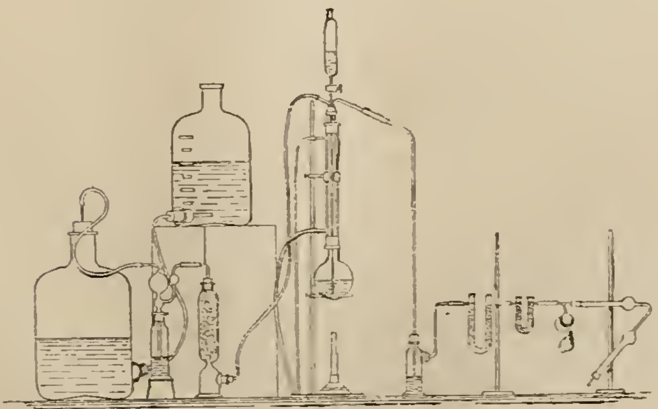


Fig. 2.



is a tap funnel which passes through the other perforation to nearly the bottom of the flask. The tube of this funnel is provided with a short lateral tube immediately below the tap. This short tube slants upwards and admits purified air, hydrogen, or carbon dioxide, as the case may be. Without interrupting the course of the experiment, the decomposition liquid can be admitted by opening the tap. These condenser-flasks are very convenient to work with, and there is no fear of hot acid fumes coming in contact with the stopper. In estimating the sulphur in iron as well as when decomposing antimony sulphide, iron sulphide, &c., by means of hydrochloric acid and determining the hydrogen sulphide evolved, as barium sulphate, the cooler-bulb is directly connected with the absorption apparatus *E*. This consists of a straight tube 350—400 mm. long and 12 mm. wide, which, at its upper end, is directly connected with a 150 cc. bulb, and at its lower end is connected with a 100 cc. bulb by means of a strong capillary tube about 40 mm. long. To avoid a cork or india-rubber connexion, the tube from the condenser bulb is ground into the absorption apparatus. Absorption is very perfect. With this apparatus determinations of ammonia in water analysis, or Kjeldahl's method can be easily carried out if a current of air be employed. It can also be employed in the determination of the carbon dioxide in minerals, decomposition being effected with hydrochloric acid and the gas evolved carried on by a current of purified air. The absorption apparatus in this case, however, is replaced by the following series of tubes, &c. (Fig. 2.) A small wash-bottle containing sulphuric acid, a chloride of calcium tube filled with pumice permeated with anhydrous copper sulphate for the removal of traces of hydrochloric acid, a weighed chloride of calcium tube containing soda-lime, potash bulbs, and finally, the usual precautionary tube. The carbon dioxide in beer can also be determined with this apparatus, provided only the quantity is to be determined which the beer contains when being served, and not the total quantity. The apparatus is specially useful for the determination of the carbon in iron or steel by combustion with chromic and sulphuric acid.—F. W. T. K.

Analysis of a Mixture of Potassium Chloride and Sodium Chloride by a Polarimetric Method. F. Schütt. Ber. **21**, 2586—2594.

The influence exercised by inactive bodies on the rotatory power of polarising substances has recently been extensively investigated by Landolt and others, the former having pointed out that this property might be applied to the quantitative determination of inactive substances which are in solution along with a known quantity of an active substance. In order to test the practicability of this suggestion, the author examined the applicability of optical analysis for a mixture of the chlorides of potassium and sodium. Tartaric acid and its salts proved very suitable as an active substance, and at last potassium tartrate, $C_4H_4K_2O_6 + \frac{1}{2}H_2O$, was definitely chosen as "activum" for the analytical method. If the two alkaline chlorides occur along with other salts, they must first be separated in the usual manner. The mixture of the pure chlorides is then carefully dried and 10 grms. introduced into a flask having a capacity of 50 cc. at 17·5° C. 11 grms. of neutral potassium tartrate, dried at 110° C., are then added, and the contents of the flask dissolved in warm water. The solution is cooled to 20° C., filled up with water to the mark, shaken, and quickly filtered through a dry filter into a test tube, covering the funnel with a watch-glass. 40 cc. of the filtrate are at once introduced into the tube of a saccharimeter and submitted to polarisation. It was found by experiment that 20 grms. of sodium chloride and 22 grms. of potassium tartrate dissolved in 100 cc. of water (normal concentration) turned the plane of polarisation by 62·06 divisions, whereas 20 grms. of potassium chloride and 22 grms. of potassium tartrate dissolved in 100 cc. of water produced a deviation of 73·72 divisions. The total difference is 11·66 divisions, and it was proved, by a series of experiments, that the optical action of the two chlorides is exactly proportional to their quantity. The following tables (Tables I. and II.) show, at a glance, the percentage of potassium chloride corresponding to each rotation of the plane of polarisation, and by deducting the percentage of potassium chloride from 100, the amount of sodium chloride is found.

Table I.

Angle of Rotation.	Per Cent. KCl.	Angle of Rotation.	Per Cent. KCl.	Angle of Rotation.	Per Cent. KCl.	Angle of Rotation.	Per Cent. KCl.	Angle of Rotation.	Per Cent. KCl.	Angle of Rotation.	Per Cent. KCl.
62·06	0·00	64·00	16·13	66·00	33·00	68·00	50·04	70·00	67·30	72·00	84·79
10	0·33	10	16·97	10	33·84	10	50·89	10	68·17	10	85·67
20	1·16	20	17·81	20	34·69	20	51·75	20	69·04	20	86·55
30	1·99	30	18·65	30	35·54	30	52·61	30	69·91	30	87·43
40	2·81	40	19·49	40	36·39	40	53·47	40	70·78	40	88·32
50	3·64	50	20·33	50	37·24	50	54·33	50	71·65	50	89·21
60	4·47	60	21·18	60	38·09	60	55·19	60	72·52	60	90·08
70	5·30	70	22·02	70	38·94	70	56·06	70	73·39	70	90·96
80	6·13	80	22·86	80	39·79	80	56·92	80	73·27	80	91·85
90	6·96	90	23·70	90	40·64	90	57·78	90	75·14	90	92·73
63·00	7·79	65·00	24·54	67·00	41·49	69·00	58·65	71·00	76·02	73·00	93·61
10	8·62	10	25·39	10	42·34	10	59·51	10	76·90	10	94·50
20	9·45	20	26·23	20	43·20	20	60·38	20	77·77	20	95·38
30	10·29	30	27·07	30	44·05	30	61·27	30	78·65	30	96·27
40	11·12	40	27·92	40	44·90	40	62·10	40	79·53	40	97·16
50	11·95	50	28·76	50	45·76	50	62·97	50	80·49	50	98·04
60	12·79	60	29·60	60	46·61	60	63·83	60	81·28	60	98·93
70	13·62	70	30·45	70	47·47	70	64·70	70	82·16	70	99·82
80	14·46	80	31·30	80	48·32	80	65·56	80	83·03	72	100·00
90	15·29	90	32·15	90	49·18	90	66·43	90	83·91		

Table II.

Angle of Rotation.	Per Cent. KCl.	Angle of Rotation.	Per Cent. KCl.	Angle of Rotation.	Per Cent. KCl.	Angle of Rotation.	Per Cent. KCl.	Angle of Rotation.	Per Cent. KCl.	Angle of Rotation.	Per Cent. KCl.
0·01	0·08	0·01	0·08	0·01	0·09	0·01	0·09	0·01	0·09	0·01	0·09
0·02	0·17	0·02	0·17	0·02	0·17	0·02	0·17	0·02	0·17	0·02	0·18
0·03	0·25	0·03	0·25	0·03	0·26	0·03	0·26	0·03	0·26	0·03	0·27
0·04	0·33	0·04	0·34	0·04	0·34	0·04	0·34	0·04	0·35	0·04	0·35
0·05	0·42	0·05	0·42	0·05	0·43	0·05	0·43	0·05	0·44	0·05	0·44
0·06	0·50	0·06	0·51	0·06	0·51	0·06	0·52	0·06	0·52	0·06	0·53
0·07	0·58	0·07	0·59	0·07	0·60	0·07	0·60	0·07	0·61	0·07	0·62
0·08	0·67	0·08	0·67	0·08	0·68	0·08	0·69	0·08	0·70	0·08	0·71
0·09	0·75	0·09	0·76	0·09	0·77	0·09	0·78	0·09	0·79	0·09	0·80

The results recorded in Table III. are evidence for the accuracy of the method.

Table III.

Rotation observed.	Per Cent. KCl found in Table 1. and II.	Per Cent. KCl actually present.	Rotation calculated on the actual Percentage of KCl present.	Difference in Per Cent. KCl.	Difference in Rotation.
63·82	14·63	15	63·87	+0·37	+0·05
65·07	25·13	25	65·05	−0·13	−0·02
66·82	39·96	40	66·83	+0·04	+0·01
68·03	50·30	50	68·00	−0·30	−0·03
70·32	70·08	70	70·31	−0·08	−0·01
73·13	94·77	95	73·16	+0·23	+0·03

—S. H.

Volumetric Determination of Phosphoric Acid by Molybdic Acid. A. Grete. Ber. **21**, 2762—2765.

The yellow precipitate of ammonium phospho-molybdate is of a variable composition. On attempting to find out the conditions under which a compound of constant composition is formed, the author observed that in the presence of gelatin, molybdic acid gives at first with phosphoric acid a white flocculent precipitate, which only on further addition of molybdic acid turns yellow. The great insolubility of this compound of phospho-molybdic acid and gelatin, as well as its property of settling quickly, caused the author to base on this reaction a volumetric test for phosphoric acid. A measured quantity of a phosphoric acid solution is neutralised with alkali, using methyl orange as an indicator. A concentrated solution of ammonium nitrate (Solution I.), equal in volume to the phosphoric acid solution, is added to it, as well as 1 grm. of sodium sulphate and 1 cc. of a gelatin solution (Solution II.). The whole is heated to 80°—90° C., and the liquid then titrated with standard ammonium molybdate (Solution III.), stirring continually, until a precipitate no longer forms by a further addition of the molybdate. In order to find this point accurately, a little gelatin solution is added from time to time to the liquid which is being titrated. The gelatin will produce a white precipitate as long as an appreciable amount of phosphoric acid is still in solution. This white precipitate formed on the top is clearly seen in the liquid, and as soon as it ceases to be formed the liquid is boiled, until the precipitate becomes granular and settles rapidly. The supernatant liquid soon becomes quite clear, and any turbidity, produced by a further addition of the molybdate, is at once seen. Solution I.—750 grms. of ammonium nitrate are dissolved in 1,000 cc. of water, which also contains 40 grms. of sodium sulphate. Solution II.—100 grms. of gelatin are boiled with water and 50 cc. of nitric acid, and the solution made up to 1,000 cc. Solution III.—1 kilo. of ammonium molybdate is dissolved in ammoniacal water, 100 grms. of gelatin are then boiled with water and a few cc. of nitric acid for some time, when both solutions are mixed with each other. The yellow alkaline liquid is then poured into 3 litres of nitric acid (sp. gr. 1·2), the mixture made up to 10 litres, and allowed to stand for several days, with frequent shaking. A precipitate is gradually formed, which soon settles to the bottom; after filtering, the solution is ready to be standardised.—S. H.

Estimation and Separation of Zinc. J. Riban. Compt. Rend. **107**, 341—343.

The solution containing the zinc salt is treated with sodium carbonate until a permanent precipitate forms, which is re-dissolved by a few drops of weak hydrochloric acid. Excess of a solution of sodium or barium dithionate is then added, and the liquid diluted until it contains not more than 0·1 grm. of zinc per 100 cc. On passing a current of sulphuretted hydrogen in the cold, zinc sulphide falls as a granular, very dense precipitate, easily washed by decantation, and having no tendency to clog the filter. It can be dealt with by any of the usual processes. This method is proposed for separating zinc from the alkali and alkaline earthy metals. Its estimation in solutions containing iron, manganese, &c. which are not precipitated by sulphuretted hydrogen in presence of dithionate remains to be investigated.—J. M. H. M.

Salicylic Acid as a Means of Preserving Standard Solutions. H. Borntrāger. Zeits. Anal. Chem. **27**, 641—642.

Sodium thiosulphate solution with the addition of a small quantity of salicylic acid, will keep nearly unchanged for six weeks, as experiments of the author show. He ascribes the decomposition of many solutions to the presence of micrococci, which the salicylic acid destroys.—J. B. C.

The Absorption of Gases by Petroleum. S. Gniewosz and A. Walfisez. Zeits. f. Phys. Chem. 1, 70.

The coefficient for the absorption of oxygen and many other gases by petroleum is much higher than that for water. The authors consider it, therefore, illusory to try to protect liquids from oxidation by covering them with a layer of petroleum.—J. B. C.

Determination of Ammonia. E. Hintz. Zeits. Anal. Chem. 27, 646—647.

Berthelot and André found that MgO in presence of magnesium salts does not completely expel ammonia from its salts. Schlösing, on the other hand, has proved that although the ammonia is less readily driven off, by protracted distillation it may be completely expelled. Calcium chloride acts in the same manner as magnesium chloride, though in a lesser degree. Ammonium magnesium phosphate in the solid form is not completely decomposed by milk of lime, but when the salt is dissolved first the ammonia is completely driven off. When magnesia is used in ammonia determinations in presence of CO_2, part of the CO_2 passes over with the ammonia and dissolves in the normal acid of the receiver. The acid must, therefore, be boiled a minute before titrating back with alkali.—J. B. C.

Determination of the Fluorine contained in Substances Decomposable by Sulphuric Acid. H. Lasne. Bull. Soc. Chim. 50, 167—170.

The following method for the determination of fluorine in presence of much lime or organic matter has been found to give good results :—50 cc. of concentrated sulphuric acid and 10 grms. of fine sand, together with enough substance to yield about 0·2 grm. calcium fluoride are heated in a flask on a sand-bath at 180°—200°, a slow current of air being passed through the apparatus, consisting of the flask already mentioned and two washing-bottles for absorbing the evolved gas. The silicon fluoride is absorbed in the wash-bottles, the first of which contains 2·5 grms. of NaHO in 25 cc., and the second 0·5 grm. of NaHO in the same volume of water. At the end of the operation the absorption liquids are washed into a 125 cc. flask, and boiled for 15 minutes. A drop of phenolphthaleïn is next added, and carbonic acid gas passed through, until the liquid is decolourised. The liquid is heated for half an hour at 50°, ammonium carbonate being added from time to time, to prevent re-solution of the precipitated silica. The whole is then cooled quickly, and made up to the 125 cc. mark, filtered from the silica, and 100 cc. taken for the estimation of the fluorine. If there should be a doubt that the silica has been completely precipitated by the above means, a little zinc oxide in ammonia is added, and the ammonia boiled off. After again filtering, a few drops of a solution of tropaolin OO, are added, and the solution very carefully neutralised with hydrochloric acid. 0·5 grm. of sodium carbonate is then added, the excess of CO_2 driven off, and finally the fluorine precipitated with an excess of calcium chloride. After filtering and washing, the precipitate is treated with acetic acid to dissolve out precipitated calcium carbonate, and the calcium fluoride remaining is then dried and weighed.—J. W. L.

On the Estimation of the Proportion of Lead in Tin Alloys by determining their Specific Gravity. C. Winkler. Chem. Zeit. 12, 1229—1231.

In consequence of the recent law in Germany prohibiting the use of any tin alloy containing more than 10 per cent. of lead for eating, drinking and cooking utensils, it has become important to be able to estimate rapidly the amount of lead in any such alloy. For this purpose the author uses the apparatus described below for taking the specific gravity of the article to be tested, which will be the greater the larger the proportion of lead it contains.

The apparatus consists of a vessel provided with an exit tube bent at right angles, one limb of which reaches nearly to the bottom, while the other projects horizontally from the side, and is curved slightly downwards at the end. The vessel is filled with water until it overflows through the exit tube. When the flow ceases, an accurately graduated burette is placed beneath the exit tube, the reading noted, and the article to be tested carefully lowered by any convenient means into the water, avoiding splashing. The water displaced by it flows out into the burette, and thus its volume is ascertained. The weight of the article having been previously taken, all data necessary for determining its specific gravity are obtained.

Results are given showing sufficiently close agreement with those obtained by more delicate methods. It is also proved that the specific gravity of lead-tin alloys is an accurate criterion of their composition.—B. B.

Tests for Saccharine, Antipyrine, and Antifebrine. D. Lindo. Chem. News, 58, 51 and 155.

Saccharine.—If saccharine be evaporated with nitric acid on the water-bath, the residue allowed to cool, and a few drops of a strong solution of potash in 50 per cent. alcohol added, a faint yellow colour is developed. On spreading the liquid over the surface of the dish, and then applying heat rapidly, streaks of blue, violet and red colours are developed.

Antipyrine.—Heated with strong nitric acid until a reaction commences, a purple-coloured solution is obtained. On pouring into water, and filtering, the filtrate shows a purple red colour, while a violet-coloured precipitate remains on the filter. The reaction is very delicate.

Antifebrine is best detected by converting into sulphanilic acid, diazotising and observing the colours obtained with phenols.—A. R.

Test for Ethyl Alcohol. J. Habermann. Zeits. Anal. Chem. 27, 663.

The method is based on the fact that commercial methyl alcohol contains impurities which have a strong reducing action on potassium permanganate. To eliminate in like manner from spirits of wine those substances, which, when present, reduce potassium permanganate without at the same time extracting the impurities usually present in commercial methyl alcohol, the spirits of wine are shaken thoroughly, though not violently, with pure olive oil (30—40 cc. spirits to 20 cc. olive oil). This is repeated, and after drawing off the spirits they are tested with permanganate for methyl alcohol. Sugar, if present, is separated by distillation, and the distillate tested. The test is as follows : to 10 cc. liquid 1 cc. $KMnO_4$ (1:1,000) is added at 20° C. Pure alcohol decolourises it after 20 minutes, methyl alcohol instantaneously.—J. B. C.

Detection of Sulfonal. Zeits. Anal. Chem. 27, 664—665.

This substance, used as a hypnotic, may be identified as follow :—It melts at 125·5°, dissolves in 15 parts of boiling water, and 500 parts of water at 15°; in 133 parts of ether at 15° C., 2 parts of boiling alcohol, 65 parts of alcohol at 15°, and in 110 parts of 50 per cent. alcohol at 15°. The sample should also be tested for sulphuric acid, potassium, and manganese. It is exceedingly inert towards all reagents, a characteristic property of the substance. Fused with potassium cyanide it gives a smell of mercaptan. Mercaptan, according to *Ritsert*, may be formed by heating sulfonal with sodium amalgam or pyrogallic acid. Fused with dry potash a peculiar smell of mustard oil is evolved. Mercaptan is also formed by heating the substance in a test tube with a trace of charcoal; the white fumes which are at the same time given off turn litmus-paper red, and decolourise blue iodide of starch paper.—J. B. C.

Acetanilide and Phenacetine. Zeits. Anal. Chem. 27, 665—668.

These two substances bear a close resemblance, and it is not easy to detect the cheaper acetanilide in the more expensive phenacetine. The melting point of acetanilide is 112°, that of phenacetine 132·5°—133°. A mixture of phenacetine with 5 per cent. of acetanilide shows at 113°—114° drops of liquid in the capillary tube. At 127°—128° the mixture melts completely. The test for acetanilide is the indophenol reaction: 0·1 grm. of acetanilide boiled with 1 cc. of hydrochloric acid should give a clear solution which, on the addition of 3 cc. of water, a drop of melted phenol and a solution of bleaching powder (1:10) forms a turbid red solution. If this be saturated with ammonia it changes to blue. Aniline gives the same reaction; but if the reaction be conducted in the cold a white precipitate is formed with acetanilide and no colouration. Acetanilide also gives the isonitrile reaction. It may be also recognised by the following reactions:—

1. One cc. of the solution in concentrated hydrochloric acid well cooled gives with 5 drops of fresh Cl water a dark blue colouration which disappears at the end of five minutes, but reappears on adding more Cl water.
2. One cc. of the same solution gives with 6—7 drops of a bleaching powder solution (1:200) a deep blue colouration.
3. One cc. of the same solution gives with 1—2 drops of permanganate solution a green colouration.
4. With 1—2 drops of a 3 per cent. chromic acid solution, it is coloured yellowish-green at first, and after five minutes dark green; when potash is added an insoluble dark blue precipitate is formed.

If acetanilide contain phenacetine the following test may be used for the latter:—The solution in hydrochloric acid to which 10 times the volume of water is added, gives on the addition of a few drops of chromic acid solution a ruby-red colouration in presence of phenacetine or clear yellow if free from it. The four tests, applied above in the case of acetanilide, give the following reactions with phenacetine:—

1. With chlorine water the acid solution is first reddish-violet, and after five minutes deep ruby-red. By a further addition of Cl water it changes to a pale rose tint.
2. With bleaching powder solution a ruby-red colouration is produced.
3. With permanganate a violet colouration, changing to an intense ruby-red.
4. Diluted with 10 times its volume of water an addition of chromic acid produces a red colouration.—J. B. C.

Direct Method for Detecting Chloral or Chloroform in Liquids. C. Schwarz. Zeits. Anal. Chem. 27, 668–669.

If chloral hydrate or chloroform be heated with a solution of resorcinol in presence of excess of caustic soda, a red colouration is produced, which, on the addition of acid, disappears, but reappears with caustic alkali. If, on the other hand, chloral hydrate or chloroform be heated with excess of resorcinol and only a small quantity of caustic soda to boiling, a yellowish-red liquid is obtained, which, on largely diluting, gives a yellowish-green fluorescence. In 1 cc. of the liquid under examination, 0·05 grm. resorcinol are dissolved, and on the addition of five drops of caustic soda (official solution), well boiled. In the case of urine, the boiling must be protracted, and a considerable excess of alkali must be present (to decompose urochloralic acid or trichlorethylalcohol). Coloured solutions must be previously decolourised.—J. B. C.

Reactions for the Detection of Dyestuffs on the Fibre. R. Lepetit. Zeits. f. angew. Chem. 1888, 535—547.

J. J. **Hummel's** handbook, "The Dyeing of Textile Fabrics," contains a scheme for the detection of dyes on the fibre. The author enlarged Hummel's tables by adding the reactions of 62 artificial dyes, which have been introduced since the publication of the handbook in question. The tables were arranged in the manner adopted in Hummel's handbook, and the reagents employed were:—

Hydrochloric acid, 21° B.; sulphuric acid, 66° B.; 10 per cent. sodium hydrate solution; concentrated ammonia. Equal parts of conc. hydrochloric acid and stannous chloride ($SnCl_2.2\,H_2O$); 95 per cent. alcohol.

No.	Name of Dye and Maker.	HCl.	SO_4H_2.	NaOH.	NH_3.	$SnCl_2$ and HCl.	Alcohol.	Remarks.
	RED DYES.							
1	Orsellin B B. Fr. Bayer & Co.	Fibre at first black-violet, finally black. Solution pale indigo-blue.	Fibre blackish-blue. Solution indigo-blue, becoming reddish-violet on diluting.	Fibre violet. Solution reddish-violet.	Like sodium hydrate.	Fibre slowly decolourised in the cold; on boiling the fibre is quickly decolourised.	No reaction.	Nitric acid: Violet spot, which disappears after washing.
2	Congo-red. Act. Ges. Berlin.	Dilute HCl: Fibre at once bluish-black. Conc. HCl: Fibre at once bluish-black. Solution colourless.	Fibre bluish-black. Solution dark blue, which colour turns bluish-black on dilution.	Fibre scarcely changed. Solution colourless.	No reaction.	Fibre at first bluish-black, then blue, afterwards grey and finally colourless.	No reaction.	Nitric acid: Blackish blue spot, the original colour is restored by the action of ammonia. Nitrous acid: Fibre reddish-brown; ammonia does not restore the original colour, but turns the fibre brownish-purple and the solution bluish-red. Picric acid: Fibre bluish-black.
3	Benzopurpurin 1 B. Fr. Bayer & Co.	Dil. HCl: Fibre reddish-brown. Solution colourless. Conc. HCl: Fibre dark brown.	Fibre blackish-blue. Solution bluish-black, turns on dilution at first reddish-black, and finally violet.	No reaction.	No reaction.	Fibre at first brownish-red, then pink, and finally decolourised.	Extracts traces of the dye.	Nitrous acid: Fibre brownish-black. Picric acid: Fibre reddish-brown. All these dyes, which resist sodium hydrate, are strongly attacked by a hot soap solution.
4	Benzopurpurin 11 B. Fr. Bayer & Co.	Dil. HCl: Fibre bluish-black. Solution colourless. Conc. HCl: Fibre bluish-black.	Fibre blackish-blue. Solution dark blue, blue on dilution.	No reaction.	No reaction.	Fibre at first bluish-black, then light grey, ultimately colourless.	No reaction.	Nitrous acid: Fibre bluish-black, then violet. Picric acid: Fibre dark brown.

Red Dyes—*continued.*

No.	Name of Dye and Maker.	HCl.	SO_4H_2.	NaOH.	NH_3.	$SnCl_2$ and HCl.	Alcohol.	Remarks.
5	Deltapurpurin G. Fr. Bayer & Co.	Dil. HCl: Fibre brown-red. Solution colourless. Conc. HCl: Fibre greenish-black.	Fibre blueish-black. Solution dark blue, on dilution at first grey, then brown-red.	No reaction.	No reaction.	Fibre at first dark brown, then lighter, then pink, and at last colourless.	No reaction.	Nitrous acid: Fibre violet-black, turns violet-red on the addition of ammonia. Picric acid: Fibre brownish-red.
6	Brilliant Congo. Fr. Bayer & Co.	Dil. HCl: Fibre brown-red. Solution colourless. Conc. HCl: Fibre blackish-violet with a reddish tint.	Fibre blue-black. Solution blue, on dilution purple violet.	No reaction.	No reaction.	Fibre at first reddish-brown, becomes gradually decolourised.	Extracts some dye.	Nitrous acid: Fibre black, turns black-violet with ammonia. Picric acid: Fibre brown.
7	Direct Red R. Geigy & Co.	Dil. HCl: Fibre black-violet. Conc. HCl: Fibre blue. Solution colourless.	Fibre blackish-blue. Solution black-violet, on dilution greyish blue.	Fibre becomes darker and assumes a bluish tint. Solution pale brown-red.	Fibre brilliant red. Solution scarcely reddish.	Decolourised.	No reaction.	Nitrous acid: Fibre reddish-brown, unchanged by ammonia. Picric acid: Brown spot.
8	Delta-purpurin 5 B. Fr. Bayer & Co.	Dil. HCl: Fibre reddish-brown. Conc. HCl: Fibre olive-black.	Fibre dark brown. Solution dirty green, turns reddish-brown on dilution.	No reaction.	No reaction.	Fibre at first brown, becomes gradually colourless.	Extracts some dye.	....
9	Naphthylene Red. Bad. Anil. Sod. F.	Fibre dark greenish-black.	Fibre bluish-black. Solution black-blue.	Scarcely any action.	Extracts traces of the dye without altering the colour of the fibre.	Fibre at first black, then grey, and finally colourless.	Solution pale pink.	Nitric acid: Blue spots with green edges. Nitrous acid: Fibre yellowish-brown. On washing the fibre and applying sodium hydrate it becomes dark brown. Solution is light brown.
10	Rosazurin B. Fr. Bayer & Co.	Dil. HCl: Fibre purple-red. Conc. HCl: Fibre olive-green.	Fibre dark blue. Solution dark blue, turns greenish on dilution, then violet.	No reaction.	No reaction.	Fibre at first purple-red, then colourless.	Extracts some dye.	Nitric acid: Fibre dark yellowish-grey, turns reddish-brown after washing and moistening with ammonia.
11	Congo Corinth. Fr. Bayer & Co.	Dil. HCl: Fibre black. Conc. HCl: Fibre black.	Fibre black. Solution dark blue.	Fibre reddish-blue. Solution colourless. After washing the original colour appears again.	Fibre reddish. Solution pale pink.	Fibre black, then blue, then grey, and finally colourless.	Solution scarcely coloured.	Nitrous acid: Fibre dark blue; washed with ammonia it turns magenta-red.
12	Hessian Purple N. Leonhardt & Co.	Dil. HCl: Fibre black. Solution colourless.	Fibre black. Solution blue, after dilution greyish-blue.	No reaction.	No reaction.	Fibre at first black, then colourless.	Solution scarcely coloured.	Nitrous acid: Fibre violet-black, turns brown-red with ammonia. Picric acid: Fibre brown.
13	Hessian Purple B. Leonhardt & Co.	Conc. HCl: Fibre dark grey, nearly black.	Fibre grey-black. Solution pale blue.	No reaction.	Solution pale pink.	Fibre at first reddish-grey, then colourless.	No reaction.	Nitrous acid: Fibre dark purple-violet; with ammonia dark red-brown.
14	Azarine S. Meister, Lucius, & Brüning.	Fibre gradually brown-red. Solution scarcely coloured.	Fibre darker red. Solution brilliant red. On dilution both fibre and liquid turn yellow.	Fibre bluish-red. Solution cherry-red.	Similar to sodium hydrate, but less energetic.	On boiling, both fibre and solution turn yellow.	Solution scarcely coloured.	The tissue or yarn often smells of Turkey-red oil, the ash contains tin. Nitric acid: Orange spots. Nitrous acid: No reaction. If ammonia be added to the solution obtained by stannous chloride, fibre and solution turn violet.
15	Azo-eosin. Fr. Bayer & Co.	Fibre dark red-violet. Solution scarcely violet. On dilution the original colour is restored.	Like hydrochloric acid.	Fibre dirty orange.	Fibre scarlet-red. Solution not coloured.	Very little action in the cold. On heating fibre becomes decolourised.	No reaction.	Nitric acid: Brown spot, disappearing on washing.
16	Carmoisin. Fr. Bayer & Co.	Dil. HCl.: No rection. Conc. HCl.: Fibre dark violet, the original colour is restored after washing.	Fibre and solution blackish-violet.	Fibre turns slightly brown. Solution light pink.	Fibre unaltered. Solution pink.	Very little action in the cold. On heating fibre becomes decolourised.	No reaction.	Nitric acid: Brown violet spot, disappearing on washing.

Red Dyes—*continued.*

No.	Name of Dye and Maker.	HCl.	SO_4H_2.	NaOH.	NH_3.	$SnCl_2$ and HCl.	Alcohol.	Remarks.
17	Rhodamine. Bad. Anil. Sod. F.	Fibre brick-red. Solution colourless. The colour is restored after washing.	Like hydrochloric acid.	Fibre a little darker with a bluish tint. Solution uncoloured.	Fibre a little darker. Solution slightly pink and fluorescent.	No action in the cold. On heating fibre becomes brown-red. Solution slightly pink.	Extracts some dye and yields a fluorescent solution.	Nitric acid: Orange spot, disappearing on washing. Nitrous acid: No reaction. Rhodamine resists hot soap solution.
18	Primulin Red. Brooke, Simpson & Spiller.	Fibre red-brown. Solution pale red-brown.	Fibre black-violet. Solution the same colour, becomes red on dilution.	Fibre dirty dark brownish-red.	No reaction.	Fibre turns gradually reddish-brown.	No reaction.	Nitrous acid: No reaction. R. Geigy & Co. sells this dye under the name of Polychromin.
19	Alizarin S. with alum.	Fibre orange-yellow. Solution light orange.	Fibre orange-brown. Solution orange, turns yellow on dilution.	Fibre violet. Solution also violet.	Fibre dark-red. Solution colourless.	Fibre turns gradually orange. Solution yellow.	No reaction.	The yellow colour of the solution obtained with stannous chloride turns violet on the addition of sodium hydrate.
20	Alizarin S. with bichromate.	Fibre brownish-yellow. Solution yellow.	Fibre brown. Solution light brown-red, turns yellow on dilution.	Fibre and solution violet.	No reaction.	No action in the cold. On heating fibre turns brown-red. Solution pale-brown red.	No reaction.	Nitric acid: Orange-yellow spots.

Yellow Dyes.

No.	Name of Dye and Maker.	HCl.	SO_4H_2.	NaOH.	NH_3.	$SnCl_2$ and HCl.	Alcohol.	Remarks.
21	Quinoline Yellow. Bad. Anil. Sod. F.	Fibre more yellow. Solution colourless. On dilution the original colour of the fibre is restored.	Like hydrochloric acid.	Fibre at first dark yellow, gradually decolourised. The yellow colour is restored after washing.	Scarcely any action.	No reaction in the cold. On heating solution yellow. Fibre pale yellow.	No reaction.	Nictric acid: A dark yellow spot, probably caused by the action of nitric acid on wool.
22	Auramine. Bad. Anil. Sod. F.	Fibre nearly decolourised. Solution colourless. On dilution the original colour is almost restored.	Fibre decolourised. Solution colourless.	Fibre decolourised. Solution colourless. After washing the yellow colour is partly restored.	Fibre pale yellow. Solution colourless.	Fibre gradually decolourised in the cold; quickly on heating.	No reaction.	Nitric acid: A white spot, which gradually turns orange in the centre.
23	Chrysamine Fr. Bayer & Co.	Dil. HCl: Fibre pale yellow. Conc. HCl: Fibre reddish-brown. Solution light pink. On dilution yellow.	Fibre magenta red. Solution red-violet.	Fibre dark orange. Solution scarcely coloured.	Fibre light orange. Solution colourless.	Fibre slowly decolourised.	No reaction.	Nitric acid: Brown spot, which gradually turns reddish-grey.
24	Chrysophenin. Fr. Bayer & Co.	Dil. HCl: No reaction. Conc. HCl: Fibre blackish-violet. Solution scarcely coloured.	Fibre brown, then dark red-violet. On dilution blue.	Fibre unaltered. Solution pale yellow.	No reaction.	Fibre at first brownish-yellow, then decolourised.	No reaction.	Nitric acid: Violet spot. Nitrous acid: No reaction.
25	Hessian Yellow. Leonhardt & Co. Fr. Bayer & Co.	Dil. HCl: Fibre lighter. Conc. HCl: Fibre blackish-blue. Solution violet.	Fibre dark violet. Solution red-violet.	Fibre dark red. Solution light pink.	Fibre dark orange. Solution slightly orange.	Fibre pale yellow, gradually decolourised.	No reaction.	Nitric acid: Brown spot, with yellow edge. Nitrous acid: Like dilute hydrochloric acid.
26	Brilliant Yellow. Leonhardt & Co. Fr. Bayer & Co.	Dil. HCl: No reaction. Conc. HCl: Fibre dark violet. Solution scarcely coloured.	Fibre black-violet. Solution violet.	Fibre cherry-red. Solution slightly pink.	Like sodium hydrate.	Fibre dirty yellow; gradually decolourised.	No reaction.	....
27	Curcumin W. Act. Ges. Berlin. Leonhardt & Co.	Dil. HCl: No reaction. Conc. HCl: Fibre blackish-violet. Solution scarcely coloured.	Fibre black-violet. Solution violet. On dilution blue.	Like brilliant yellow.	Like on brilliant yellow.	Fibre brownish-yellow, then decolourised.	No reaction.	....
28	Tartrazin. Bad. Anil. Sod. F.	Fibre orange. Solution yellow.	Like hydrochloric acid.	Fibre orange. Solution orange-yellow.	Like sodium hydrate, but less energetic.	Decolourised on heating.	No reaction.	Nitric acid: No reaction.

Yellow Dyes—*continued.*

No.	Name of Dye and Maker.	HCl.	SO_4H_2.	NaOH.	NH_3.	$SnCl_2$ and HCl.	Alcohol.	Remarks.
29	Citronin. Gerber & Uhlmann.	Fibre dark red-violet. On dilution the red-violet turns to magenta-red.	Fibre dark violet. Solution violet.	Fibre yellowish-green. Solution colourless; turns yellow on dilution.	Fibre unaltered. Solution colourless.	Fibre yellow-brown, decolourised on heating. Solution yellowish.	Extracts traces of the dye.	Nitrous acid: At first red-violet spot, then magenta-red in the centre and violet at the edge.
30	Primulin Yellow. Brooke, Simpson, & Spiller.	No reaction.	Fibre at first dark yellow, then pale yellow.	Fibre orange-yellow. Solution colourless.	No reaction.	Scarcely any action.	No reaction.	Nitrous acid: Fibre dark orange, and, on the addition of ammonia, orange-brown. β-naphthol: Fibre red.
31	Toluylene Orange G. K. Oehler & Co.	Dil. HCl: No reaction. Conc. HCl: Fibre violet. Solution reddish. On dilution fibre and solution assume the original colour.	Fibre magenta-red. Solution slightly coloured.	Fibre light orange. Solution scarcely coloured.	No reaction.	Fibre at first pink, decolourised on heating. Solution colourless.	No reaction.	Nitrous acid: Fibre turns grey, and, on the addition of ammonia, the grey colour turns dirty yellow.
32	Toluylene Orange R. K. Oehler & Co.	Dil. HCl: Fibre pink. Conc. HCl: Fibre paler. Solution yellow. On dilution fibre turns pink. Solution flesh-coloured.	Fibre yellowish. Solution yellow.	Fibre orange. Solution colourless.	No reaction.	Fibre at first pink, gradually decolourised on heating.	No reaction.	Nitric acid: Red-violet spot, which gradually turns grey. Nitrous acid: Fibre greyish, and, on the addition of ammonia, reddish-grey.
33	Primulin Orange. Brooke, Simpson, & Spiller.	Fibre reddish-brown. Solution the same colour.	Fibre orange-brown. Solution dark red.	Fibre dark red-brown. Solution scarcely coloured.	No reaction.	Fibre orange-brown, then decolourised.	Extracts same dye.	Nitric acid: Red-brown spot.
34	Oriol. R. Geigy & Co.	Dil. HCl: No reaction. Conc. HCl: Fibre dark red. Solution light red. On dilution yellow.	Like hydrochloric acid.	Fibre orange-red. Solution colourless.	Fibre orange-yellow. Solution scarcely coloured.	Fibre at first pale yellow, gradually decolourised. Solution colourless.	No reaction.	Nitric acid: Pale orange-red spot. Nitrous acid: No reaction.
35	Crocein Orange. Fr. Bayer & Co.	Fibre reddish-brown. Solution pink.	Fibre darker. Solution orange. On washing the fibre assumes the original orange colour.	Fibre orange-brown. Solution scarcely coloured.	No reaction.	No reaction in the cold. On boiling nearly completely decolourised.	No reaction.	Nitrous acid: Blackish-brown spot. Bleaching powder: Fibre brownish, finally decolourised.
36	Anthracin. R. Geigy & Co. Derived from natural yellow dye-matters.	Fibre greenish-yellow. Solution the same colour. On dilution fibre and solution become colourless.	Like hydrochloric acid.	Fibre dark yellow. Solution pale yellow.	Fibre unchanged. Solution scarcely yellow.	Fibre lighter. Solution pale yellow. On boiling no further change takes place.	No reaction.	Nitric acid: Brown spot, which gradually becomes lighter in the centre. Iron perchloride: Fibre and solution olive-green. Alum does not produce a green fluorescence as it does with fustic. The ash contains chromium or aluminium.
37	Xanthaurin. R. Geigy & Co. Derived from natural yellow dye-matters.	Like on anthracin.	Like on anthracin.	Like on anthracin.	Like on anthracin.	Like on anthracin.	No reaction.	Anthracin and xanthaurin are probably derived from yellow berries.
38	Galloflavin. Bad. Anil. Sod. F. (Yarn mordanted with alum, cream of tartar, and stannic chloride.)	Fibre slightly darker. Solution yellow. On dilution fibre and solution nearly colourless.	Like hydrochloric acid.	Fibre a little darker and slightly orange. Solution yellow.	Fibre darker and pale olive-green. Solution nearly colourless.	No reaction.	••	Warmed with iron perchloride, fibre turns dirty green.

Green Dyes.

No.	Name of Dye and Maker.	HCl.	SO_4H_2.	NaOH.	NH_3.	$SnCl_2$ and HCl.	Alcohol.	Remarks.
39	Resorcin Green. Durand & Huguenin.	Fibre yellowish-grey. Solution orange red.	Fibre light brown. Solution the same.	Fibre dark green. Solution very pale green.	No reaction.	Slight decolourisation. Solution brown.	No reaction.	Nitric acid: Yellow brown spots. The ash contains iron.

No.	Name of Dye and Maker.	HCl.	SO_4H_2.	NaOH.	NH_3.	$SnCl_2$ and HCl.	Alcohol.	Remarks.
	BLUE DYES.							
40	Victoria Blue. Bad. Anil. Sod. F.	Fibre at first blue-black. Solution red. On dilution turns at first green, then blue.	Like hydrochloric acid.	Fibre dark brown-red. Solution colourless.	Fibre black-blue. Solution colourless.	Fibre dark blue in the cold. On boiling, greenish blue. Solution warm, green; cold, light blue.	Extracts same dye in the cold: considerably more on boiling.	Nitric acid: At first black spot, which gradually turns red-brown. On the addition of ammonia the colour changes to yellow-brown, and remains permanent after washing.
41	Azo-Blue. Fr. Bayer & Co.	Dil. HCl: No reaction. Conc. HCl: Fibre blackish-blue. Solution colourless.	Fibre bluish-black. Solution blue.	Fibre cherry-red. Solution pale pink.	Fibre violet-red. Solution pink.	Fibre at first black-blue, slowly decolourised.	No reaction.	Picric acid: Fibre blackish-brown.
42	Benzo-azurin G. Fr. Bayer & Co.	Fibre blue-black. Solution colourless.	Fibre black-blue. Solution greenish-blue. On dilution more reddish-blue.	Fibre dark red. Solution pale pink.	Fibre dark violet. Solution cherry-red.	Slowly decolourised.	No reaction.	On boiling with soap solution the liquid turns intensively blue.
43	Basle Blue. Durand & Hüguenin.	Fibre dark grey. Solution yellow. On dilution fibre turns blue again.	Fibre at first blue-black, then green, finally yellowish. Solution yellow. On dilution both turn blue again.	Fibre darker	No reaction.	No reaction.	Solution pale blue.	Nitric acid: Black spot.
44	New Blue. Casella & Co.	Fibre reddish-violet.	Fibre dark grey. Solution grey.	Fibre brownish-violet. Solution pale pink.	Like sodium hydrate.	Fibre at first green, then decolourised. Solution colourless. Turns in the air at first green, then blue.	Solution pale blue.	....
45	Nile Blue. Bad. Anil. Sod. F.	Fibre at first greenish, then orange-yellow. Solution orange-yellow.	Fibre and solution brown-red. On dilution at first yellow, then green, and finally blue again.	Fibre red. Solution pink.	Fibre violet.	Fibre at first green, then decolourised. Solution colourless, turns blue in the air.	Solution pale blue.	Nitric acid: At first yellow spot, then green in the centre and yellow at the edge.
46	Naphthylene Blue G. Fr. Bayer & Co.	Fibre brownish-violet. Solution brown-orange.	Fibre brown-black. Solution dark brown. On dilution dirty blue.	Fibre brown. Solution brown-orange.	Fibre brownish-violet. Solution light pink.	Fibre decolourised. Solution colourless.	Solution pale violet.	Vapours of hydrochloric acid change the blue colour of the fibre to chocolate-brown.
	VIOLET DYES.							
47	Fast Violet.	Fibre dark blue-black. Solution pale blue.	Fibre black. Solution grey-blue. On dilution at first greenish-blue, finally red.	Fibre black-blue. Solution pale violet.	Fibre unchanged. Solution pale violet.	Fibre decolourised slowly in the cold, quickly on boiling.	Solution scarcely coloured.	Nitric acid: Blue-black spot.
48	Azo-violet.	Dil. HCl: Fibre blue. Conc. HCl: Fibre blackish-blue. Solution colourless.	Fibre black-blue. Solution bluish-green.	Fibre red. Solution colourless.	Fibre dark violet. Solution pale magenta-red.	Fibre very slowly decolourised.	No reaction.	Picric acid: Fibre black. Dilute acetic acid: Fibre blue.
49	Hessian Violet.	Fibre dark blue. Solution scarcely coloured.	Fibre dark violet-blue. Solution black-blue. On dilution blue-violet.	Fibre red. Solution colourless.	Fibre red. Solution pale violet-red.	Fibre at first blue, is decolourised on long continued boiling.	No reaction.	Nitric acid: White spot with blue edge. Nitrous acid: Fibre dirty grey-violet is turned dirty red on the addition of sodium hydrate.
50	Heliotrope.	Dil. HCl: Fibre dark violet. Conc. HCl: Fibre black-blue. Solution light blue. On dilution violet.	Fibre black-blue. Solution blue.	Fibre dark red. Solution colourless.	No reaction.	Fibre at first dark grey, is slowly decolourised.	No reaction.	Nitrous acid: Fibre greenish-grey. Washed and treated with ammonia turns bluish-orange. Solution pale brown. Picric acid: Fibre dark brown.
51	Acid Violet 7 B. Fr. Bayer & Co.	Fibre green. Solution yellowish-brown. On dilution greenish-blue.	Fibre black, then brown, finally brown-red. Solution brown-red. On dilution green-blue.	Fibre quickly decolourised. Solution colourless.	Like sodium hydrate.	Fibre fine green. Solution blue-green. On dilution fibre and solution blue.	Solution scarcely coloured.	Nitric acid: At first olive-green spot, then dirty yellow spot.

No.	Name of Dye and Maker.	HCl.	SO_4H_2.	NaOH.	NH_3.	$SnCl_2$ and HCl.	Alcohol.	Remarks.
	VIOLET DYES—*continued.*							
52	Gallocyanin. Durand & Huguenin.	Fibre and solution unchanged.	Fire dark blue. Solution intensively blue. On dilution light magenta-red.	Fibre black-violet. Solution dirty purple-violet.	Like sodium hydrate, but less energetically.	Fibre grey. Solution colourless.	No reaction.	Nitrous acid: Fibre dirty grey-violet. Solution at first blue-green, then green, finally yellow.
53	Muscarin. Durand & Huguenin.	Fibre blue-black. Solution dirty blue.	Fibre greenish-black. Solution greenish. On dilution dirty violet.	Fibre brownish-black. Solution scarcely coloured.	Fibre violet-blue. Solution pale violet.	Fibre blackish. On heating blue, then green, finally yellowish-grey.	No reaction.	Nitric acid: Black spot.
	BROWN DYES.							
56	Benzo-brown. Fr. Bayer and Co.	Dil. HCl: Fibre reddish-brown. Conc. H.Cl: Fibre darker. Solution purple-red.	Fibre brown-black. Solution dark brown.	No reaction.	No reaction.	Fibre lighter and yellowish. Solution brownish-yellow.	Extracts traces of dyestuff.	Benzo-brown resists light, but very badly.
55	Anthracene Brown. Bad. Anil. Sod. F.	Fibre yellow and lighter. Solution greenish-yellow.	Fibre lighter with a reddish tint. Solution pure brown. On dilution yellow.	Fibre black. Solution grey.	Fibre brownish-grey. Solution scarcely coloured.	Fibre and solution brownish-yellow.	Extracts traces of dyestuff.	Nitric acid: Black spot.
56	Fast Brown R. G. Act. Ges. Berlin.	Fibre dark red-violet. Solution violet. On dilution fibre becomes brown again.	Like hydrochloric acid.	Fibre brilliant dark red. Solution cherry-red.	Like sodium hydrate.	Fibre at first darker, quickly decolourised on boiling.	No reaction.	Nitric acid: Black spot, turning quickly light red-brown.
	BLACK DYES.							
57	Cachou Laval.	Fibre unchanged. Solution pale grey.	Fibre lighter with a yellow tint.	No reaction.	No reaction.	Fibre reddish-brown.	No reaction.	Cloth or yarn is rarely dyed with cachoo laval alone.
58	Alizarin Black. Bad. Anil. Sod. F.	Fibre unchanged. Solution pale greenish-blue.	Like hydrochloric acid.	Fibre unchanged. Solution pale blue.	No reaction.	No reaction in the cold. On boiling fibre brown. Solution yellow.	No reaction.	Nitric acid: After some minutes a dark olive-green spot.
59	Brilliant Black. Bad. Anil. Sod. F.	Fibre unchanged. Solution pale red-violet.	..	Fibre greenish-black. Solution violet-black.	Fibre unchanged. Solution black-violet.	On boiling fibre dark red, finally almost decolourised. Solution colourless.	No reaction.	Nitric acid: Dark red-brown spot.
60	Naphthol Black. Meister, Lucius, & Brüning.	Fibre unchanged. Solution reddish.	Fibre unchanged. Solution olive-green.	Fibre unchanged. Solution pale red.	No reaction.	On boiling fibre light green, turns blue after washing.	No reaction.	Nitric acid: Brown spot after some time. This dye is a mixture of green, violet, orange, indulin, &c. The wool assumes a fine black colour with a violet shade.
61	Resorcin Black. Durand & Huguenin.	Fibre yellow-grey. Solution orange-brown.	Fibre and solution brown.	Fibre unchanged. Solution pale green.	No reaction.	Fibre and solution light brown.	No reaction.	Nitric acid: Brown yellow spot. The ash contains iron.
62	Wool Black. Act. Ges. Berlin.	Fibre unchanged. Solution light blue. On dilution pink.	Like hydrochloric acid.	No action in the cold. On boiling fibre dark violet. Solution violet.	No reaction.	Fibre decolourised.	No reaction.	Nitric acid: Light red-brown spot.

—S. H.

Use of the Osmometer in Sugar Manufactories. Leplay. Sucrerie Indigène **31**, 550.

THE author is making a number of experiments with the osmometer described in Dingl. Polyt. J. **268**, 275 (this Journal 1888, 509). When working with pure cane sugar solutions, he finds that :—

1. The rate of diffusion of a sugar solution is proportional to its density at all temperatures.
2. The diminution in the rate of diffusion and in the density is greater at high than at low temperatures.
3. The rate of diffusion of hot solutions is four times greater than for cold ones of the same density.
4. The density of the diffusion liquid increases, at all temperatures, inversely as the density of the original solution.
5. The influence of the density of the sugar solution on the loss of cane sugar by diffusion is the same at all temperatures.
6. At a temperature of 80°—82° C. the loss of sugar by diffusion is about twice as great as it is at 18°—20° C.—H. T. P.

The Chloroform Test in the Valuation of Ground Bones. E. Heiden. Chem. Zeit. **12**, 1341.

CHLOROFORM is an excellent reagent for detecting the presence of nitrogenous substances added to bone-meal, such as ground horn, blood (dried), and leather, and also for quantitatively estimating them, since they are lighter than chloroform whilst the bone-meal is heavier.

In the case of 200 bone-meals this test had been used and the substances separated by its means had contained on the average 12 per cent. of nitrogen. However, it is shown that if fatty matter be present an error may creep in. The fatty matter must first be extracted or else some bone-meal would be reckoned as if superfluity. In the case of pulverised bone-meals especially, a microscopic examination ought to be used in conjunction with the chloroform test, and it is pointed out that in all cases, though a valuable method, it should be supported by microscopic and also by a chemical examination.—W. S.

Determination of Glycerol by Oxidation. V. Planchon. Compt. Rend. **107**, 246—247.

Fox and Wanklyn's method, which consists in oxidising the glycerol in alkaline solution with permanganate ($C_3H_8O_3 + O_6 = CO_2 + C_2H_2O_4 + 3\,H_2O$) has the disadvantage that a voluminous precipitate of MnO_2 has to be washed thoroughly, which entails much loss of time. The author finds that glycerol may be oxidised by permanganate in acid solution, only CO_2 and water being formed ($C_3H_8O_3 + 7\,O = 3\,CO_2 + 4\,H_2O$). The latter is weighed by allowing it to pass through U-shaped tubes filled with soda-lime. The method gives satisfactory results.—A. R.

PATENT.

A Process for Testing or Estimating the Strength of Solutions of Tannin. B. Nicholson, South Norwood, and T. Palmer, Sevenoaks. From C. Collin and L. Benoist, Paris, France. Eng. Pat. 15,667, November 15, 1887. 6*d*.

THIS process for the estimation of tannin consists in titrating a solution of gelatin and an aniline colour with the tannin solution.

The following solutions are used:—A 5 per cent. solution of gelatin in water; a 5 per cent. solution of methylene blue in water; a 5 per cent. solution of acetate of lime or other suitable salt; and a 5 per cent. solution of pure tannin, by means of which the gelatin solution is standardised. To perform an estimation, 0·5 cc. of the gelatin solution is placed in a test glass, and two drops of the blue solution, with 5 cc. of the acetate of lime. The solution is diluted to 80 cc. with distilled water at a temperature of 55°—66° C. The tannin solution is gradually added from a burette till all the gelatin is precipitated, and the solution becomes colourless.—B. H.

New Books.

CHEMIKER KALENDER, 1889. Ein Hülfsbuch für Chemiker, Physiker, Mineralogen, Industrielle, Pharmaceuten, Hüttenmänner, u.s.w., mit einer Beilage. Von. Dr. RUDOLF BIÈDERMANN. *Zehnter Jahrgang.* Verlag von Julius Springer, Monbijou-Platz, 3, Berlin, N. H. Grevel & Co., 33, King Street, Covent Garden, London.

SMALL 8vo. volume in pocket-book form, price 3*s*., containing Table of Contents; Chronological Table of important Occurrences and Discoveries, during the Christian era, relating to Chemical and Physical Science; Calendar, with blank pages for notes; Table of more frequently used Atomic Weights. After the Calendar are some 28 pages of blank ruled paper for memoranda, &c. Next follows a complete set of Tables supplying almost every imaginable want of the chemist that can be supplied by such means. The work closes with a few pages ruled for the record of names and addresses, fly-leaves at the end supplying the German Post Office Regulations, and a complete railway map of the German Empire. The text fills 297 pages, a small volume forming an Appendix to the Kalender. In this are to be found tabulated matter for physicists, and at the end an Appendix giving information as to the Professors and Docenten in the various Polytechnic Schools and Universities, and to the subjects taught in those Institutions. A tabulated list is added of the prices of the various kinds and sizes of the more important articles of chemical apparatus. With the Kalender is also given a set of groups of statistics of general interest, contained in a small four-page leaflet, amongst which is one relating to emigration. Out of the 99,712 Germans emigrating to foreign lands in 1887, no fewer than 95,976 made for the United States.

Trade Report.

(From the Board of Trade and other Journals.)

BOARD OF TRADE NOTICES.

PROSECUTIONS UNDER THE FOOD AND DRUGS ACT FOR ADULTERATION OF OLIVE OIL WITH COTTON-SEED OIL.

The Board of Trade has received a communication to the effect that the first prosecution under the provisions of the Food and Drugs Act for the adulteration of olive oil with cotton-seed oil has been undertaken at Burton-on Trent. It appears, from the *Grocer* of the 28th October last, that a tradesman of that town purchased, through a London house, direct from Italy, a large quantity of olive oil, which he was given to understand was perfectly pure. A sample of the oil was taken by the inspector under the Sale of Food and Drugs Act, and, upon analysis, it was found to contain no less that 50 per cent. of cotton-seed oil. Thereupon proceedings were taken, and a small fine imposed.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

FRANCE.

The Legal Tare on Heavy Oils and Petroleum Tars.

The Director-General of French Customs, in a circular dated the 22nd September last, calls the attention of French Customs officials to the fact that, by a decree inserted in the *Journal Officiel*, the legal tare applicable to heavy oils and tars of petroleum in petroleum casks is fixed at 17 per cent.

ITALY.

Classification of Articles in Customs Tariff.

"*Fenacetina*" (phenacetine) is analogous to "*acetanilidi*" (acetanilide) or "*antefebrina*" (antifebrine), and should be classified among the alkaloids not specified (*see* Category 33*b*.).

THE NETHERLANDS.

Customs Classification of Saccharine.

The *Moniteur Belge* for the 6th October last states that saccharine should be considered, according to the present Dutch legislation respecting import duties, as an article of grocery chargeable with a duty of 5 per cent. *ad valorem*. Saccharine is also imported under the head of "benzoylsulfinide acid."

NEW CUSTOMS TARIFF OF NEW ZEALAND.

The following statement, supplementing the information published on pp. 145 50 of the *Board of Trade Journal* for August last, shows the rates of Customs Duties now levied on imports into New Zealand, in accordance with the new Customs Act of the House of Representatives of New Zealand, passed on the 20th July last:

Articles.	Rates of Duty.			
		£	*s.*	*d.*
Acid, acetic	Lb.	0	0	1½
Acid, tartaric	"	0	0	1
Baking powder	15 °/₀ *ad val.*			
Blue	Lb.	0	0	2
Cement	Barrel	0	2	0
Cream of tartar	Lb.	0	0	1
Drugs and druggists' sundries	15 °/₀ *ad val.*			
Essences, flavouring	15 °/₀ *ad val.*			
Gelatin	15 °/₀ *ad val.*			
Glucose	Lb.	0	0	1
Glue and size	"	0	0	1½
Glycerin, refined	15 °/₀ *ad val.*			
Ink, writing	20 °/₀ *ad val.*			
Naphtha	Gallon	0	0	6
Oil, mineral	"	0	0	6
Oil, olive or vegetable, in bulk	"	0	0	6
Paints and colours ground in oil	Cwt.	0	2	0
Photographic chemicals, not otherwise enumerated	15 °/₀ *ad val.*			
Saccharine	Oz.	0	5	0
Soap, common	Cwt.	0	5	0
Soap, scented and fancy	25 °/₀ *ad val.*			
Soap powder and soft soap	20 °/₀ *ad val.*			
Soda ash	Cwt.	0	1	0
Soda carbonate and bicarbonate	"	0	1	0
Soda crystals	"	0	2	0
Starch	Lb.	0	0	2
Spirits, methylated	Liq. gall.	0	1	0
Stearine	Lb.	0	0	1½
Sugar	"	0	0	0¾
Sulphur	Cwt.	0	0	6
Syrups	20 °/₀ *ad val.*			
Varnish	Gallon	0	1	6
Washing powder	20 °/₀ *ad val.*			

The following articles are free of duty:—

Acids, nitric and pyrogallic; alum; arsenic; borax; dyestuffs and dyeing materials, crude; essential oils; gelatin dry plates; glycerin, crude; gum arabic and tragacanth; gutta-percha, not otherwise enumerated; nitrate of silver; palm oil; paints, not otherwise enumerated; paper, albuminised; pearl-ash; phosphorus; potash; saltpetre; soda, caustic, soda sulphate; strychnine; tanning materials, crude; spirits of tar.

THE QUEENSLAND TARIFF.

The Queensland Government has submitted an important new Tariff Bill with a protectionist tendency, in which it is proposed to pretty generally double the present rates of duty on imported goods. We give the proposals as far as they relate to drugs and chemicals:—

Articles.	Present Tariff.	Proposed Tariff.
Acid—		
Acetic, carbolic, carbolic (pure), muriatic, nitric, oxalic, picric	7½ per cent.	15 per cent.
Sulphuric	"	2*s.* 6*d.* per cwt.
Tartaric and other	"	15 per cent.
Alkali soda—		
Ash	"	Free.
Bicarbonate and caustic	"	15 per cent.
Crystals	1*s.* per cwt.	2*s.* per cwt.
Silicate of	7½ per cent.	15 per cent.
Arrowroot	1*d.* per lb.	1*d.* per lb.
Arsenic	7½ per cent.	15 per cent.
Brushware	"	"
Drugs and druggists' wares	"	"
Dye	"	"
Earthenware	"	"
Extract of meat	2*s.* per doz. lbs.	4*s.* per doz. lbs.
Glass—Bottles, plate, window	7½ per cent.	15 per cent.
Glassware	"	"
Glue	2*d.* per lb.	2*d.* per lb.
India-rubber goods	7½ per cent.	15 per cent.
Lime juice	"	"
Machinery	5 per cent.	15 per cent., with exceptions.
Oil—Castor	1*s.* per doz. pints.	2*s.* per doz. pints
Cod liver	6*d.* per gallon	1*s.* per gallon
In bottles	..	2*s.* per doz. pints
Opium	20*s.* per lb.	20*s.* per lb.
Pepper	2*d.* per lb.	3*d.* per lb.
Perfumery and pomades	7½ per cent.	15 per cent.
Photographic goods	"	"
Quicksilver	Free	Free
Saltpetre	4*s.* per cwt.	4*s.* per cwt.
Sarsaparilla	4*s.* per gallon	5*s.* per gallon, and bitters.
Seeds	7½ per cent.	15 per cent., and garden free.
Seltzer water	"	15 per cent.
Soap	5*s.* per cwt.	10*s.* per cwt.
Spices	2*d.* per lb.	3*d.* per lb.
Spirits	12*s.* per gallon	12*s.* per gallon
Perfumed	"	20*s.* per gallon
Methylated	5*s.* per gallon	5*s.* per gallon
Sponge	7½ per cent.	15 per cent.
Strychnine	"	"
Sulphur	"	"
Turpentine	6*d.* per gallon	6*d.* per gallon
Varnish	7½ per cent.	15 per cent.

—*Chemist and Druggist.*

TONQUIN.

Regulations as to Imposition of Import Duties.

The following statement, which has been prepared in the Department mainly from the *Tariff Officiel des Douanes de France*, has been forwarded to a correspondent in reply to a question as to whether goods sent to France for finishing (bleaching, dyeing, or printing), and intended for ultimate re-shipment, incur the full import duties, seeing that they are not intended to remain for home consumption.

Under the conditions of the régime of temporary admission ("*admission temporaire*") the privilege of entry into France free of duty is extended to certain articles under certain conditions. One condition is that the goods are to be re-exported or warehoused within a stated period, varying for particular articles, the period being in no case extended beyond six months. Another condition is that the importation and re-exportation of all such articles may only take place at certain specified places; and a further one is that the goods are to be represented at re-exportation or warehousing by a certain proportion of manufactured produce.

The following is a list of the articles to which the conditions of temporary admission are applied, with the state in which they are to be re-exported:—

Bromides	Bromide of potassium.
Chlorate of potash	Chlorates of soda and baryta.
Coal tar ("essence de houille")	Aniline.
Garancine (root)	The same, ground.
Cloves	Essence of cloves.
Seeds, oleaginous	Oils of the same.
Raw seed oils	The same, purified.
„ olive oil	„ „ „
„ palm oil	Candles or oleic or stearic acids.
Iodine of all kinds	The same crystallised, or iodoform or iodide of potassium.
Potash and carbonate of potash	Prussiate of potash crystallised.
Cinchona or Peruvian bark	Sulphate or other salts of quinine.
Tartar	Cream of tartar or tartaric acid.

UNITED STATES.

Classification of Articles in Customs Tariff.

An article claimed by the importers to be dye-wood extract, but which upon analysis was found to consist of an extract of logwood mixed with a salt of copper, so as to constitute in fact a lake colour, is held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 87) for "colours and paints, including *lakes*, whether dry or mixed."

Certain so-called "refuse bone-black," which upon chemical analysis was found to be a substance commercially known as "bone-char," which had lost some of its properties in the line of its special efficacy, is held to be dutiable at the rate of 25 per cent. *ad valorem*, under the special provision for "bone-char" contained in Schedule A. (T. I., 88), notwithstanding the fact that it might not be valuable in its present condition for the uses to which bone-char is usually adapted.

MISCELLANEOUS TRADE NOTICES.

THE DYEING OF SMYRNA CARPETS.

The *Journal de la Chambre de Commerce de Constantinople* for the 27th October has a notice to the effect that the Government of Aidin has recently enjoined the makers of carpets, known as "Smyrna," to use in their works vegetable dyes, as has been formerly done, and not aniline colours. Offenders against these regulations will be severely punished.

CONDITION OF CHILIAN TRADE.

The Belgian *Bulletin du Musée Commercial* for the 20th October last, remarks that the importance of the export of guano from Chili has lately been declining in consequence of the successful competition of the artificial manures which are now prepared from phosphates. The product of the Chilian guano in 1887, collected from the islands of Lobos de Afruea, Punta de Lobos, and Pabellon de Pico, represented a value of about 90,000*l*., while 7,410*l*. of this had to be paid to Peru, as representing 5 per cent. of the guano of Lobo, in conformity with the treaty of peace of 1883.

On the other hand, the export of saltpetre is developing; in the course of last year, the province of Tarapaca exported 712,000 tons of this article. The Chilian Senate has adopted the bill for selling the concessions of saltpetre belonging to the State in the newly-annexed Tarapaca region. This property is divided into 67 concessions, and was obtained by the Government at the price of 5,800,000 dollars.

NATURAL WEALTH OF THE NORTHERN TERRITORY OF SOUTH AUSTRALIA.

See Board of Trade Journal, November, p. 567.

STATISTICAL SKETCH OF JAPAN.

Ib., p. 576.

MOZAMBIQUE AS A FIELD FOR COMMERCIAL ENTERPRISE.

Ib., p. 586.

CUSTOMS REGULATIONS FOR THE LOWER ELBE.

Ib., p. 589.

CAFFEINE MANUFACTURE.

A few months ago we drew attention to the success which attended the efforts of the Chemical Trade Section of the London Chamber of Commerce to induce the Customs authorities to give facilities for the manufacture of caffeine in this country. While it was necessary that producers here should pay a duty of 6*d*. per pound on all tea, damaged or otherwise, which they got from the warehouses, it was impossible for them to compete with the Germans, who obtained all they wanted at a nominal cost, little more than that involved in taking the tea away. Now, however, the Customs authorities in the United Kingdom allow manufacturers of caffeine to obtain the damaged tea without payment of duty, provided they comply with certain very reasonable conditions, and provided, also, that the tea is so "denatured" with lime and assafœtida as to make it absolutely unfit for human consumption. Though this is the case, the elements from which the caffeine is extracted are not destroyed. Already considerable quantities of the new product have been produced here, and the effect on the German drug market has been startling, as the demand for English and American consumption can be met without sending to Germany for supplies. Those who predicted the transfer of this business to the English producers have not had long to wait for the change they anticipated. Nor have the Germans themselves been slow to recognise the loss they have incurred, and we have recently seen German trade papers and trade circulars in which the decline of the caffeine industry is admitted. The figures on the subject are conclusive. At the beginning of 1860 caffeine was quoted in Germany at 700 marks per kilo.; 10 years later it was only worth 200 marks; last year the price fell to 70 marks; and now it is valued at only 40 marks. At this price the drug ceases to be remunerative to the German manufacturers. The current price in England is now about 15*s*. per lb., or 30 marks per kilo.; and as the British manufacturer can produce large quantities at the same rate, he has practically secured the trade, not only at home, but even in Germany and the United States, which uses over 4,000 lbs. weight of caffeine every year. The *Pharmaceutische Zeitung*, published in Berlin, and dated the 10th of last month, devotes about a column to the question of caffeine production in England, in which the facts already given in this Journal are fully stated, but the article is interesting as a sorrowful admission that, instead of Germany in future supplying all the world, she will now have to draw her supplies from Great Britain. The Chemical Section of the London Chamber have, therefore, every reason to be satisfied with their success in wresting an important industry from the Germans, thus reversing the previous course of things.—*Chamber of Commerce Journal.*

MEETING OF CHEMICAL MANUFACTURERS IN LIVERPOOL.

The makers of bleaching powder met on the 1st instant, and decided to prolong their association's existence. It practically includes the whole of the makers of bleaching powder in the United Kingdom, and through its operations the position of the chemical trade had been greatly changed. It will be continued from month to month, for the year 1889, pending the formation of a new association on broader lines, to include the caustic soda and chlorate of potash associations, with the object of regulating the decomposition of salt and the production of chlorine and alkali products. The newer process of manufacture of soda crystals threatened the existence of the older process; but the latter had a by-product not included in those of the newer. It seems to be the belief of chemical makers now that alkali is more able to take care of itself, and that next year it will command much higher prices.—*British and Colonial Druggist.*

DEPOSITS OF COAL, SALT, &c. IN THE DON TERRITORY.

At a meeting of the Russian Physico-chemical Society at St. Petersburg, Mendelejew called attention to the rich deposits of coal, salt, iron, and mercury ores in the Don territory, and stated that this district had, in his opinion, a large industrial future before it. Accumulations of firedamp in the coal mines were almost unknown, as the shafts were not deep enough, and open lamps were used.

The following is the composition of a sample of gas issuing from a coal fissure in one of these shafts:—

—	CH_4.	H.	CO_2.	N.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
I.	20·5	7·5	2·7	69·3
II.	13·6	5·8	3·2	77·4

—O. H.

FRAUDULENT MERCHANDISE MARKS BILL.

A measure, known as the Fraudulent Merchandise Marks Bill, has been introduced into the Indian Viceregal Council. It prohibits the importation of goods with false trade marks or descriptions, and goods made abroad but having the name or mark, or a colourable imitation of the names or marks, of manufacturers in the United Kingdom, unless accompanied by a definite indication that such goods have been made abroad. The penal code in force in India respecting false trade marks is made strictly applicable to all cases coming within the scope of the new measure. The Bill has the general support of the mercantile community in the United Kingdom and in India.—*British and Colonial Druggist.*

REWARDS FOR MERITORIOUS DISCOVERIES AND INVENTIONS.

The Committee on Science and the Arts of the Franklin Institute, of the State of Pennsylvania, inform us that the committee is empowered to award, or to recommend the award of, certain medals for meritorious discoveries and inventions which tend to the progress of the arts and manufactures. These medals are:—(1.) The Elliott Cresson gold medal, which was founded by the legacy of Elliott Cresson, Philadelphia, and conveyed to trustees of the Franklin Institute. (2.) The John Scott legacy premium and medal ($20 and a medal of copper), founded in 1816 by John Scott, a merchant of Edinburgh, Scotland, who bequeathed to the city of Philadelphia a considerable sum of money, the interest of which should be devoted to rewarding ingenious men and women who make useful inventions. Upon request from interested parties, made to the secretary of the Franklin Institute, full information will be sent respecting the manner of making application for the investigation of inventions and discoveries; furthermore, the Committee on Science and the Arts will receive and give respectful consideration to reports upon discoveries and inventions which may be sent to it with the view of receiving one or other of the awards herein named, and full directions as to the manner and form in which such communications should properly be made will be sent on application.

STATE AID TO INDUSTRY IN GERMANY.

Not only has the Prussian Government fitted up mechanical and technical testing establishments at Charlottenburg and in the Royal chemico-technical laboratory in Berlin, at which establishment technical novelties are tested as to their practicability and usefulness, but they also afford direct pecuniary support to such technical experiments. We hear, for instance, that the Prussian Minister of Public Works has ordered the experiments with ferrosilicon at the Gleiwitz smelting works to take place at the expense of the Government. This will be highly appreciated by our ironfounders, who are following these experiments with lively interest.—*Kuhlow.*

SYNDICATE TO GOVERN THE SUPPLY OF KAINITE.

The *Chemiker Zeitung* says:—As we have already informed our readers in No. 85, a syndicate has been formed to govern the supply of kainite after long continued negotiations between the interested firms in Berlin. The arrangement continues in force for ten years. Accounts appeared in the daily papers immediately after the formation of the syndicate, giving accounts of the arrangements made, some of which partially misrepresent the facts. We are in the position to give the following accurate statistics as to the supply both of carnallite and kainite, those relating to carnallite having been previously published by us:—

——	CARNALLITE.		KAINITE.	
	For Manufacturing Purposes.	Agriculture, Bath Salts, &c.	Crude for Agriculture.	Working up for Conc. Salts.
	Per Cent.	Per Cent.	Per Cent.	Cwt.
Royal Prussian Works, Stassfurt..............	$18\frac{12}{15}$	20	18·125	1,300
Herzagl. Anh. Saltworks, Leopoldshall..........	$18\frac{12}{15}$	20	18·125	1,300
Consol. Alkali Works, Westeregeln	$14\frac{8}{15}$	10	15·0	800
Neustassfurt Mining Co., Löderburg	$14\frac{8}{15}$	30	18·125	1,800
Potash Works, Aschersleben Mining Co......	$14\frac{8}{15}$	5	18·125	*2,000
Ludwig II. Mining Co., Stassfurt..............	$10\frac{12}{15}$	10	..	..
Vienenburg Potash Works, Vienenburg...........	$7\frac{12}{15}$	5	12·500	..

* Or 2,800 cwts. Schoenite.

The normal demand for kainite is therefore calculated at 7,200 cwts. per diem. If this be decreased, the division is effected by only diminishing the production of the Consol. Alkali Works, Westeregeln, after that of each of the first two-mentioned works has been lowered by 800 cwts. A rise in the daily demand is met by raising the production of the two Government works and of the Consol. Alkali Works until it has reached 1,800 cwts. a day, a further rise being then equally divided with Neustassfurt. The amount required above 10,000 cwts. a day is shared equally among all five works.

MANUFACTURE OF SPIRITS IN BOND.

We hear that the vexed question of drawback on spirituous preparations manufactured in this country for export has been practically settled in a manner which will be entirely satisfactory to our exporters. The conditions upon which the drawback will be allowed are to be published almost immediately, and, though their precise terms are still more or less unknown, it is stated that the Excise authorities have given up their previous contention that the preparations should only be exported in bottles or containers of three distinct sizes. It is stated that each package on which the drawback is allowed will be provided with an official declaration to the effect that the tinctures it contains are of the alcoholic strength prescribed in the B.P The new regulation will be put in force almost at once, and is expected to enable British exporters to cope on equal terms with the German manufacturers.—*Chemist and Druggist.*

EXTRACTS FROM BRITISH AND FOREIGN CONSULAR REPORTS.

DUTCH COLONIES.

Drug Exports into Surinam.

The production of arrowroot and indigo in the Dutch colony of Surinam (Netherlands Guiana) is receding, but on the other hand there is an extension in the cultivation of cocoa. Among the exports of pharmaceutical articles are:—

——		1884.	1885.	1886.
Arrowroot	Kilos.	482	328	185
	Value florins	487	328	185
Orange peel	Kilos.	6	..	5
	Value florins	2	..	1
Quassia wood	Kilos.	..	1,095	2,565
	Value florins	..	22	52
Tamarinds	Kilos.	27	243	46
	Value florins	11	98	19
Tonquin beans	Kilos.	1,570	348	190
	Value florins	1,570	348	190

Imports of Drugs.

Considering the sparsity of the population which, excluding Bushniggers and Indians, was only 56,869 in 1886, and the unfavourable economical condition of the colony, the imports of drugs and chemicals are fairly considerable, the figures (in Dutch florins of 1*s.* 8*d.* sterling) for 1886 being: chemicals, 29,762 fl.; dyestuffs, 70,732 fl.: varnish paints, 1,456 fl.; mineral waters, 20,961 fl.; opium, 11,680 fl.; perfumery, 2,785 fl.; soap (toilet), 2,405 fl.; soap (common), 34,742 fl.; tea, 22,048 fl.

ECUADOR.

Guayaquil Cinchona.

The shipments of cinchona bark from Guayaquil in 1887 were: to the United Kingdom, 35,804 Spanish lbs.: to Spain, 300 Spanish lbs.; to the United States, 11,758 Spanish lbs.; to France, 1,100 Spanish lbs.; and to other parts, 5,915 Spanish lbs.; a total of 54,877 Spanish lbs.

STRAITS SETTLEMENTS.

Singapore Drug Exports.

The following articles of pharmaceutical interest were exported from Singapore in 1887, the unit being given in piculs of $133\frac{1}{3}$ lbs.: Gambier (block), 579,389; gambier (cube), 48,260; cutch, 257; gum damar, 5,000; dragons' blood, 47; gum benjamin, 884; copal, 31,354; sticklac, 2,686; nutmegs, 3,473; mace, 172; pepper (black), 178,268; pepper (white), 32,461.

TURKEY IN ASIA.

Olive Oil.

The three principal districts furnishing the oil which is brought to Smyrna as a central market are Mytilene, Aivali, and Edremite, and the district of Yerli, to which must be added the gardens of the Caister and Maunder valleys. The oil is all pressed locally, steam presses having of late been erected in many parts in addition to the old hand presses. Perhaps the most perfect pressing plant is found in the island of Mytilene, the largest, which is the property of an English lady, being at Yera, on the Porte-Oliveiro. There, and also at Aivali, olives are also used in the manufacture of soap for local consumption. The oil is generally brought to market in sheep or goat skin sacks, containing from 1 to $1\frac{1}{2}$ cwts. Old petroleum casks are also used, but, being generally leaky, they do not answer very well. The oil is shipped to all parts of Europe and America, and the fact that it acquires the taste of the skin which serves as a container does not matter very much, considering that most of it is used for technical and illuminating purposes. As an illuminant it is mostly employed in Russia for the church lamps, petroleum being not allowed for that purpose.—*Chemist and Druggist.*

STATISTICS.

EXPORTS OF CAMPHOR FROM JAPAN.

(From Japanese Official Statistics.)

TOTAL SHIPMENTS.

—	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883	1884.	1885.	1886.	1887.
Piculs*	12,620	15,670	20,040	25,043	26,500	36,838	50,084	48,513	45,719	39,701	54,500	64,781
Value, 1,000 yen†	174	238	323	456	598	706	869	708	550	559	928	1,131

DISTRIBUTION OF EXPORTS (QUANTITIES).

Country.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Catty.	Catty.	Catty.	Catty.	Catty.	Catty.	Catty.	Catty.
China	1,545,658	2,200,551	2,773,475	1,973,877	2,311,390	2,783,810	3,077,851	2,770,189
United States........	735,445	746,330	920,380	1,947,992	1,516,749	954,823	1,356,330	2,133,016
United Kingdom....	368,859	736,933	1,005,432	810,193	257,331	29,538	735,498	811,717
Germany	..	..	289,338	121,619	115,163	131,866	197,500	558,472
France	..	..	132	659	371,271	56,688	67,208	133,626
British India	..	..	19,656	..	..	13,358	15,646	40,529
Total catties	2,649,962	3,683,814	5,008,413	4,854,340	4,571,904	3,970,083	5,450,033	6,478,094

DISTRIBUTION OF EXPORTS (VALUES).

Country.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Values (Yen).	Values (Yen).	Values (Yen).	Values (Yen).	Values (Yen).	Values (Yen).	Values (Yen).	Values (Yen).
China	337,755	413,611	467,629	269,363	260,964	385,207	513,492	455,812
United States	179,413	141,947	158,438	300,433	191,564	140,011	239,829	387,648
United Kingdom	81,055	143,579	187,988	120,069	31,856	4,858	127,112	156,702
Germany	..	..	51,573	18,027	15,420	15,735	33,813	99,518
France	..	..	27	102	49,699	10,207	10,993	23,699
British India	..	..	3,472	..	..	2,628	2,789	7,122
Total values (yen)	598,223	706,137	869,127	707,994	549,503	558,646	928,028	1,130,596

* A picul (= 100 catties) equals 133⅓ lbs. † The yen is nominally equal to 4*s.* 2*d.* —*Chemist and Druggist.*

EXTRACTS FROM TWENTY-FOURTH ANNUAL REPORT ON ALKALI, &c. WORKS BY THE CHIEF INSPECTOR.

PROCEEDINGS DURING THE YEAR 1887.

The number of works registered under the Act is 927, being an increase of 17 over those registered in 1886, or including 139, the number of registered works in Scotland, the total in the United Kingdom is 1,066, distributed as follows:—

NUMBER OF REGISTERED WORKS.

—	Dist. I. Ireland.	Dist. II. North of England.	Dist. III. Cheshire, North Wales, and part of Lancashire.	Sub-Dist. Widnes.	Dist. IV. East Lancashire and Yorkshire.	Dist. V. South Midland.	Dist. VI. South-West of England.	Dist. VII. South-East of England.	Total.		
									1887.	1886.	1885.
Alkali works	2	19	16	18	36	8	7	10	116	118	132
Other works	44	83	107	9	131	127	127	183	811	792	762
Total	46	102	123	27	167	135	134	193	927	910	894

In many of these, however, several processes are carried on, each of which comes under inspection, and hence they are in that respect separate works. They are classified thus :—

TABLE OF SEPARATE PROCESSES UNDER INSPECTION.

—	Dist. I. Ireland.	Dist. II. North of England.	Dist. III. Cheshire, North Wales, and part of Lancashire.	Sub-Dist. Widnes.	Dist. IV. East Lancashire and Yorkshire.	Dist. V. South Midland.	Dist. VI. South-West of England.	Dist. VII. South-East of England.	Total. 1887.	Total. 1886.
Alkali	2	12	15	16	11	3	4	3	66	67
Hydrochloric acid (cylinder)	..	..	..	..	18	3	..	7	28	28
Copper (wet process)	..	5	3	4	4	2	3	..	21	20
Cotton carbonising (alkali)	..	..	..	..	7	..	..	..	7	9
Sulphuric acid	13	24	21	18	43	28	44	33	224	227
Chemical manure	20	33	15	2	28	44	43	57	242	245
Gas liquor	..	2	3	..	17	4	..	..	26	21
Nitric acid	..	2	5	1	40	22	2	18	90	82
Sulphate and muriate of ammonia	16	30	26	4	51	59	61	64	311	291
Chlorine and bleaching powder	2	8	17	18	8	2	1	2	58	48
Salt	10	7	56	1	..	4	..	..	78	77
Cement	2	14	1	..	5	7	7	58	94	93
Total	65	137	162	64	232	178	165	242	1,245	1,208

There were during the year 4,383 visits made to the different works, and 4,102 tests taken.

In the next table is given the average escape of acid gases :—

AVERAGE AMOUNT OF ACID GASES ESCAPING FOR EACH DISTRICT.

—	Dist. I. Ireland.	Dist. II. North of England.	Dist. III. Cheshire, North Wales, and part of Lancashire.	Sub-Dist. Widnes.	Dist. IV. East Lancashire and Yorkshire.	Dist. V. South Midland.	Dist. VI. South-West of England.	Dist. VII. South-East of England.	Average. 1887.	Average. 1886.	Average. 1885.
	Grains, per Cubic Foot.										
Hydrochloric acid in chimney gases	0·10	0·10	0·07	0·10	0·08	0·09	0·11	0·11	0·10	0·10	0·10
	Per Cent.										
Hydrochloric acid. Amount escaping, compared with that produced	1·47	2·73	1·49	1·90	2·04	2·12	2·19	..	1·99	2·13	2·39
	Grains, per Cubic Foot.										
Acid gases escaping from sulphuric acid chambers given as SO_3	1·31	1·39	1·45	1·30	1·14	1·64	1·91	1·97	1·50	1·40	1·52
Acidity of chimneys given as SO_3	0·78	0·64	0·65	0·58	0·74	0·70	0·89	0·97	0·74	0·77	0·67
Acidity of gases from manure works given as SO_3	0·25	0·11	0·67	0·60	0·21	0·56	0·50	0·65	0·44	0·50	0·67

From this it will be seen that the average escape of HCl per cubic foot is one-tenth of a grain, being exactly half the limit allowed under the Act. In the case of SO_3 the limit of escape allowed is 4 grams per cubic foot, whilst the observed escape is on an average equivalent to 1½ grains of sulphuric anhydride per cubic foot. There have been four prosecutions during the year, of which three were for non-registration and one "for neglecting to use the best practicable means for preventing the escape of noxious gases."

Alkali Works.

The amount of capital at present invested in the Leblanc process is about 3,000,000*l*. During the past year there were 601,580 tons of salt decomposed in England and Ireland, or, including Scotland, 649,867 tons. Of this quantity there were decomposed in Ireland 6,872 tons, in the North of England (Dist. II.) 117,225 tons, in Cheshire, North Wales, and part of Lancashire (Dist. III.) 148,600 tons, and in Widnes 236,430 tons. From the above total 10 per cent.

should probably be deducted to allow for stoppages, for repairs, and holidays.

In the ammonia-soda process 158,636 tons of salt were decomposed during the year. In the subjoined table is given a comparison of the amounts of salt decomposed in the two processes for the past three years:—

—	1885.	1886.	1887.
	Tons.	Tons.	Tons.
Leblanc process	598,096	584,323	577,381
Ammonia-soda	115,032	137,220	158,636
Total	713,128	721,543	736,017

Alkali Waste.

This receives the constant attention of the inspectors in order to secure the adoption of the best method in laying it, and to see that the surfaces are well rammed and that every precaution is taken to prevent the ingress of air. The importance of constant care is seen in the fact that the waste is produced at the rate of 1,500,000 tons per annum. In Widnes alone the heaps contain 8,000,000 tons of material and cover 450 acres of ground, and receive daily an addition of 1,000 tons of the waste.

Sulphate of Ammonia produced.

This is chiefly obtained from the liquor of gasworks, from which source 85,022 tons were last year obtained. The total production was 113,896 tons, made up as follows:—

—	1886.	1887.
Gasworks	82,480	85,022
Iron works	3,950	5,098
Shale works	18,080	21,098
Coke and carbonising works	2,100	2,678
Total for the United Kingdom	106,610	113,896

The market value of the above was 1,253,000*l*.

From Messrs. Brunner, Mond, and Co.'s new coke ovens and gas producers there is obtained, per ton of slack burned, about 66 lbs. of sulphate of ammonia, being three or four times the amount obtained in gasworks, though even this is only about half the possible ammonia.

Black Coal Smoke.

The conditions necessary for the proper combustion of bituminous coal are given, and it is then pointed out how the emission of any black smoke might be avoided by the use of gaseous fuel. And, as has been shown above, the value of the ammonia produced is nearly sufficient to pay for all the coal used in districts where that is cheap. Another change in the combustion of fuel is likely to be effected by the use of the Hargreave's hot-air engine. In this engine an energy of 40 horse-power can be maintained with the expenditure of two gallons of coal tar, or 45 lbs. of coal, per hour; a result three times more favourable than that realised with the best steam engines.

Notes on the Alkali Act.

As the Act at present stands it is not all noxious gaseous emanations that can be dealt with. Thus in the manufacture of Venetian red ferrous sulphate is wasted at a high temperature, whereby sulphuric and sulphurous acids are given off in quantity. But such a process as this does not come under inspection and registration unless some effort is made to condense the acid fumes, when the plant becomes a place for the manufacture of sulphuric acid. Again, in the use of nitric acid for oxidising purposes, large quantities of acid fumes are given off, but unless these are reoxidised and condensed no inspection can take place, and the whole of the fumes may escape unchecked so far as the Alkali Act is concerned. In the manufacture of strontia, also from the sulphate, of antimony from the sulphide, recovery of sulphur from alkali waste, &c., none of the processes come under inspection. A noticeable case in the manufacture of HCl is also specially mentioned. Hydrochloric acid gas was found in the chimney escape, but a part of this came from a process not under inspection. Hence the flues had to be traced back and the amount of gas arising from this portion of the plant subtracted. Clearly, however, the action of the acid fumes on the trees and crops in the neighbourhood would be the same whether they came from the registered or unregistered portion of the works. Hence it would seem very much better to draw up a list of noxious gases for inspection rather than of the works producing them, as is the case at present. New processes are constantly being discovered which will certainly be contrary to the spirit of an Act drawn up before they were invented. Then again it is pointed out that instead of defining a limit to the gaseous escapes beyond which the manufacturer must not go, that it would be better to enact that all manufacturers *should adopt the "best practicable means"* for preventing the escape of the noxious gases generated by them. In this way greater facilities would be placed in the hands of the manufacturer, and these would prove "an elastic band ever tightening as chemical science advanced." The report concludes with reference to one or two points of procedure at law which require amendment.—S. G. R.

BOARD OF TRADE RETURNS.

QUICKSILVER.

	Imports.			
	1888.	1887.	1886.	1885.
	Bottles.	Bottles.	Bottles.	Bottles.
October	645	1,298	1,200	2,057
Jan. to Oct.	65,777	58,639	57,562	52,981
	Exports.			
October	1,333	4,320	2,542	2,317
Jan. to Oct.	39,797	54,077	58,912	43,028
Average Price	£ *s.* *d.* 8 18 6	£ *s.* *d.* 7 11 6	£ *s.* *d.* 7 6 6	£ *s.* *d.* 6 0 6

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

14,683. R. Free and H. J. Pierce, London. Thermometers. October 12.

14,697. J. J. Walsh and F. H. Varley, London. Apparatus for separating solids, and drying, desiccating, or delivering compounds, whether in the crystalline or amorphous state, from fluids containing the same. October 12.

14,753. S. H. Wright, Liverpool. Improvements in actuating syphons or syphonic apparatus and apparatus operated thereby. October 13.

14,821. I. Singer and M. W. Judell, London. Apparatus for concentrating, distilling, or cooling liquids. October 15.

14,864. J. Gilchrist, Manchester. Apparatus for raising or forcing sulphuric acid from lower to higher levels. October 16.

14,918. F. Westmeyer, London. A regulating cock for liquids and gases. October 17.

11,984. R. R. Hutchinson, London. Method and apparatus for rotating hydro-extractors by means of a current of electricity, and automatically checking or arresting the motion thereof when desired. Complete Specification. October 18.

11,988. R. R. Hutchinson, London. Improvements in "mashers" and "mixers" as employed in brewing and other processes, and method and apparatus for applying electricity as a motive-power for same. Complete Specification. October 18.

15,014. G. W. Share, London. Cases or packages for the safe conveyance and preservation of chemicals and the like. October 18.

15,060. F. F. Clarke.—From E. F. Clarke, New Zealand. Machine for compressing air or other gas. October 19.

15,229. J. Newton and D. A. Quiggin, Liverpool. Coiled tubular heating or cooling surfaces for apparatus for condensing steam, for heating or cooling fluids, or evaporating water. October 23.

15,290. W. Ambler, J. Rhodes, and S. Rhodes, Bradford. Ladles for molten glass and other metals. October 24.

15,460. R. Cunliffe, Manchester. Apparatus for calcining, drying, roasting, or carbonising substances or materials, and extracting gases, spirits, or acids, &c, therefrom. October 27.

15,491. L. Serpollet, London. A method of pulverising, dividing, or gasifying liquids. October 27, but ante-dated, under section 103, Patents Act, 1883, March 27, 1888.

15,495. J. Hilton, E. Jackson, and G. C. Hilton, London. Improvements in furnaces for the economisation of fuel and consumption of smoke. October 27.

15,509. T. Pratt, Keighley. Valves for reducing the pressure of liquids or gases in pipes. October 29.

15,533. P. Evans, Liverpool. Improvements in and connected with apparatus for evaporating or concentrating liquids. October 29.

15,563. J. L. Stevenson, London. An improved valve for Siemens' gas furnaces. October 29.

15,662. B. Brown, Liverpool. Improvements in gas-holders. October 31.

15,675. T. McDougal and J. Jardine, Glasgow. Improvements in apparatus for incinerating spent or used alkaline lyes or other waste products or precipitates containing carbonaceous matter. October 31.

15,735. I. Beardmore, Glasgow. Improvements in or relating to the gas and air flues of regenerative gas furnaces. November 1.

15,856. R. Kennedy, Glasgow. Mercurial vacuum pumps. Complete Specification. November 2.

16,139. E. Fabrig and H. E. Billing, London. Apparatus for the production of ozone. November 7.

16,283. H. H. Lake, London.—From E. Hill, United States. Improvements in and relating to valves for use in air-compressors, &c. Complete Specification. November 9.

16,372. H. Puplett and J. L. Rigg, London. Improvements in apparatus for the distillation and liquefaction of condensible gases. November 12.

16,443. L. Johnson and J. Powell, London. Apparatus for charging furnaces, or for analogous purposes. November 13.

16,535. T. Gaunt and E. H. Clapp, London. Improvements in apparatus for evaporating, distilling, refining, or concentrating liquids. November 14.

16,547. A. T. Rapkin, London. Improvements in pyrometers. November 14.

* COMPLETE SPECIFICATIONS ACCEPTED.

1887.

17,220. P. A. Maignen. Filters. November 3.

17,712. J. S. Sawrey and H. Collet. Apparatus for separating liquids from solids suspended therein. November 3.

17,938. E. R. Cook and J. W. Ingham. Retorts for use in making charcoal and for like operations. November 3.

18,041. A. R. Pechiney. Apparatus for treating bodies at a high temperature. October 27.

1888.

761. T. J. Rayner. Surface apparatus for heating, cooling, and condensing. November 10.

6442. J. Illingworth. Pipes, gas retorts, and other hollow articles. November 3.

11,727. T. Gaunt and E. H. Clapp. Apparatus for evaporating liquids. October 27.

12,254. C. E. D. Winesinger. Agitating or mixing apparatus for mixing solid substances with liquids, and for like purposes. October 27.

13,625. H. H. Leigh.—From E. Gasquet and A. de Gaulne. Filtering apparatus. November 3.

14,448. L. Block. Apparatus for compressing gas or gaseous bodies. November 10.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

14,675. H. D. Fitzpatrick and G. Rose, Glasgow. Method and apparatus for manufacturing gas from mineral or other oils. October 12.

14,811. L. Coleman, London. A new or improved absorbent composition for firelighters, torches, boiling water, and other such like purposes. October 15.

14,872. J. McMurray Rose, London. Improvements in the manufacture of gas. Complete Specification. October 16.

14,878. J. King, Manchester. Improvements in apparatus for taking off the gas from gas retorts and delivering it into hydraulic mains, and for preventing the tar or liquors which condense in the ascension pipes from returning to the retorts. October 16.

14,925. W. T. Walker, London. Improvements in apparatus to be used in the purification of coal gas. October 17.

15,084. J. Templeman and A. Laird, Glasgow. Improvements in the construction of moulds for making firelighters and fuel blocks. October 20.

15,155. D. D. McLellan, Glasgow. Improvements in the apparatus for forcing oil or other liquids through pipes into gas generators of industrial lights, or for heating purposes. October 22.

15,393. H. H. Lake.—From F. Honnay, Belgium. Improvements relating to the preparation of tar, chiefly designed for use in the manufacture of artificial fuel.

15,400. J. Cannon, Dublin. A new or improved composition for kindling or lighting fires. October 26.

15,407. D. P. Mudie, West Bromwich. The prevention of the choking of pipes from retort to hydraulic main in gasworks, by means of baffle plates placed in mouthpiece of retort. Complete Specification. October 26.

15,410. L. W. Leeds and the Leeds Patent Floor Warming Stove Company, Limited, London. Improvements in stoves for burning gas or liquid fuel. October 26.

15,492. H. A. O. E. Grunbaum, Stratford. Improvements in the means of rendering petroleum a more handy and less dangerous fuel for cooking, heating, and lighting. Complete Specification. October 27.

15,501. C. H. Land, London. Improvements relating to the burning of liquid and liquescent fuel, and to apparatus therefor. October 27.

15,617. H. G. Holdsworth and E. W. Holdsworth, London. Improvements in night-lights and similar articles. October 30.

15,655. W. T. Walker, London. Desulphurising the lime used in gas purifiers and recovering the sulphur therefrom. October 30.

15,799. W. Eacrett, London, Ontario. An indestructible firelighter. Complete Specification. November 2.

15,935. D. Latchinoff, London. Improvements in the production of oxygen and hydrogen in large quantities by means of the electrolysis of water, applicable for ballooning and other uses. November 3.

15,983. B. Loomis, London. Improved process of and apparatus for manufacturing heating or fuel gas. November 5.

16,118. C. Brotherhood, Bristol. Improvements in apparatus for automatically controlling the generation of gas from oil or other liquid fuel. November 7.

16,179. I. Carr, London. Improvements in or connected with the manufacture of illuminating gas. November 8.

16,184. S. B. Darwin, London. Improvements in apparatus for and in the method of using materials for the manufacture of illuminating gas. November 8.

16,191. J. H. R. Dinsmore, Liverpool. Improvements in and connected with the manufacture of illuminating gas. November 8.

16,217. J. Jefferay, Whitby. A new or improved firelighter. November 9.

16,307. G. Watson, Oldbury. A reversible hydraulic gas valve, to be fixed between retort and gas main on retort bed, applicable also to regenerative furnaces. November 10.

16,348. J. G. H. Lenk, F. E. Wendt, and M. A. Wandel, Berlin. Improvements in carburettors. November 12.

16,368. H. J. Fenner, London. Improvements in apparatus for moulding naphthalene. November 12.

16,610. J. Somerville and A. Allen, London. Improvements in apparatus for the prevention of stoppages in gas ascension pipes, and increasing the illuminating power of the said gas. November 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

17,218. R. Wallwork and A. C. Wells. Self-generating oil, gas or vapour burners, and arrangements connected therewith. November 3.

17,676. R. S. Lawrence. Carburettors or apparatus for enriching or producing gas. November 17.

17,734. W. R. Wells. An improved firelighter. November 10.

1888.

1844. E. B. Ellice-Clark and L. Chapman. Method and apparatus for the production of oxygen and nitrogen gases from atmospheric air. November 17.

7097. A. G. Meeze. Method of manufacturing gas. November 3.

13,108. F. Fowkes. Manufacture of firelighters. November 3.

13,147. L. Doms. Carburetting or naphthalising gas, and apparatus therefor. October 27.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

15,588. F. Lennard and S. P. Eastick, London. A new process for the purification of crude anthracene, and in relation to which the otherwise waste materials may be utilised. October 30.

16,324. J. Bowing, London. Improvements in the distillation of coal tar and similar substances. November 10.

COMPLETE SPECIFICATION ACCEPTED.

1887.

11,716. M. L. Honnaij. Process for enriching pitch obtained by the evaporation of tars produced from coal, and apparatus therefor. October 27.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

14,822. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Bruning, Germany. Improvements in the production of green and bluish-green colouring-matters. October 15.

14,836. W. G. Thompson and W. H. Claus, Middleton, Manchester. The production of new colouring-matters. October 16.

14,884. G. Pitt.—From L. Cassella and Co., Germany. The production of new yellow dyestuffs called thioflavines. October 16.

15,121. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture of derivatives of alizarin-green suitable for dyeing and printing. October 20.

15,179. E. Fischer, London. Process for production and treatment of oxidisable derivatives of orthonitro-benzylchlorides. October 22.

15,258. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Improvements in the production or manufacture of diazo dyestuffs. October 23.

15,259. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. The manufacture of a new red basic naphthaline dyestuff and its sulpho-acids. October 23.

15,260. B. Willcox, London.—From The Farbenfabriken vormals F. Bayer and Co. The production of, and obtainment of, colouring matters or dyestuffs from alizarin-mono-sulpho-acids. October 23.

15,496. J. C. L. D. Kœchlin, D. E. H. Kœchlin, and A. J. J. d'Adrian Kœchlin, London. A complete indigo dye. Complete Specification. October 27.

15,654. H. H. Leigh.—From R. G. Williams, New York. Improvements in the process for manufacture of azo colouring matters. October 30.

15,849. A. G. Green, London. Improvements in the manufacture of a beta-naphthylamine sulphonic acid. November 2.

16,133. H. H. Leigh.—From R. G. Williams, United States. New colouring matters. November 7.

16,325. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of induline colouring matters soluble in water. November 10.

16,333. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of a new sulphone or diethyl sulphone methyl ethyl methan. November 10.

16,393. C. D. Abel.—From The Farkwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of colouring matters resembling the indulines. November 12.

16,563. F. Rhodes, Huddersfield. Improvements in dye-extracting apparatus. November 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,646. C. A. Bennert. Production of coloured compounds or colouring materials. October 27.

1888.

687. C. D. Abel.—From The Actiengesellschaft fur Anilin Fabrikation of Berlin. Separating β-naphthylamine δ-sulphonic acid from β-naphthylamine β-sulphonic acid. October 27.

1346. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture of blue and blueish azo dyes. November 17.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

14,705. E. P. Klug, London. Process for smoking or finishing textile threads, chiefly applicable for preparing warp threads in lieu of the sizing process. October 12.

14,809. P. Puech, London. Process for carotting wool on sheep and lamb skins, the first feltings for woollen hats, woollen waste, hair or fur, or mixtures of wool and hair or fur, woollen fabrics and felts generally, and carded or combed woollen threads. October 15.

COMPLETE SPECIFICATION ACCEPTED.

1888.

14,039. G. Burnell and A. Burnell. Apparatus for cleansing wool and other textile products. November 3.

VI.--DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

15,019, J. Downham, Manchester. Improvements in damping and conditioning machines used in bleaching, calendering, finishing, and other analogous processes. Complete Specification. October 19.

15,757. G. Young, London. Improvements in mechanism or apparatus for dyeing or bleaching roving yarns or thread in the cop or bobbin form. November 1.

15,804. J. H. Pickles and T, Pickles, Manchester. Improvements relating to the dyeing or bleaching of warps for weaving purposes. November 2.

15,955. J. W. Hepworth, London. Improvements in the method of and apparatus for dyeing woollen cloths and other fabrics. November 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

17,102. G. A. Schleber. Bleaching, dyeing, &c., cloth and other fabrics, and apparatus therefor. October 27.

17,254. G. W. Liddiard. Apparatus for dyeing, soaping, washing, and finishing yarn. November 17.

1888.

329. J. Morland and J. C. Morland. Scouring or dyeing woollen rugs or skins with or without the wool or fur on them, or any woollen fabric or leather, and apparatus therefor. November 10.

336. J. B. McKay. Machinery for dyeing yarns. November 10.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

14,701. H. W. Deacon and F. Hurter, London. Improvements in the manufacture of chlorine. October 12.

14,775. T. A. Reed and J. Newell, Liverpool. Improvements in obtaining calcium sulphate. October 15.

14,857. J. A. Just, London. Improvements in apparatus for the production of chlorine. Complete Specification. October 16.

14,859. J. A. Just, London. Improvements relating to the production of chlorine. Complete Specification. October 16.

14,962. J. B. Readman, Edinburgh. Producing phosphorus. October 18.

14,977. H. H. Leigh.—From F. T. Romignières. Improvements in the manufacture of caustic alkalis and of their carbonates by means of their chlorides, which process is also applicable to the dissociation of alloyed metals. October 18.

15,006. L. L. Labois, London. Improvements relating to the treatment of pyrites and other ores containing sulphur, and to apparatus therefor. October 18.

15,056. T. Ryan, London. An improved method of and apparatus for the recovery of chlorine from calcium chloride. October 19.

15,063. H. W. Deacon and F. Hurter, London. Improvements in or connected with the manufacture of chlorine. October 19.

15,097. J. R. Wylde, M. J. Hammill, and H. Auer, Liverpool. Improvements in or appertaining to the separation of chlorate of potash (and if desirable the chloride of calcium or magnesium or other similar salt in the mother-liquor) from solutions thereof. October 20.

15,173. C. F. Claus, London. Improvements in obtaining carbonic acid gas from mixtures with other gases, obtaining and utilising the residual gases or otherwise, and in the production of carbonates of ammonia. October 22.

15,256. A. C. Ponton, B. L. Mosely, and C. Chambers, London. Process for the crystallisation of silica. October 23.

15,293. P. McLaren, Glasgow. An improved process of manufacturing acetate or pyrolignite of iron or iron liquor. October 24.

15,367. H. W. Wallis, London. Improvements in the precipitation as sulphides of metals in solution, and in the production of carbonate and sulphate of soda. October 25.

15,582. F. N. Seyde, Birmingham. An improved method of manufacturing salt. October 30.

15,624. G. H. Bolton and J. R. Wylde, Liverpool. Improvements in or connected with the concentrating of caustic alkali and other liquors by multiple effect or yaryan plant for the purpose of preventing incrustation or deposit in or on the tubes. October 30.

15,830. J. Dowse and E. Marin. *See* Class XVIII., B.

15,980. H. Albert, C. Fellner, and C. Ziegler, London. Apparatus or appliances in combination with furnaces for roasting pyrites and other minerals containing sulphur for cooling the sulphurous gases given off therefrom. Complete Specification. November 5.

16,103. H. Ellison and G. E. Saville, Manchester. Improvements in apparatus for treating ammoniacal liquors. November 7.

16,166. T, Turner, Birmingham. The treatment of waste liquors from galvanising works, or other liquids containing chloride of iron, or chloride of iron and hydrochloric acid, and for extracting therefrom oxide of iron and hydrochloric acid. November 8.

16,246. H. J. Kirkman, London. Improvements in the utilisation of waste pickle from tinning and galvanising works where sulphuric acid is used for pickling. November 9.

16,247. H. J. Kirkman, London. Improvements in the utilisation of waste pickle from tinning and galvanising works where hydrochloric acid is used for pickling. November 9.

16,327. W. P. Thompson, Liverpool. Improvements in or relating to the manufacture of superheated steam, and in utilising the same for obtaining carbonic acid, evaporating brine, or heating or evaporating other solutions, and in apparatus therefor. November 10.

16,349. G. E. Davis, Manchester. Improvements in the construction of ammonia stills. November 12.

16,398. G. Kerner and J. Marx, London. Improvements in and apparatus for or connected with the obtaining, liquefying, and storage of chlorine. November 12.

16,412. E. W. Parnell and J. Simpson, Liverpool. Improvements in the treatment of ammoniacal bicarbonate of soda produced in the ammonia alkali process for the recovery of ammonia and carbonic acid, and in apparatus therefor. November 13.

16,466. H. Simon.—From Messrs. Vorster and Gruneberg and The Berlin-Anhaltische Maschinen-Bau-Actiengellschaft, Germany. Apparatus for purifying sulphuric acid from arsenic. November 13.

16,472. P. M. Justice.—From C. Dietzsch, Germany. *See* Class IX.

16,523. W. Townsend, London. Improvements in vessels used for boiling and evaporating acids or strong alkalis. November 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

173. E. Solvay. Manufacture of sodium bicarbonate, and apparatus therefor. November 10.

17,612. F. L. Teed, London. Purification of sulphuric acid. October 27.

17,657. W. W. Staveley. Manufacture of alkaline carbonates. November 10.

18,041. A. R. Pechiney. *See* Class I.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

14,786. J. Broadhurst, Stoke-on-Trent. An improved oven or kiln for firing pottery or other articles. October 15

14,792. S. Washington, Manchester. Glass bottles, and moulds therefor. October 15.

14,830. W. M. Derrick, Bristol. A new or improved method for the ornamentation of glass. October 16.

14,990. J. Colton and J. H. Lambert, Glasgow. Improvements in or relating to glass mosaic work. October 18.

15,300. G. R. Grant, Liverpool. Improvements in pictures, paintings, or decorative plaques formed largely of glass. October 24.

15,447. L. H. Goggs and T. T. Irvine, Liverpool. Improvements in vases, jars, and other ceramic ware, and in the method of forming or ornamenting the same. October 27.

15,485. J. Armstrong, London. A method of rolling glass, and machinery and apparatus therefor. October 27.

15,511. M. Winter, Hereford. The manufacture of brilliant crystal flowers of various hues. October 29.

15,621. E. Lyon, Liverpool. Improvements in decorative window panes or panels, and in the manufacture thereof. October 30.

15,656. F. Defoing and W. Defoing, London. An improved construction of mould, without springs or valves, for moulding articles of glass. October 30.

15,665. T. Walton, Liverpool. Improvements in the manufacture of glass hollow ware, and in machinery, apparatus, or moulds therefor. October 31.

15,944. A. D. Brogan and A. M. Malioch, Glasgow. Improved apparatus for imparting surface ornamentation to glass. November 5.

16,453. J. Syer, Manchester. Improvements in the silvering of glass. Complete Specification. November 13.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

14,750. C. Waxin and A. Clery, London. An improved cement or artificial stone. Complete Specification. October 13.

14,768. A. Coxon, London. Improvements for drying slurry in the manufacture of cement by the use of an extracting fan to create a draught for kilns, furnaces, and boilers. October 13.

14,853. G. Pankhurst, London. An improved brick, tile, or slab for building and other purposes. October 16.

15,011. G. J. Randall and F. Carter, London. Hardening the faces of all soft oolites limestone for the purposes of enamelling same and producing imitation marble, ebonite, &c. October 19.

15,256. A. C. Ponton, B. L. Mosely, and C. Chambers. *See* Class VII.

15,441. F. Ransome, London. Improvements in furnaces for burning cement and like materials. October 26.

16,113. P. Evans, Liverpool. Improvements in and in the manufacture of cement. November 7.

16,234. J. W. H. James, Liverpool. Improvements in apparatus for calcining cement materials, hydraulic lime, plaster of Paris, and like substances. November 9.

16,262. P. J. Neate, Rochester. Improvements in apparatus for the manufacture of Portland cement, &c. November 9.

16,323. A. V. Bouvier and J. Billoré, London. Improvements in the manufacture of bricks, tiles, and other like articles. November 10.

16,410. F. W. S. Stokes, London. Improvements in revolving furnaces for burning, calcining, or roasting cement, lime, ores, or similar substances. November 13.

16,472. P. M. Justice.—From C. Dietzsch, Germany. Improved furnace for the production of carbonic acid gas and the burning of calcareous material. November 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,371. J. Toy and S. H. Stephens. *See* Class X.

17,899. B. Willcox.—From M. Perret. Furnaces for burning pulverulent materials. October 27.

1888.

14,750. C. Waxin and A. Clery. An improved cement or artificial stone. November 17.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

14,702. J. Nicholas and H. G. Owen, London. The recovery of metals from their ores. October 12.

14,718. R. B. Pope, Glasgow. Improvements in making the joints of pipes of steel or copper, or other similar metal or alloy. Complete Specification. October 13.

14,771. R. A. P. Taunton, Birmingham. Improvements in the manufacture of the steel shell bodies of projectiles for machine guns and ordnance, and in tools or apparatus to be used in the said manufacture. October 13.

14,807. E. Brazier and J. Thompson, London. Improvements in the method and apparatus employed in coating metal plates or sheets with tin, terne, or lead. October 15.

14,833. A. E. Sarti, London. Improvements in copper amalgamating plates. October 16.

14,837. H. H. Eames, Manchester. Improvements in the method of and apparatus for refining metallic ores. Complete Specification. October 16.

14,937. E. Norton and J. G. Hodgson, London. Improvements in the manufacture of sheet metal, and in apparatus therefor. Complete Specification. October 17.

14,946. I. Beardmore, Glasgow. Improvements in or relating to the distributing or regulating valve of regenerative gas furnaces for steel-melting and analogous purposes. October 17.

14,947. I. Beardmore, Glasgow. Improvements in or relating to the distributing or regulating valve of regenerative gas furnaces for steel-melting and analogous purposes. October 17.

15,073. A. R. Molison and T. P. Sims, Swansea. Improved machine for cleaning tin-plate from the oil or grease used in the process of manufacture, and such like purposes. October 20.

15,085. J. Willis, Sheffield. Improvements in the manufacture and finish of iron and steel tools, files, forgings and castings. October 20.

15,101. C. N. B. Wetzlar.—From W. L. Card, United States. Improvements in dry concentrators for the treatment of ores. October 20.

15,110. S. S. Lloyd, jun., and J. H. Lloyd, London. Improvements in the manufacture of steel and iron pipes or tubes. October 20.

15,153. H. le Neve Foster and W. Coultas, London. Improvements in the method of working hot blast stoves for blast furnaces. October 22.

15,156. H. S. Blackmore, London. An improved process for the manufacture of sodium. Complete Specification. October 22.

15,172. R. J. Atcherley and A. E. Sarti, London. Improvements in copper amalgamating plates. October 22.

15,213. A. R. Molison and T. P. Sims, Swansea. Improved process of preparing iron or steel plates for the after process of tinning and for such like purposes. October 23.

15,311. A. Seddon, Sheffield. Improvements in apparatus for turning and otherwise manipulating and supporting ingots and other forms of steel or iron. October 24.

15,326. C. Hessel, London. Improvements in the treatment of auriferous and argentiferous ores of antimony. October 24.

15,394. G. C. Levey, London. An improved electric miners' safety lamp. October 25.

15,506. L. Q. Brin and A. Brin, London. A method of plating metals with aluminium and other metals such as platinum, silver, gold, &c. October 29.

15,507. L. Q. Brin and A. Brin, London. Improved methods to alloy metallic aluminium with any other metal. October 29.

15,572. W. Feld and G. von Knorre, London. Improvements in the manufacture or production of silicium copper. October 29.

15,606. G. H. Lloyd, A. L. Lloyd, and H. Bewlay, London. Improvements in the manufacture of malleable metal pipes. October 30.

15,607. T. K. Cavill, Sheffield. Improvements in apparatus used for holding and turning ingots and other masses of metal. October 30.

15,627. M. A. Howell, London. Improvements in the process of carbonising steel in bars or plates, and in the permanent retorts or boxes employed therein. October 30.

15,698. A. Levy, London. Improvements in the dipping process for depositing metals upon iron and steel. October 31.

15,708. M. Yglesias, London. A new or improved method of treating the effluent waters from mines, or other waters holding metals in solution. October 31.

15,721. J. Pointon, Huyton. Improved method of manufacturing cast iron, by which the sulphur, phosphorus, and silicon are eliminated, applicable also to the production of malleable iron and steel. November 1.

15,812. G. A. Dick, London. Improvements in the manufacture of articles from metals and from metallic alloys and compounds. November 2.

15,870. H. Marcussen and L. Aubanel, London. An improved process and apparatus for producing castings, especially middle size and small castings. November 2.

15,871. H. Marcussen and L. Aubanel, London. An improved process and apparatus for producing stereotype plates. November 2.

15,972. F. E. Chatillon, London. An improved process of condensation of metallic vapours. November 5.

16,040. A. G. Greenway and J. C. Stitt, Liverpool. Improvements in and connected with the manufacture of iron. November 6.

16,051. H. J. Smith, Glasgow. Improvements in and relating to steel and iron. November 6.

16,221. E. L. Ransome, London. Certain improvements in strengthening and testing wrought metal and steel bars. Complete Specification. November 9.

16,231. J. Hilton, London. Improvements in cupolas and in means for operating the same. November 9.

16,235. W. Patterson, Newcastle-on-Tyne. Improvements in miners' safety lamps. November 9.

16,403. F. Tribbensee, London. An improved process for providing copper, iron, and other metallic vessels with a lining or coating of lead. Complete Specification. November 12.

16,419. D. Brothers and Co., Limited, and E. A. Davies, London. Improvements in preparing metal sheets or plates previously to coating the same with other metals. November 14.

16,454. J. Ewart, Liverpool. Improvements in or relating to protecting surfaces of iron or steel from oxidation, and for giving them an ornamental appearance, applicable for gun-barrels and other bright work. November 13.

16,499. H. B. Fulton, Kirkintilloch. Improvement in the treatment of quartzose or silicious and sulphuretted ores containing gold, silver, or copper. November 14.

16,501. J. H. Pollok, Glasgow. An improvement in the wet method of extracting gold from crushed ores or other finely divided auriferous material. November 14.

16,567. H. Schneider, London. Improvements in the manufacture of iron and steel alloyed with nickel. November 14.

16,568. H. Schneider. A manufacture of iron and steel alloyed with copper. November 14.

16,569. H. Schneider. A manufacture of steel alloyed with copper. November 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

10,588. F. Fenton.—From J. Woolford. Extracting gold from simple, compound, and refractory ores, slags, or wastes, or cinders of ores or metals, by fusion with antimoniac compounds. November 3.

14,371. J. Toy and S. H. Stephens. Machinery for reducing tin stuff and other partially pulverised ores to extract the metal therefrom, also for grinding paint, cement, and other hard substances. October 27.

14,602. C. Netto. Manufacture of sodium and potassium, and apparatus therefor. November 3.

14,904. C. W. Kitto. Apparatus for distributing, mixing, separating, grinding, cleaning, and amalgamating gold or other ores or tailings. November 3.

16,604. A. S. Ramage. Chemical treatment or utilisation of scrap tin or terne plates, scrap zinc, galvanised iron, &c. November 10.

16,862. E. J. Ball and B. H. Brough. Appliances for amalgamating auriferous and argentiferous substances. October 27.

17,037. W. Robinson. Ingot moulds. November 10.

17,127. J. Law and H. Law. Apparatus for heating, hardening, and tempering steel wire. November 3.

17,169. D. Edwards, R. Lewis, and P. Jones. Apparatus for coating metal plates with tin or other metal. November 17.

17,770. J. Lysaght. Apparatus for coating metal plates. October 27.

17,809. F. Rigaud. Furnaces for smelting zinc and other ores. October 27.

17,890. W. Dick, jun. Securing cast metal plate work together. November 10.

1888.

36. R. R. Gubbins. Manufacture of bar iron. November 3.

418. J. H. Darby. Manufacture of steel or iron. November 10.

716. J. Noble. Regenerative furnaces for use in the manufacture of steel and other metals. November 17.

6143. E. A. Davies. The construction of galvanised cisterns and tanks. November 3.

7159. S. T. Dahl. Method and apparatus for amalgamating gold and other metals. October 27.

12,658. T. Williams. Pulveriser for metallic ores, &c. November 17.

14,435. J. R. R. Yeats. Process for amalgamating gold by volatilised mercury. November 10.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

15,237. M. W. W. Mackie, London. An improved process for the manufacture of alkaline metals, such as aluminium, chromium, &c., by electrolysis and chemical reactions, and apparatus therefor. October 23.

15,252. O. E. Madden and A. F. Madden, London. Improved machines for making battery plates. Complete Specification. October 23.

15,369. P. A. Fiebet and A. Nodon, Paris. Improvements in secondary batteries. Complete Specification. October 25.

15,388. A. Shippey.—From A. G. Waterhouse, United States. Improvements in apparatus for regulating dynamo-electric machines. Complete Specification. October 25.

15,433. T. J, Handford.—From L. Duncan, United States. Improvements in plates or electrodes for secondary batteries, and in the methods of making the same. October 26.

15,506. L. Q. Brin and A. Brin. *See* Class X.

15,508. L. Q. Brin and A. Brin, London. Improved methods of producing aluminium and its alloys by means of electricity. October 29.

15,626. P. Schoop, London. Improvements in electric batteries. October 30.

15,741. P. V. McMahon, Louth. Improvements in dynamo-electric machines. November 1.

15,755. A. J. Jarman, London. Improvements in the construction of dry galvanic cells, and elements therefor. November 1.

15,868. A. Winkler, A. Kuhnt, and R. Deissler, Berlin. A process of reduction of aluminium by electrolysis. November 2.

15,910. L. Kayser, London. Improvements in galvanic batteries. November 3, but ante-dated (under sec. 103, Patents Act, 1883) April 13.

16,048. W. P. Thompson.—From C. H. Thompson, United States. Improvements in or relating to secondary or storage batteries. November 6.

16,140. E. Tyer, London. Improvements in the charging of secondary electric batteries from primary batteries, and apparatus for that purpose. November 7.

16,479. H. H. Lake.—From H. Walter, United States. Improvements in storage or secondary batteries. November 13.

16,484. E. M. H. Andreoli, London. Improvements in ungumming and bleaching by electrolysis flax, hemp, cotton, and similar exogenous plants. Complete Specification. November 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,494. W. Spilker. Electrolysing chlorides, bromides, and iodides, and utilising the products thereof. November 3.

16,296. A. F. St. George and C. R. Bonne. Primary and secondary galvanic batteries. October 27.

16,455. H. Thame. Secondary batteries. November 3.

16,790. S. C. Hanburg. Dynamo-electric machines. November 10.

1888.

39. E. Tyer. Voltaic batteries. October 27.

208. O. C. D. Ross. Utilisation of waste products from electrical batteries. November 10.

472. W. Webster, jun. *See* Class XVIII., B.

2259. H. Mestern. Thermo-electric and furnace batteries. November 10.

7826. H. B. Cox. Galvanic generators. October 27.

10,415. C. Gassner, jun. Electrical dry elements. November 10.

11,817. J. C. Hobbs. Electric furnaces. November 3.

11,890. C. R. Bonne.—From L. Schaefer. Method of stopping off when etching or metal plating by galvanic action. November 3.

12,153. W. P. Thompson.—From P. Diehl. Apparatus for hardening and tempering by electricity. November 17.

13,122. E. J. Paterson and C. F. Cooper. Armatures of dynamo-electric machines. November 10.

13,194. E. M. H. Andreoli. Ungumming and bleaching by electrolysis China grass, rhea, ramie, and other nettles. October 27.

14,522. D. Humphreys. Galvanic batteries. November 10.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

14,692. H. Ritter von Dahmen, London. An improved manufacture of oleaginous material from hydrocarbons, applicable for saponification and other purposes. October 12.

15,124. J. C. A. Brünner, London. Improvements in and relating to the purification of glycerin. October 20.

15,558. H. C. Foulsham, London. An improved soap powder. October 29.

15,580. W. Thornham, Hull. An improvement in wood-oil press wrappers or plates used in the extraction of oil from various seeds and nuts by hydraulic pressure. October 30.

16,328. M. Crawford, Liverpool. Improvements in or relating to the treatment oil-bearing substances during expression of the oil, and in presses applicable for receiving and discharging such substances without intermission. November 10.

16,340. H. C. Foulsham, London. An improved soap powder. November 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

6939. J. Thomson. Mercurial antiseptic soap. November 10.

13,850. H. Hamelle. Apparatus for filtering and clarifying oil. November 3.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

14,854. B. F. McIntyre, London. An improved fireproofing and preserving compound. Complete Specification. October 16.

15,561. T. Baynes, W. H. Doughty, and H. T. Greaves, London. An improved paint or composition especially suitable for coating ships' bottoms, and the process of manufacturing the same. October 29.

15,971. J. Danby, London. A cement or paint coating or covering for protecting iron or steel ships and other vessels or structures liable to corrosion through exposure to water or otherwise. November 5.

15,997. A. J. Boult.—From C. H. Eichler, Germany. Improvements in the manufacture of paint. Complete Specification. November 5.

16,035. S. Challoner, London. Improvements in lacquers and varnishes. November 6.

16,185. A. J. Smith, London. Improved apparatus for dressing white lead and other colours. November 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

14,371. J. Toy and S. H. Stephens. *See* Class X.

15,772. F. Crane.—From W. D. Field. Process for purifying or clarifying shellac or solutions of shellac. November 17.

17,442. A. Ford. Composition for coating fabrics for advertising and other purposes. November 17.

1888.

7206. C. Straub. Wall covering composition. October 27.

10,379. J. H. Jackson. Liquid enamelling composition. November 3.

14,107. J. W. Hall.—From G. T. Lewis. Manufacture of lead pigments and apparatus therefor. November 10.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

14,869. G. V. Anderson and C. W. Gouert, London. Improvements in machines for the treatment of hides and skins. Complete Specification. October 16.

14,889. J. Hauff, London. Means for removing lime from skins, kips, or hides, and for swelling or puffing the same. Complete Specification. October 16.

16,545. L. D. S. Cufflin and G. Hughes, London. A new improved machine for extracting the hair from skins. November 14.

16,618 S. Wohle, London. Improved process and ingredients for treating leather hides to render them impervious to water, to make them grease-proof and have great wear-resisting properties. November 15.

COMPLETE SPECIFICATION ACCEPTED.

1888.

14,889. J. Hauff. Removing the lime from skins, kips, or hides, and swelling or puffing the same. November 17.

XV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

14,865. F. Lavington, London. Improvements in the manufacture of manure from peat. October 16.

15,145. C. N. Watts, London. Fertilising compound. October 27.

COMPLETE SPECIFICATION ACCEPTED.

1888.

571. F. I. R. Seaver. Improvements in manures. November 17.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATIONS.

15,815. R. H. Steedman, Glasgow. Improvements in treating a product obtained from seaweed. November 2.

16,138. E. Fahrig and H. E. Billing, London. Improvements in the manufacture of sugar and apparatus therefor. November 7.

16,397. F. Bauder, London. Improvements relating to the refining of sugar and to the treatment of syrup obtained therefrom. Complete Specification. November 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1752. A. Chapman. Apparatus for evaporating saccharine or other solutions or liquids. November 17.

13,129. O. Bluhme. Filtration of beetroot juice in process of making beetroot sugar, and utilisation of the filtering material thereafter. October 27.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

14,824. W. P. Thompson.—From P. F. Tettelin, Belgium. Improvements in the manufacture of yeast, and its application in the production of palatable alcohols therewith. Complete Specification. October 15.

14,964. J. H. Wheeler, Bristol. An improved method of sparging mash tun "goods," and spargers therefor. October 18.

14,965. E. A. B. Beaumont, Brighton. A means by which alcoholic liquors may be rendered more wholesome. October 18.

14,988. R. R. Hutchinson. *See* Class I.

15,018. S. Briggs, London. An improved apparatus or means for drawing off liquids from tanks or vats without disturbing sediment such as in wort or other liquors. October 18.

15,171. W. Lawrence, London. Improvements in brewing apparatus. October 22.

15,261. W. Kuhn, London. Improvements relating to the treatment of beer, wine, and other liquids, and to apparatus therefor. Complete Specification. October 23.

16,582. J. Clegg, Liverpool. Improvements in the purification of alcoholic liquors or other substances containing impurities more volatile than themselves, or capable of being destroyed by gases innocuous to the goods operated upon, and in apparatus therefor. November 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

13,294. A. D. Meritens. Process for treating and purifying water, beer, wine, and other liquids, and apparatus therefor. October 27.

14,824. W. P. Thompson.—From P. F. Tettelin. Manufacture of yeast, and its application in the production of palatable alcohols. November 17.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

14,945. E. Edwards.—From J. Lapeyrére, France. An improved preparation to be used as a substitute for or in combination with coffee. October 17.

15,364. Sir E. B. Sladen, R. McLeod, and C. H. White, London. Treating dangway beans (cassia tora) cassia occidentalis as a substitute for coffee. Complete Specification. October 25.

15,751. J. Quaglio, London. The manufacture of soup or bouillon capsules. Complete Specification. November 1.

15,813. R. S. Baxter and G. D. Macdougald, Glasgow. Improvements in the manufacture of seed cake or cattle food from cotton seed. November 2.

16,335. H. Stuchelhaus, London. An improved process for manufacturing conserved meats. Complete Specification. November 10.

B.—Sanitary Chemistry.

14,709. W. Horsfall, London. A new or improved construction of furnaces for burning towns' or other refuse. Complete Specification. October 13.

15,138. G. Collier, Staple-fitz-Payne. The purification of water and other liquids. October 22.

15,321. H. Wollheim, London. An improved process for clarifying, purifying, disinfecting, and utilising sewage and other foul or waste waters. October 24.

15,702. H. L. Sulman and E. E. Berry, London. Improvements in the purification of waters contaminated with sewage, dye-matters, or other impurities. October 31.

15,810. E. Knowles, Accrington. Improvements in and combination of mechanical applications for the purification of sewage. November 2.

15,830. J. Dowse and E. Marin, London. Improvements in purifying fumes from noxious constituents. November 2.

16,093. J. G. Lorrain, London. Improved method of and apparatus for the formation of organic oxides, and the oxidation of matter suspended or dissolved in liquids. November 7.

C.—Disinfectants.

15,015. C. A. Day.—From W. H. Daniels, United States. Antiseptic compound. October 19.

15,676. J. E. Reynolds, Dublin. Improvements in disinfectants October 31.

15,925. T. Rowan, L. Hakeman, and The Coal Tar Disinfectants Company, London. Improvements in apparatus for distributing disinfectants. November 3.

15,993. C. T. Kingzett, London. Improvements in the preparation and preservation of peroxide of hydrogen. November 5.

15,994. C. T. Kingzett, London. Improvements in the preparation of antiseptics, disinfectants, and sanitary reagents. November 5.

16,242. H. Wollheim, London. A new reagent for disinfecting, preservative, or remedial purposes. November 9.

16,463. J. E. P. Meyer, London. An improved compound or composition for developing ozonised oxygen. November 13.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1887.

17,756. W. L. Williams and S. Puplett. Mode of applying mechanical refrigeration for the preservation of alimentary and other substances, and apparatus therefor. October 27.

1888.

1653. H. H. Lake.—From F. Teidemann. Process for preserving eggs. October 27.

14,113. W. C. Hallett.—From K. G. Dahl. Apparatus for preserving milk. November 17.

B.—Sanitary Chemistry.

1887.

17,630. J. B. Alliott. The disposal of towns' refuse by burning, utilising the heat generated therefrom, and apparatus therefor. October 27.

17,650. A. H. Hobson and C. H. Rosher. Method of and apparatus for purifying water. October 27.

1888.

472. W. Webster, jun. Apparatus for treating sewage and other impure liquids by electrolysis. November 17.

1105. W. Webster, jun. Means for treating sewage by electrolytic action, and for disposing of the deposits thereof. November 10.

14,709. W. Horsfall. Furnaces for burning towns' or other refuse. November 17.

C.—Disinfectants.

1888.

1393. J. Hanson. Means for effecting the evolution of sulphurous acid for disinfecting and deodorising. November 17.

6939. J. Thomson. A mercurial antiseptic soap. November 10.

7854. W. P. Thompson.—From P. Mateovich and A. Grossich. A septic or antiseptic paper, applicable for use as bandages for wounds, or for hygienic or preservative purposes. November 3.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

15,189. H. J. Allison.—From K. J. Collins, United States. Improvements in celluloid and analogous bindings and the like. October 23.

15,956. J. H. Shorrock, London. A new or improved machine for preparing or finishing wood pulp and other vegetable fibres for making paper. November 5.

16,465. O. Imray.—From J. R. France, United States. Improvements in manufacture of collars, cuffs, shirt fronts, and other ornamental articles from celluloid, xylonite, or other pyroxyline compounds. Complete Specification. November 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1146. F. Hawke and C. J. Ford. Method and apparatus for producing water-mark like designs on paper, &c. November 17.

4704. W. P. Bruce. Manufacture of paper and apparatus therefor. November 10.

7854. W. P. Thompson.—From P. Mateovich and A. Grossich. *See* Class XVIII., C.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

14,877. G. Christopher and R. W. Leftwich, London. Improvements in the preparation and treatment of extract of tea. October 16.

15,299. W. P. Thompson.—From G. D. Nellensteyn, Holland. Improvements in extracting perfumes from flowers, fruits, and other substances containing ethereal oils or aromatic matters, and apparatus therefor. Complete Specification. October 24.

16,404. J. Y. Johnson.—From T. von Heyden, Germany. Improvements in the manufacture or production of paroxybenzoic acid. November 12.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

15,068. T. P. Graham, Bedford. Photographic appliances. October 19.

15,984. D. Grant, London. Improved means of producing copies of photographic pictures in colours. November 5.

16,258. W. Oldham, London. An improvement in the method of and materials or compound employed in developing photographic pictures or images. November 9.

16,537. W. Oldham, London. An improvement in the method of and materials or compound employed in developing photographic pictures or images. November 14.

XXII.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

14,699. F. W. Pleydell Bouverie, A. Brock, and G. J. Mayer, London. Improvements in pyrotechnic signals, chiefly designed for naval and military purposes. October 12.

14,814. W. Ellicott, London. Improvements in the manufacture of cartridges. October 15.

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15,067. E. Turpin, London. An improved explosive shell. October 19.

15,159. J. C. Thompson, London. A mechanical fuse for causing the explosion of shells and indicating the number of revolutions performed and distances traversed by projectiles. October 22.

15,692. J. Cox, Greenwich. An improved method of and apparatus for mixing dynamite. October 31.

15,934. A Noble, London. Improvements in fuses or igniting apparatus for armour-piercing shells. November 3.

16,117. W. Budge, Launceston. Improved smokeless gunpowder. November 7.

16,213. H. S. Maxim, London. Improvements relating to the manufacture of explosives, and to apparatus therefor. November 8.

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1887.

17,506. G. Quick. Improvements in cartridges for ordnance partly applicable to gunpowder generally. November 17.

1888.

641. Baron Armstrong. Fuses for projectiles. November 10.

1591. C. D. Abel.—From H. Schöneweg. Improvements in explosive compounds. November 17.

2662. M. von Forster and O. Wolff. Explosive projectiles. November 17.

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SESSION 1888-89.

The Third Meeting of the Section will take place on Monday, January 7th, 1889.

Papers to be read by—

Mr. Otto Hehner. "On the examination of glycerin in soap lyes and crude glycerin."

Mr. John Ruffle. "On a modified form of Orsat's apparatus."

Mr. W. Crowder will introduce for discussion the following technical query:—"Have any experiments been made to ascertain the quantity of nitrous acid, soluble in sulphuric acid of sp. gr. 1·750 at temperatures ranging between 32° and 120° F.; and what is the *maximum* temperature at which nitrous acid can be economically absorbed in the Gay-Lussac tower during the summer season?"

Monday, February 4th.

Dr. T. L. Thorne. "Some industrial applications of oxygen."

Mr. C. Napier Hake's paper on "Explosives" is postponed until Monday, May 6th, 1889.

Meeting held Monday, December 3rd, 1888.

MR. DAVID HOWARD IN THE CHAIR.

In opening the meeting, the Chairman drew attention to the fact that the Secretary of the London Section, in his capacity of Chairman of the Chemical Section of the London Chamber of Commerce, was in communication with the Government with a view to obtaining for technologists an amelioration or the removal of the existing hindrances to the use of pure alcohol, and said he hoped that all members who had experience of those chemical industries which were suffering from the present restrictions on the use of that body would furnish himself or the Secretary with any facts which in their judgment might assist in attaining the very desirable end which Mr. Tyrer had in view.

He further remarked, in pursuance of the announcement as to discussions made at the last meeting of the Section, that the question of technical education would shortly come before the Legislature in a practical form. In his opinion, it would be nothing less than a national misfortune if the settlement of that great question were left entirely to theorists—many of whom were utterly ignorant of even the simplest elements of practical work. It was the intention of the Council to refer the question to the Sections for discussion, and there were many members of the London Section capable of throwing most valuable light upon it. He therefore hoped that when arrangements should be made for bringing the subject forward, those members would attend and give the Society and the country the benefit of their knowledge and experience.

* * *

THE ANALYTICAL EXAMINATION OF WATER FOR TECHNICAL PURPOSES.

BY ALFRED H. ALLEN, F.I.C., F.C.S.,
President of the Society of Public Analysts.

Much has been written of late years on the analysis of drinking water, and the methods devised by Frankland, Wanklyn, and others for this purpose find their proper place in our text-books. But I would venture to suggest that the analytical examination of water for other than sanitary purposes has not made much progress of late years, and the particular items on which information is required for special purposes are often by no means adequately described. Of course it may be said with some force that there is not much now to be learnt respecting the determination of calcium, sulphates, or chlorides in water; but I contend that there is much time wasted in ascertaining useless facts, and that the value of the results to our clients is by no means so great as it might be if more attention were paid to the exact nature of the problems to be solved.

The first method of analysis to which I propose to refer is the well-known process of Clark for determining the hardness of water by a standard solution of soap. This, which is one of the oldest processes of volumetric analysis, is generally recognised as giving very useful indications. In fact, the subdivisions of the hardness into "temporary" and "permanent" have a very practical value. But while fully recognising the value of some method of readily determining the "hardness" of water, and admitting that the soap test gives constant and fairly accurate results when applied to certain waters of moderate hardness, I contend that it by no means fulfils its purpose when used for the assay of very hard water or highly magnesian water. In short, while Clark's process has done good work in its day, and may still be found of service for certain strictly comparative and technical purposes, I submit that the time has come when professional chemists should cease to report results obtained by the soap test, and should abandon it in favour of other methods which furnish the information required more accurately and quite as speedily as Clark's process.

In illustration of the anomalous and misleading results yielded by the soap test when applied to waters outside the general run of those met with in the South of England, I may quote the following figures I obtained from waters pumped from colliery shafts near Batley, Yorkshire. It will be seen that though there are five samples, they only represent the water from three shafts, two of which (A and W) are very near together.

	Shaft A.		Shaft W.		Shaft C.
—	1. April 7, 1887.	2. April 23, 1887.	3. October 17, 1887.	4. May 25, 1888.	5. May 25, 1888.
Total solid matter	114·34	114·00	120·68	124·81	136·04
Non-volatile matter	107·68	100·50	114·03	110·67	105·95
Deposit on boiling	35·00	30·16	37·31	33·82	16·46
Inorganic constituents—Analytical results:					
Carbonic acid (combined)	14·46	13·77	17·02	14·74	7·17
Sulphuric acid (combined)	36·50	35·64	41·20	43·94	58·11
Chlorine	7·40	6·25	3·90	2·70	1·55
Silica	1·20	Not determined.	1·57	Not determined.	Not determined.
Oxide of iron	0·56	Not determined.	0·20	Not determined.	Not determined.
Magnesia	9·28	8·37	10·80	8·89	13·10
Lime	17·66	17·18	20·08	19·32	27·47
Nitric acid	None.	None.	None.	None.	None.
Constituents expressed in combination:					
Calcium carbonate	32·87	30·68	35·82	33·52	16·30
Magnesium carbonate	None.	0·52	2·40	None.	None.
Calcium sulphate	3·04	None.	None.	1·31	45·54
Magnesium sulphate	27·84	24·36	28·98	26·67	39·30
Sodium sulphate	28·68	34·43	38·84	45·07	8·38
Sodium chloride	12·19	10·30	6·42	4·45	2·55
Silica and oxide of iron	1·76	Not determined.	1·77	Not determined.	Not determined.
	106·38	100·29	114·23	111·02	112·07

The method adopted for combining the bases and acids is not that which I myself prefer, but was employed in order to render the results more readily comparable with those of certain other chemists. Mr. George Jarmain, of Huddersfield, analysed duplicate samples of all the above waters, and our results generally agreed in the closest manner, so that there can be no doubt of the substantial accuracy of the determinations.

DETERMINATIONS OF HARDNESS IN ABOVE COLLIERY WATERS.

—	Hardness.			Deposit on Boiling.	
	Total.	Permanent.	Temporary.	Weight.	$CaCO_3$ by Titration.
Shaft A:					
I.—April 7, 1887 .... Allen ...	46·0	18·4	27·6	35·00	32·90
„ „ .... „ ...	44·0	18·6	25·4	..	..
„ „ .... Jarmain	33·0	15·7	17·3	..	..
II.— „ 23, 1887 .... Allen ...	48·0	24·0	24·0	30·16	31·30
„ „ .... „ ...	56·0	29·0	27·0	..	..
„ „ .... Jarmain	58·0	18·0	40·0	..	..
Shaft W:					
III.—October 17, 1887 .... Allen ...	57·0	28·0	29·0	37·31	38·68
„ „ .... „ ...	45·0	28·0	17·0	..	..
„ „ .... Jarmain	58·8	22·0	36·8	..	..
„ „ .... Mr. X...	40·0	..	..	..	..
IV.—May 25, 1888 .... Allen ...	56·8	32·0	24·8	33·82	33·52
„ „ .... „ ...	59·0	37·0	22·0	..	..
„ „ .... Jarmain	64·0	27·6	36·4	..	..
Shaft C:					
V.— „ „ .... Allen ...	73·6	52·0	21·6	16·46	16·30
„ „ .... „ ...	86·0	60·0	26·0	..	..
„ „ .... Jarmain	99·0	71·0	28·0	..	..

These figures are very instructive, and show the limited value of determinations of hardness in such waters. Not only do the determinations of Mr. Jarmain disagree with those made in my laboratory, but even the latter are discordant, although made at only a few days' interval. Again, the loss of hardness by boiling for one hour (the so-called "temporary hardness") ought to agree approximately with the weight of the deposit on boiling, and more closely with the carbonate of calcium in the deposit, as calculated from its alkalinity determined by titration with standard acid. But the table shows as many discrepancies as agreements.

It is commonly assumed that the hardness of an ordinary water represents the total calcium in terms of carbonate *plus* the total magnesium in terms of calcium carbonate. Mr. Wanklyn, however, dissents from this view, and states that a molecule of MgO has a greater hardening power than a molecule of CaO in the proportion of three to two. This means that while 10 grains of $CaCO_3$ or 13·6 of $CaSO_4$ per gallon will produce a hardness of 10 degrees, 8·4 grains of $MgCO_3$ or 12·0 of $MgSO_4$ will produce a hardness not of 10 but of 15 degrees.

Of the above colliery waters, with the exception of the sample from shaft C (which contains calcium sulphate), the calcium may be taken as existing substantially as calcium carbonate, and the magnesium as magnesium sulphate, or in other words, the temporary hardness is practically due to calcium carbonate, and the permanent to magnesium sulphate. On this assumption we can calculate the theoretical hardness of the waters in question.

THEORETICAL HARDNESS.

—	1.	2.	3.	4.	5.
Temporary hardness (Ca in terms of $CaCO_3$).	32·9	30·6	36·2	33·5	16·3
Permanent hardness (Mg in terms of $CaCO_3$)	23·4	20·9	27·0	22·2	..
Permanent hardness, on Wanklyn's assumption	35·1	30·3	40·5	33·3	..
Total hardness (Mg + Ca in terms of $CaCO_3$).	56·3	51·5	63·2	55·7	..
Total hardness, on Wanklyn's assumption ...	68·0	60·9	76·7	66·8	73·0

A casual comparison of these figures with those obtained by actually determining the hardness of the waters in question suffices to show the erroneous nature of any estimate of the proportions of lime and magnesia which might be based on the observed hardness.*

In all the foregoing experiments, ample time was allowed, so that the results are certainly not vitiated by the formation of the false lather characteristic of magnesian water. Nor can the objection of too great concentration be taken, for enough distilled water was always added to reduce the hardness within the limits usually recognised as necessary for accurate results.

This practice of diluting any hard water before titrating with soap solution raises the question: What is meant by the "hardness" of water. Does it mean the soap-destroying power; or does it mean the proportion of calcium and magnesium compounds expressed in terms of calcium carbonate? If by the term "hardness" the soap-destroying power of a water is to be understood, it seems very improper and unfair to dilute the water before making the determination. The laundress and manufacturer do not dilute the water they use, and hence to report a water as destroying as much soap as one containing, say, 30 grains of chalk per gallon, when, as a matter of fact, it does nothing of the kind unless diluted before making the test, is misleading, and, in my opinion, a practice which ought to be abandoned.

On the other hand, if the "hardness" is intended to represent the calcium and magnesium compounds of the water, the figures I have quoted suffice to show that the results are of the crudest possible character, quite unworthy of anyone aspiring to the title of chemist. If an estimate of the calcium and magnesium compounds be wanted, a very fair approximation can be obtained by boiling down the water to a small bulk with carbonate of sodium, and filtering and washing the precipitated earthy carbonates. On then dissolving the precipitate in standard acid, and titrating back with standard alkali and methyl-orange, a result is obtained which represents the total calcium and magnesium very closely, and may be expressed in terms of calcium carbonate. By titrating the original water with standard acid and methyl-orange an estimate of the earthy carbonates (temporary hardness) can be obtained in a few minutes.

My friend Mr. O. Hehner described substantially the same method of operating some years since (Analyst, VIII., 77), the chief difference being that he evaporates the water to dryness in platinum with a known amount of sodium carbonate, redissolves the residue in water, filters, and titrates the filtrate to ascertain the excess of sodium carbonate.

In the paper in which he describes this process, Mr. Hehner points out that soap is partially decomposed on diluting its solution into an acid oleate and free alkali, and that the alkali set free will vitiate the result more or less by precipitating magnesia and neutralising the carbonic acid which kept the earthy carbonates in solution.

Mr. Herbert Jackson has pointed out (Chem. News, xlix., 149), that the results of the titration hard water by soap solution are largely affected by temperature, a condition which usually is entirely ignored. Mr. Jackson states that exactly similar results are obtainable by heating the water to a temperature of 70° C. as are obtained in the ordinary way by dilution. He points out that, as a consequence, hot water destroys more soap than cold.

The statement of Mr. Wanklyn that one molecule of MgO has the same hardening power as 1½ molecules of CaO, seemed to me to need confirmation, especially as no proof has been adduced that the oleate of magnesium precipitated has the improbable formula MgO, H_2O, 3 $C_{18}H_{33}O$. This ought to be the case if $MgSO_4$ reacts with 3 $NaC_{18}H_{33}O_2$, caustic soda being liberated, and further complicating the reaction! In such a case experiment appeared far preferable to theory, and Mr. H. Court has therefore made some experiments for me on solutions of magnesium sulphate of known strength. The standard soap solution used for the determinations was proved to be correct by assaying it with standard water of 14 degrees of hardness. 50 cc. of this standard water required 15 cc. of soap solution to produce a permanent lather. In another experiment 25 cc. of hard water mixed with 25 cc. of distilled water required 8 cc. of soap solution. Making in each case the correction of 1 cc. for the volume of soap solution requisite to form a lather with 50 cc. of distilled water (as directed by Wanklyn), the soap solution is evidently of the exact strength prescribed by Wanklyn. A solution of magnesium sulphate was made by dissolving 0·246 grms. of the crystallised salt in 700 cc. of water. This corresponds to 4 grains of MgO, or 12 of $MgSO_4$ per gallon.

1. 50 cc. of this solution required 11·5 cc. of the standard soap solution to produce a permanent lather.

2. 25 cc. of the same solution diluted to 50 cc. with distilled water required 6·5 cc. of soap solution.

Experiment 1 shows a hardness of 10·5°. Experiment 2 a hardness of 11·0°, before dilution. Water containing four grains of MgO per gallon, according to Wanklyn should have a hardness of 15 degrees. The experiments are far more in favour of the equivalence of CaO : MgO (= 10° hardness) than 3 CaO : 2 MgO.

3. 25 cc. of the magnesian water and 25 cc. of the standard hard water ($CaCl_2$ = 14°) were mixed and titrated with soap solution. 9·9 cc. required, corresponding to a hardness of 8·9, instead of (5·5 + 7·0) = 12·5°. Hence a water containing both lime and magnesia does not destroy so much soap as the same amounts of lime and magnesia would do separately.

This result was so startling and perfect a proof of the unreliable nature of the soap test, that I had the following experiments made in support of it. A solution of calcium chloride, of which 50 cc. consumed 15 cc. of soap solution, corresponding to 14° hardness, and a solution of magnesium sulphate, 50 cc. of which required 11·9 cc. of the same soap solution (= 10·9° hardness), were mixed in various proportions :—

$CaCl_2$ Solution used.	$MgSO_4$ Solution used.	Soap Solution required.	Soap Solution calculated.
cc.	cc.	cc.	cc.
50	0	15·0	..
0	50	11·9	..
20	30	11·1	13·15
30	20	11·6	13·76
25	25	10·5	13·46

These results seemed to furnish the strongest of arguments against the employment of the soap test for the examination of water containing a notable proportion of both calcium and magnesium compounds, unless some means could be found of counteracting the disturbing action caused by magnesium salts. A solution of the problem seemed to be furnished by a simple and ingenious method described by Mr. Wanklyn in his "Water Analysis," by which the magnesia in a water may be determined "in a quarter of an hour." It consists simply in adding powdered ammonium oxalate, in the proportion of 1 grm. per litre, to a portion of the water, agitating for one minute, filtering, and determining the hardness of the filtrate in the usual way. It is assumed by Mr. Wanklyn that the oxalate will precipitate the calcium only, but do that fairly completely, and hence that the hardness of the filtered water will represent the magnesia of the sample. Each degree of hardness thus found (= 1 grain of $CaCO_3$ per gallon), according to Mr. Wanklyn, corresponds to 0·267 of MgO, 0·56 of $MgCO_3$, or 0·80 of $MgSO_4$. I have made a number of experiments on the use of oxalate of ammonium for the purpose in question, and although they go to show the valueless character of the process for the purpose intended, they are sufficiently interesting in themselves to deserve recording. Thus :—50 cc. measure of a solution of *magnesium sulphate* was titrated with soap solution, and the experiment repeated after adding various amounts of ammonium oxalate, shaking for one minute (there was no precipitate to filter), and titrating :—

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* Since reading this paper, I find that Dr. J. Grossmann had previously arrived at the same conclusion (*Chem. News*, xxxix., 258). A water analysed by him would have had a hardness of 35·9° if Wanklyn's assumption had been correct, and 29·4° on the assumption of MgO and CaO having the same hardening power; whereas the hardness found by careful experiment was only 23·3.

—	Weight of Ammonium Oxalate added, in Grammes.			
	None.	·050=1 grm. per Litre.	·300=6 grms. per Litre.	·500=10 grms. per Litre.
Soap solution required	11·9	7·4	4·2	2·8
= Hardness	10·9	6·4	3·2	1·8

Hence it appears that the presence of a neutral and presumably indifferent salt like ammonium oxalate is capable of reducing the hardness due to magnesium sulphate from 10·9 to 1·8 degrees. Of course, the next question was whether the action would be common to other ammonium salts and to other oxalates, and the following results were obtained in my laboratory by Mr. Les Taylor in elucidation of the point. In each case half a gramme of the salt was added to 50 cc. of the magnesium sulphate solution :—

—	None.	0·500 grm. Salt added to 50 cc. (= 10 grms. per Litre).						
		Ammonium Oxalate.	Sodium Oxalate.	Pot. Sod. Tartrate.	Ammonium Citrate.	Ammonium Chloride.	Sodium Chloride.	Sodium Sulphate.
Soap solution required	11·9	2·8	1·4	8·3	2·9	5·0	9·4	9·4
= Hardness	10·9	1·8	0·4	7·3	1·9	4·0	8·4	8·4

The following experiments were then made with smaller amounts of some of the same salts added to the magnesium sulphate solution :—

—	None.	Salt added to 50 cc.						
		Sodium Oxalate.				Pot. Sod. Tartrate, ·050.	Ammonium Citrate, ·050.	Sodium Sulphate, ·050.
		·250	·125	·062	·050			
Solution required	11·9	1·4	2·7	4·0	6·7	11·7	9·7	11·9
= Hardness	10·9	0·4	1·7	3·0	5·7	10·7	8·7	10·9

The following experiments were made by Mr. Taylor with a solution of calcium chloride of 14 hardness :—

—	Salt added to 50 cc.			
	None.	Ammonium Oxalate, ·050 grm.	Ammonium Chloride, ·500 grm.	Sodium Chloride, ·500 grm.
Soap solution required	15·0	1·1	15·0	17·2
= Hardness	14·0	0·1	14·0	16·2

In the experiment with ammonium oxalate the liquid was filtered after one minute. In another experiment in which the titration was conducted in presence of the precipitate of calcium oxalate, 3·7 cc. of soap solution was required.

A series of experiments was now made with London water, to which various salts were added in the proportion of 0·050 grm. to 50 cc. (= 1 grm. per litre).

	Salt added.							
	None.	Sodium Oxalate.	Ammonium Oxalate.	Ammonium Citrate.	Ammonium Chloride.	Potassium Sodium Tartrate.	Sodium Sulphate.	Sodium Chloride.
Soap solution required	15·8	2·0	2·0	15·7	16·0	15·7	15·7	15·9
– Hardness	14·8	1·0	1·0	14·7	15·0	14·7	14·7	14·9

The following table shows the effect of various proportions of sodium oxalate :—

		Sodium Oxalate added to 50 cc.		
	None.	·050 grm. = 1 grm. per Litre.	·025 grm. = ½ grm. per Litre.	·0125 grm. = ¼ grm. per Litre.
		cc.	cc.	cc.
$CaCl_2$ solution	15·0	2·0	..	1·6
$MgSO_4$ solution	11·9	6·7	10·0	..
London water	15·8	2·0	2·5	1·3

In the cases of London water and calcium chloride solution the softening effect of an oxalate is evidently chiefly due to the precipitation of the calcium. The softening effect on the magnesium solution varies with the amount of oxalate used, but is in all cases very marked. As the softening effect of the soluble oxalate depends on the quantity used, and this is affected by the amount of calcium, it is evident that the hardness of a magnesian water to which oxalate has been added will vary with the amount of calcium present. Hence it appears hopeless to devise a method of determining magnesia in water by the method recommended by Mr. Wanklyn.

I think the evidence and arguments I have adduced sufficiently prove the unreliable nature of the results yielded by the soap test, and I may even be accused of thrashing a dead horse. But this can scarcely be the case while the results of the soap test are still widely reported and quoted, and while so experienced a water analyst as Dr. Tidy reports hardness results to two places of decimals. On the other hand, Mr. Wanklyn would seem to regard the soap test as one of a very rough character, for he directs the solution to be prepared on the assumption that the Castile soap of commerce is of constant composition, and describes the method of ascertaining its strength with a standard calcium solution apparently simply as a precaution which may be omitted at discretion.

The vexed question of the statement of the results of the analysis of waters is by no means one of mere academic interest, but rises as a spectre in the path of the water analyst immediately he attempts to place his results on paper. The subject is one which a committee of the British Association has been appointed to consider, and I received some time ago, from Dr. Percy Frankland, the secretary of the committee, a form on which I duly expressed my views on the subject. I am not aware whether any report was presented by the committee at the Bath meeting, or whether analytical chemists generally have communicated with Dr. Frankland.

In expressing the results of water-analyses, it seems to be too often forgotten that, as far as possible, the results should be intelligible to others than professional chemists. It may not be always possible to ensure this, but much might be done if chemists would take a little more trouble to express themselves clearly. I have seen marginal notes on a highly scientific analysis of drinking water, showing that the client had made very erroneous deductions. Thus, against the "chlorine" it was noted that this was an irrespirable gas, of green colour, and very corrosive character. The "sulphuric acid" and "nitric acid" were similarly described as highly corrosive and poisonous. This misunderstanding might easily have been avoided.

An American committee appointed to consider the statement of results of water analysis have reported in favour of expressing them in proportions of Ca, Mg, Na, SO_4, CO_3, NO_3, Cl, &c. In my opinion, a fatal objection to the general adoption of this plan, so convenient to the professional chemist, is that we have no names for the salt-radicals expressed by the formulæ SO_4, CO_3, NO_3, &c. Under these circumstances we are driven to one of two alternatives: either to express the constituents in the old way, as anhydrous acids and bases, or to combine them, to the best of our knowledge and ability, and report the constituents thus evolved from our imagination. Of course, we are all aware of the objections to the latter course ; and in most cases the best way, in my opinion, is undoubtedly to state the proportions of "anhydrous sulphuric acid (combined)," "lime," &c., and then to add :—"These bodies may be conveniently assumed to be combined as follows :—"

Whether it is better to express the results of the analysis in parts per 1,000, per 10,000, per 70,000 (= grains per gallon), per 100,000, or per 1,000,000, in my opinion, should depend on circumstances. Parts per 1,000, or grms. per litre, is undoubtedly the most convenient method in the case of most mineral waters, but is equally unsuited for the majority of technical purposes. On the whole, I think grains per gallon (parts per 70,000) is the most generally convenient mode of expression, though in the case of boiler waters it is often useful to the client to add another table, showing lbs. per 1,000 gallons, which is the same as parts per 10,000. The object is to give the engineer or manager a definite idea of the amount of boiler incrustation or other mineral matters separated from or dissolved in every

1,000 gallons of the water evaporated. Few people have any well-defined notion of "1 grain," but they all realise what is meant by "1 pound."

With regard to the method of combining the basylous and acid radicals (or bases and acids) to form salts, it would unquestionably be a great advantage to have a more regular and generally-accepted practice, even though it were, to some extent, an arbitrary one. Some years ago the British Association Committee of Potash Salts and Phosphoric Acid, of which I was the secretary, recommended the general adoption of a specified method of combining the acids and bases of commercial potash salts; and this has been followed with great advantage.

In combining the acid and basylous constituents of water-solids, the majority of chemists follow the recommendations of Fresenius, but probably some are not aware that his directions have varied materially in different editions. Thus, in the 4th English edition, published in 1865, they are as follow:—"The chlorine is combined with sodium; if there is an excess, this is combined with calcium. If, on the other hand, there remains an excess of soda, this is combined with sulphuric acid. The sulphuric acid, or the remainder of the sulphuric acid, as the case may be, is combined with lime. The nitric acid is, as a rule, to be combined with lime. The silicic acid is put down in the free state, the remainder of the lime and the magnesia as carbonates."

In the latest English edition the following instructions are given:—

"The chlorine is combined first with sodium; if there is an excess (which rarely occurs) this is combined with calcium. The sulphuric acid is combined first with lime. The nitric acid is combined first with ammonia, and the remainder, if any, with soda, if the latter has not been used up for the chlorine, otherwise with magnesia. The silicic acid is put down in the free state, the remainder of the lime and magnesia as carbonates, usually as neutral carbonates . . . . if the evaporated water is strongly alkaline, carbonate of soda is present, generally along with sulphate of soda and chloride of sodium, sometimes also with nitrate of soda. The lime and magnesia should then be entirely combined with carbonic acid."

Of course, every chemist will regard any recommendation of Fresenius with the greatest respect. Nevertheless, I think the methods of combination prescribed by him are open to several objections. Thus, the combination of the chlorine with sodium, and, failing that, with calcium, is misleading if employed for waters to be used for steam-raising purposes, though the statement of the chlorine in terms of sodium chloride is certainly convenient and desirable in the case of sanitary analyses, as the amount thus shown is, to some extent, a measure of the urine present.

I contend that magnesium chloride should appear in the analysis to the full extent corresponding to the chlorine and magnesium present, for, owing to the tendency of magnesium chloride to decompose with formation of free hydrochloric acid on evaporating its solution, waters containing both Mg and Cl in notable amount are very apt to corrode the metal of the boiler at the water-line, and I believe the steam-pipes are also affected. I have known this corrosive action exerted in a very marked degree by a water containing, in grains per gallon—

Chlorine 6·71 (= $MgCl_2$ 7·14) and
combined carbonic acid 7·97 (= $CaCO_3$ 18·11).

I do not feel certain, however, that all waters containing magnesium chloride, whether potentially or actually, are equally objectionable. We know that the decomposition of magnesium chloride, on evaporating its solution, may be prevented by adding a sufficient quantity of ammonium chloride, when a stable double salt is formed, the solution of which is not decomposed on evaporation. It seems probable, from experience with sea-water, that sodium chloride acts in the same way, in which case only that amount of magnesium chloride will be objectionable which is in excess of that equivalent to the sodium chloride; and a cure for the corrosion caused by it would be found in the addition of common salt to the water. I am not aware that the subject has been at all investigated, but it seems of sufficient practical interest to repay experiment.

Again, many chemists express the nitric acid as sodium nitrate, in presence of magnesium sulphate. I suggest that this is undesirable and the truth of it improbable. Such water containing nitrates gives on evaporation a residue which evolves red fumes on ignition, a fact that proves that, after evaporation at any rate, it is nitrate of calcium or magnesium which is present, for these compounds do evolve red fumes when ignited, whereas nitrate of sodium does not.

With respect to the sulphates, my feeling is in favour of expressing all the calcium as $CaSO_4$, or at any rate all which is in excess of that required to form carbonate, assuming of course that the sulphates are present in excess. I am fully aware that such a course is inconsistent with the argument I have just used respecting the mode of existence of the nitric acid, but it is so important to give prominence to the extent to which the water would be liable to deposit calcium sulphate on evaporation, that I think this consideration of the first importance.

Not long ago I received a water, a sample of which had been sent some months previously without my knowledge to a highly competent chemist who is a personal friend of my own. On sending in my report, I was asked if I could reconcile my results with those of Mr. X. He had expressed his results in parts per 100,000, and I in grains per gallon, and his method of combining the acids and bases being different from mine, the analyses at first appeared completely discordant, but when calculated on the same basis they showed as close an agreement with mine as could be expected in the case of samples collected at an interval of some months.

Now it seems to me a great pity not to express the combined carbonic acid, as far as possible, in the form of calcium carbonate. If the term "temporary hardness" mean anything, and if the determination be worth making, it is an expression of the earthy carbonates in terms of calcium carbonate, whereas by returning them as magnesium carbonate all consistency is lost. At one time I used to be at the trouble of analysing the deposit produced on boiling the water, and used to state the amounts of calcium and magnesium found in it; but of late I have learnt that the extent to which magnesium goes into the deposit on boiling is extremely erratic, varying considerably even on repeating the process on the same water, and hence its determination is useless, even for the one purpose of which it might be supposed of value, namely, to obtain some information respecting the composition of the boiler incrustation likely to be formed in practice. It was pointed out in a very interesting paper by Mr. V. C. Driffield, read before the Liverpool Section of this Society (this *Journal* vi., 178), that the magnesium contained in boiler incrustations does not occur as carbonate, but as oxide, a fact which is of interest in connexion with the many recorded analyses of incrustations in which magnesium carbonate appears, and the sum of the constituents of which add up exactly or approximately to 100·00.

Mr. W. F. K. Stock has pointed out (*Chem. News*, xxxix., 5) that at an additional atmosphere pressure calcium sulphate is practically insoluble in water, a fact of which the practical bearing is evident.

A few years since I was interested in an attempt to ascertain the rate at which an exploded boiler had undergone corrosion. The water of the stream supplying the boiler was at times very acid, and traces of zinc and nickel in the boiler-incrustation indicated the source of the free acid in a works a little higher up the stream. The water contained 10 grains per gallon of CaO, but no iron. In the boiler-deposit the lime bore to the iron the ratio 2 : 1. Hence the inference was that for every gallon of water evaporated, at least 5 grains of iron had been dissolved from the boiler. A knowledge of the quantity of water evaporated weekly then gave the means of calculating the weight of iron in the deposit, and hence the rate of corrosion of the boiler.

E. Bohlig has published an interesting paper, an abstract of which appears in the *Journal of the Chemical Society*, vol. xxxvi., page 963. Bohlig states that if the free carbonic acid be removed at any temperature below 100° calcium carbonate is precipitated, while magnesium sulphate remains in solution. If the CO_2 be removed by simple boiling, the precipitate consists entirely of calcium carbonate if magnesia be present in sufficient quantity; but when the boiling is continued, and the boiling point becomes higher through the accumulation of soluble salts, calcium sulphate is formed. On boiling magnesium sulphate solution with calcium carbonate, CO_2 escapes and calcium sulphate remains in solution, while basic magnesium carbonate, or, if the boiling point has risen considerably, even magnesium hydrate remains in the precipitate. If the Mg found corresponds to the acid-neutralising power of the water (temporary hardness), Bohlig considers it is present wholly as carbonate, and only the excess over this amount should be expressed as nitrate, chloride, or sulphate.

These views, which appear well worth consideration, are opposed to those expressed in the text.

With regard to the amount of earthy carbonates remaining unprecipitated on boiling a water, I may point out that calcium carbonate is by no means so insoluble as is frequently assumed. Roscoe and Schorlemmer state the solubility at about 18 mgrms. in 1 litre of water, either cold or boiling. This corresponds to a solubility of 1·26 grains per gallon. But it is further stated by them, on the authority of Hofmann, that "when a solution of calcium carbonate in carbonic acid water is boiled, the liquid still contains in solution 34 mgrms. of calcium carbonate per litre (= 2·38 grains per gallon), and this solution does not render lime water turbid."

But it is probable that the presence of soluble salts, such as ordinarily occur in water, may modify the solubility of calcium carbonate in one direction or the other, and at present there is but little information on this point.

Another point of interest is the solubility of calcium carbonate in water containing carbonic acid. It is commonly assumed that the earthy carbonate is held in solution in the form of a so-called "bicarbonate," of the formula $CaCO_3, H_2CO_3$. I have not found any record of this compound having been isolated, or of the experiments on which the assumption of its existence was based. I have made a number of experiments to decide the point, but as they have so far merely led to further investigations, I must leave their detailed description for a future paper.

On the other hand, I believe calcium carbonate can be retained in solution in water through other agencies than the formation of a bicarbonate, one water in particular having evolved on boiling an amount of carbon dioxide gas equivalent to a mere fraction of the calcium carbonate simultaneously precipitated. It seems probable that calcium carbonate is capable of existing in a soluble colloid condition, changing on boiling the liquid to the ordinary insoluble modification. I am still investigating the subject, and propose to extend my experiments to analogous carbonates.

It is not unfrequently assumed by chemists that the amount of lime required to soften water by Clark's process is dependent on the temporary hardness of the water to be treated, or, in other words, must be equivalent to the calcium carbonate to be precipitated. But the least consideration renders it evident that the temporary hardness of the water has nothing to do with it, and that the amount of lime really required to be added must be the equivalent of the free carbonic acid of the water, that is, of all CO_2 not existent as CaO, CO_2 or MgO, CO_2. This statement leaves out of consideration the additional quantity of lime required to react with any sulphate or chloride of magnesium, as such extra quantity simply means a substitution of soluble calcium salts for soluble magnesium salts, and, except in the case of highly magnesian waters, such a change cannot be regarded as advantageous.

Similarly, in softening water for boiler purposes by caustic soda or soda-ash the following considerations are too often lost sight of. Sodium carbonate will react with the sulphates and chlorides of the earth-metals, and hence remove the so-called "permanent hardness," but will not affect the carbonates of calcium and magnesium. On the other hand, caustic soda, if added in quantity equivalent to the free carbonic acid present, will cause the precipitation of practically the whole of the earthy carbonates by removing their solvent; and the sodium carbonate formed will then react with an equivalent amount of the sulphates and chlorides of the earth-metals. Hence caustic soda does a double duty, and is preferable to soda-ash, except when the water is richer in calcium sulphate or chloride (not magnesium salts) than in earthy carbonates. In such cases a mixture of caustic and carbonated soda in suitable proportions may be advantageously employed. Caustic soda has the practical disadvantage that the use of a notable excess is liable to cause corrosion of the metal.

In the South of England, or at least in the home counties, the waters are so universally alkaline from the presence of earthy carbonates, that I have heard a well-known chemist express the opinion that natural waters are always alkaline. Of course this is an error, and in the North of England we frequently meet with water of very sensibly acid reaction and of very variable composition. In the case of colliery waters and other waters from deep borings in the coal-measure strata, an enormous amount of sodium chloride is frequently present. Calcium chloride sometimes occurs in very large proportion. Iron and aluminium are frequently present, and in one case I met with zinc. Mr. Fairley has found distinct traces of lithium, and the November number of the Journal of this Society contains an analysis by Messrs. Cleeves and Platts, of water from a South Yorkshire colliery where bromides and barium are present in notable proportion. I have never looked for bromides myself, and as sulphates have been present in all the waters I have examined, barium must have been absent.

Many colliery waters and waters which it is desired to use for drinking purposes contain sodium carbonate, the proportion sometimes reaching 30 or 40 grains per gallon.

Free acid in colliery waters of course is of common occurrence, a sample which I examined recently having an acidity equivalent to 19·1 grains of H_2SO_4 per gallon, while the saline constituents were, exclusive of soda, which was not directly determined :—

	Grains per Gallon.
Al_2O_3 (a little Fe_2O_3)	29·47
MgO	15·64
CaO	39·34
SO_3 (combined)	244·10
N_2O_5	39·95
SiO_2	4·48
Cl	5·10

—	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.
Total solids	207·7	1,834·0	276·1	84·28	73·6	242·9	207·7	53·10	302·3	120·41	200·2
Non-vol.	199·5	1,561·0	268·5	75·04	67·9	181·9	199·5	45·50	291·5	114·60	175·7
Calcium carbonate	10·8	15·4	11·5	21·3	6·4	None.	10·8	16·1	10·4	1·3	41·8
Calcium sulphate	15·0	92·0	..	..	8·7	42·1	16·0	2·1	..	..	..
Magnesium sulphate	20·4	None.	..	..	0·7	40·9	None.	..	..	..	108·2
Sodium sulphate	73·6	..	33·7	61·2	40·3	79·8	97·8	..	2·6	9·2	0·2
Sodium chloride	70·1	1,236·7	194·5	4·8	14·5	2·8	50·7	8·1	269·9	71·7	19·8
Sodium carbonate	..	..	25·5	2·1	..	None.	..	22·7	10·4	36·5	..
Calcium chloride	..	262·6	..	..	..	..	..	..	..	..	..
Magnesium chloride	..	92·4	..	..	..	..	..	..	..	..	..

The preceding table shows the composition of the solids from various colliery waters examined in my laboratory. The mode of combining the acids and bases is not that which I myself prefer, but was adopted to allow of the figures being more readily compared with those of certain other chemists. To save space I have not given the analytical data, but shall be happy to furnish them to anyone interested in the subject.

The water supplied to Sheffield is derived from peaty moorland, and sometimes has a strong action on iron. There is a marked difference, not readily accounted for, between the high-level and low-level supplies. The high-level supply has an acidity which can be determined in the unconcentrated water (after boiling well to expel CO_2), by titration with phenolphthaleïn as an indicator, and is equivalent to 0·25 to 0·75 grs. of H_2SO_4 per gallon. It is difficult, if not impossible, to ascertain the nature of the free acid. On concentrating the water to one-tenth it has a strong acid reaction to litmus paper. If then exactly neutralised by caustic soda and evaporated to dryness, the residue, after ignition, is alkaline, pointing to the previous presence of a fixed organic acid—very probably a product of the oxidation of the peat. In some experiments I have evaporated as much as 10 litres in the hope of ascertaining something further as to the nature of the free acid, but bearing in mind the small amount present any great advance in that direction is not to be expected. The low-level water, on the other hand, after concentration, is faintly alkaline in its reaction to litmus. On ignition, it yields a residue of marked alkalinity, and hence the water evidently contains a soluble salt of an organic acid. The high-level (acid) water acts on lead pipes to a serious extent, while the action of the low-level water is much less marked.

In conclusion, I desire to acknowledge the assistance rendered by Messrs. L. Taylor, H. Court, and C. Leigh in making many of the experiments the results of which I have recorded.

DISCUSSION.

The CHAIRMAN said that the meeting had to thank Mr. Allen for bringing before it a subject of the highest practical utility, and one which had been much neglected. Undoubtedly the sanitary use of water was of the utmost importance as far as the health of the population was concerned ; but for the manufacturing chemist there was not only the question whether the available water was wholesome or not for human beings, but whether it was suitable for boilers also, as well as for his particular industry. A small trace of iron, for example, might render the water useless to a dyer, though it would be a matter of indifference as far as boilers were concerned. It was, therefore, only by knowing the purpose for which it was intended that one could express an opinion as to the suitability of any particular water. The popular idea of water seemed to be that it was simply a fluid which, when boiled, gave off steam ; and what became of the boiler in the process was a question either never asked, or, if asked, answered by resort to those forms of quackery of which many members present had no doubt had some experience. The countless remedies proposed for preventing incrustation, and the number of tons of various bodies which were put into boilers in the course of a year for that purpose, might form an interesting inquiry ; but a sound recognition of the importance of analysis of feed water was of the first moment to all boiler users. What Mr. Allen had said about the soap test would, he thought, agree with the experience of a good many of his audience. For his own part, he had given that test up in despair. The question of the allocation of the various acids to the different bases in analysis was one of great importance. It must be remembered that there was good reason to believe that what was true at zero was not true at 100°. It was quite possible, if not certain, that the distribution of acids and bases differed under differing circumstances. Differences of tension and concentration also affected that distribution very widely. For instance, it was quite possible that under ordinary conditions magnesium chloride might not be present as such in a water, but yet might become fatally present by the concentration of the water in the boiler. It was therefore difficult to give such an expression of the results of analysis as to convey an accurate knowledge of the facts. Perhaps a study of a week's working of the boiler would throw more light on the question than any theory.

Dr. Percy Frankland was sure that all who were interested in the examination of water must have listened with great pleasure to the very instructive paper presented by Mr. Allen. The paper was of such a nature as to require careful study before any proper commentary could be made upon it, inasmuch as it contained many valuable analyses of special waters; and he proposed, therefore, to remark on a few points only. The results which Mr. Allen had obtained with ammonium oxalate in precipitating lime, and subsequently making a determination with the soap test, were very interesting: and he would like to know whether the other salts of ammonium had the same singular effect in reducing the soap-destroying power of water. He thought that the idea of precipitating in a few minutes the whole of the calcium by means of ammonium oxalate would appear questionable to those who were practically acquainted with the time required for the complete precipitation of calcium oxalate, and he did not think that any chemist but Mr. Wanklyn had adopted this very inaccurate method of determining magnesia in water. He thought that Mr. Allen had been somewhat severe on the soap test. He (Mr. Allen) had taken exceptional waters, difficult to manage with the soap test, and had passed over the great number of the more ordinary waters in this part of the country with which the soap test really did give a very approximate idea of the amount of lime and magnesia salts present. It constantly came under his notice that in the case of samples of water taken from the chalk and other calcareous strata in the South of England the determination of the hardness, temporary and permanent, by the soap test, enabled one to calculate the composition of the water, and get results agreeing fairly well with the total solid residue determined by actual evaporation. Of course, he was quite aware that any water containing magnesia or large quantities of chlorides, or much acidity, was thoroughly unsuitable for testing with soap solution; in fact, he thought it desirable that in recording the results of the soap test a note should be made as to whether there had been any evidence of a magnesia reaction. A skilled operator in performing the soap test would easily detect magnesia, if present in any considerable quantity; and the accuracy of any tests made in the presence of such a magnesium reaction should be discounted. In such cases it was advisable to rely upon the sound rather than upon the permanence of the lather. Magnesia waters gave a lather earlier than calcareous waters, but the hard sound still persisted. With regard to Mr. Allen's suggestion that they should throw over the soap test altogether and determine hardness, or rather the lime as carbonate, by titration with acid, that method had the fatal objection that in the case of waters containing carbonate of soda it would give erroneous results. It would take longer to determine whether the water had carbonate of soda in it or not (and a great many waters in the South of England, especially near London, contained that body up to 15 to 21 parts per 100,000), and thus the method would present considerable difficulty in such cases: otherwise he saw no objection to it. Mr. Allen's statement as to the time which carbonate of lime took to separate when he treated carbonic acid water with calcium hydrate was quite in accord with his own experience of the softening of water by Clark's process. In that process the water had to stand for half an hour or more before complete separation took place; and even in those methods where filtration was resorted to, the water was made to flow through a large tank in order to allow time for the formation of the precipitate. With regard to determining the quantity of carbonic acid present in waters, and finding if this acid corresponded with the carbonate of lime in solution, he feared that the determination was likely to be faulty. The boiling-out method was open to great objection, because the carbonic acid had practically to be collected over water, inasmuch as the steam condensed in the collecting tube on the surface of the mercury, and thus a low result was obtained: and though the results of duplicate experiments might be concordant, he still thought such determinations suspicious and unreliable. He was interested to learn that Mr. Allen had found alumina in colliery waters. He himself had analysed some Lancashire colliery waters, and had found large quantities of alumina, up to 11 parts per 100,000, but did not remember having seen similar results recorded before, except that in some analyses recently published by Dr. Bedson, of Newcastle-on-Tyne, alumina in considerable quantity had been found. With regard to Mr. Allen's remarks about the acid in a portion of the Sheffield water-supply acting on lead, he hoped that due precaution had been taken to exclude the condensation of acids from the gas over which the evaporation was carried on, otherwise sulphuric and nitrous acids might thus have been introduced, and given rise to error. Mr. Allen having referred to the British Association committee on the expression of the results of water analysis, he (as secretary of this committee) took the opportunity of saying that a report had been drawn up, but he regretted that the members of the Committee had not been able to come to an agreement. Some were so wedded to "grains per gallon," and others were so much in favour of the decimal system, that it had been found impossible to present the report at present. He hoped, however, for greater unanimity on the subject next year. He himself felt very strongly that any record of acids and bases in combination as salts, without a simultaneous record of the actual determinations made, was a most objectionable practice. He might instance the case of a recent German book* containing thousands of analyses of mineral waters; but as only the hypothetical salts present in the waters were given, and as there was no indication of which results were calculated and which obtained by actual determination, it was almost perfectly worthless. All chemists ought to make a rigid practice of discriminating in their reports between the results obtained by actual determination and those arrived at by calculation, otherwise their reports were of little practical use, and might be highly misleading.

Mr. John Heron thought that Mr. Allen must have been dealing with strange waters with respect to hardness, and also that he had been hard on the soap test. He, for one, would stick up for that test, but he admitted that a great deal depended on the manner in which it was conducted. He used to follow the ordinary plan of first testing approximately the number of cc.'s of soap solution required to produce a lather, and then making a second experiment, getting as near as he could to permanent lather. But as time went on he found that method not very accurate. His attention was first called to the matter by a note in the *Chemical News* by Mr. Ellis, in which he recommended the addition of the soap solution by 1 cc. at a time to the water under examination, shaking the latter up after the addition of each cc. of solution. By following that method he found that very accurate results could be obtained. He never used the soap test, however, without making a complete analysis of the acids and bases, and he found that in the great majority of cases the temporary hardness corresponded very closely with the amount of carbonates of lime and magnesium present. He had determined the hardness of water artificially hardened by the addition of gypsum, and had found that where the operation was carefully conducted the determination was possible within one-half to one grain per gallon by means of the soap test, as he had proved by actual analytical determinations of the sulphate of lime which had been added to the water. He had never got a greater difference than 1 grain per gallon, even with a water containing as much as 60 to 70 grains or even more per gallon. He quite agreed with Dr. Frankland that analyses of water should give the acids and bases separately as well as show how these were combined. It was quite possible to arrive at a very close approximation to the manner in which the mineral constituents were combined in waters used for technical purposes. In all manufacturing operations, when the water was raised to near boiling point, a certain change took place in the state of the constituents, and the state in which the constituents were at that time would be shown by the analysis of the water. He thought that the mineral constituents of water ought to be expressed in grains per gallon, as that form was more readily comprehended by practical men. In the case of brewers, at any rate, analyses would certainly be much better understood in that form than in parts per 100,000. He felt personally obliged to Mr. Allen for bringing the subject forward. It had been in the background for a long time, and there were a great number of problems in connexion with the analysis of water for technical purposes which yet required solving.

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* Raspe's "Heilquellen."

Mr. A. Shearer had been much pleased to hear Mr. Allen's remarks about the soap test; it was only surprising to chemists who had to deal with waters from the technical point of view that the question had not been dealt with before. He had abandoned the soap test years ago for the same reason as Mr. Allen, and had found that the method of titration indicated by Mr. Hehner answered all practical purposes for temporary hardness. The method was simple and short. He took 500 cubic centimetres, added methyl-orange or cochineal titrated with $\frac{n}{2}$ acid, and that gave at once the temporary hardness, or at least its equivalent, the carbonates of magnesium and calcium. There was no danger of confounding these carbonates with carbonate of sodium if reasonable care was taken, or if anything like a total analysis was made, the total lime and magnesia giving the necessary data; and he did not think a water analysis was of much value unless an amount of care was given such as was necessary for the determination of the calcium, say by the oxalate method, and the magnesium as pyro-phosphate. Those were all the data necessary to determine the points required. Why the soap test should be adhered to as a means for determining temporary hardness in the presence of so much better a method, viz.: alkalimetry, he found it difficult to understand. No doubt Mr. Heron was right in saying that fair results could be obtained by the soap test in some cases, if one knew something of the history of the water tested. But anyone who made complete analyses and compared the results so obtained with the soap test results must come to the conclusion arrived at by Mr. Allen. He was glad to hear a determinate sound given out on this question, it having been a grievance to many chemists for years. In fact it was one of those tests the results of which depended on the personal character of the analyst.

Mr. W. Thorp agreed with Dr. Frankland and Mr. Heron and disagreed with Mr. Shearer as to the value of the soap test. A long time ago he had tried this very question of titration as against the soap test, and although he got concordant results—and indeed, in repeating determinations of the same water, practically identical results—yet he gave up the method because a very considerable number of waters owed their hardness to chloride of calcium or contained carbonate of soda. It seemed to him more difficult to examine the waters for these bodies than to make the soap test, and the soap test in his hands always gave good results. The process was one which was perhaps best described as empirical, in the sense that circumstances were of the essence of the process. The determinations must be made always under the same circumstances. Dr. Clark, in his original paper, said nothing about time, but he, like Mr. Heron, found that time was essential. If, as in the old way, a rough determination was made first, and then the greater part of the soap solution was run in at once, inaccurate results would be got. He thought it best to add the soap solution at much the same rate, no matter what quantity was used. It seemed that the combination of the calcium with the soap required time, and all attempts to shorten the process by running in larger quantities ended in erroneous results. That fact had been mentioned in the second edition of Sutton's *Volumetric Analysis*, and even earlier than that. He could not agree with Mr. Allen with respect to the quantity of carbonate of calcium in solution in water apart from free carbonic acid. It seemed to him to be a simple case of solution. He had determined the quantity long since, and found it to be about three parts in 100,000. That, he believed, had been found by others in various ways both before and since. When Mr. Allen spoke of the danger to boilers from the presence of chloride of magnesium, he supposed him to mean chloride in excess of the equivalent of carbonate of calcium. He could not imagine that the acid formed by the decomposition of chloride of magnesium could do harm to a boiler while protected by the crust of calcium carbonate. He agreed with what had been said about the arrangement of results; the original numbers obtained should always be stated, however they were afterwards explained and combined. He would go further. What the ordinary client paid for and ought to have, was the analyst's opinion. The numbers should be stated for the criticism of chemists, but as far as the non-chemical reader was concerned the figures were of little consequence, and the less he was led to attempt to understand them the better. In all commercial analyses it would be of great comfort to everyone if the analyst would kindly indicate which was the number that was got "by difference." So many analyses added up in a most suspicious manner to 100 per cent. They all knew that such a thing was so rare in practice as to suggest when it did happen that a mistake had occurred. Yet the ordinary commercial analysis *always* added up so.

Mr. B. E. R. Newlands could not help thinking that if Mr. Allen had made his experiments in London instead of Sheffield (though London chemists were pleased enough to greet him in the capital), he would have had a better opinion of Clark's soap test. He had himself worked with that test, and modifications of it, continuously day after day, and with a water of a permanent hardness of 30° and a temporary hardness of 20° had obtained results which did not vary more than 1½ degrees at the outside. In the case of waters from metropolitan waterworks, he had recently been working at a method of purifying water, and had found the results given by the soap test very uniform indeed, not varying more than half a degree. A short time back he had examined a water from a coal mine in Yorkshire, and in this case he had found the soap test to be unreliable; so much so, that it could not be put into the hands of a working man. The question of temperature had a great deal to do with the working of the process of purifying water. If the temperature were raised to 80° F. it often produced a marked improvement in the treatment by Clark's process, or that process supplemented by soda. With regard to so-called boiler-preserving arrangements, he would mention one instance of the sort of fluids which were vended by the boiler doctors who interested themselves to benefit factory owners. Some time back two samples of boiler fluid were sent to him. They were to be used alternately; and he found the first to consist of nitric acid and the second of caustic soda.

Mr. W. Macnab agreed with Mr. Allen that the soap test was not a reliable method for estimating the degrees of lime and magnesia salts present in water; practically the only way to arrive at the mineral constituents was by analysis. On the other hand, the soap test was very useful, and ought not to be discarded by those interested in waters for boilers. He had had considerable experience in analysing waters from all parts. In the case of waters of the character of those round London, and, where the hardness was not above 20°, the determination of hardness by the soap test, and its calculation from actual analysis and the estimation of lime and magnesia, agreed fairly well; but in the case of waters from Lancashire and Yorkshire and other places, having a hardness of 40° or 60° or more, there was often no correspondence between the two. On the other hand, the soap test was a useful thing in the laboratory to give one an idea of the hardness, so as to regulate the quantity of water to be used for analysis. As to the conduct of the process, it was most important that the solution should be added 1 cc. at a time to secure concordant results. As a ready means of control, he considered the soap test very useful, but it should be discarded as a means of recording results to be quoted in reports.

Mr. W. Crowder suggested that if Mr. Allen in any further experiments used the solution he had spoken of and evaporated it down in vacuo, he would get crystals of bicarbonate of lime, if they were to be got at all, and that would be a better way than the indirect method he had proposed. Another point which had struck him was that the deleterious effect of water upon boilers was generally ascribed by chemists to the presence of chloride of magnesium. But if that was so, why did the action occur only in certain parts and on certain plates? The effect generally took the form of "pitting" in certain parts, as if a pea had perforated the plates. If it was due to chloride of magnesium, why did it not occur all over the boiler?

Mr. A. H. Allen, in reply, said that so many interesting points had been raised that it would almost require another paper to answer them all. Dealing first with what had been said about chloride of magnesium by the Chairman and the last speaker (Mr. Crowder), he would point out that he had not suggested that all boiler corrosion was due to the presence of chloride of magnesium, though it was recognised by all that waters containing that salt were liable to produce corrosion. But Mr. Thorpe suggested that to do so it must be in excess of the carbonate of calcium present. If the corrosion were due to hydrochloric acid produced from magnesium chloride it would probably be in the upper part of the boiler, as the acid would be evolved at the surface of the water; but it was difficult to see how the deposit or incrustation of carbonate of calcium at the bottom of the boiler could react with the acid set free at the surface. Besides, if a base would neutralise the free hydrochloric acid, why did not the magnesia simultaneously produced have that effect. With respect to the suggestion that he might have obtained crystallised bicarbonate of lime by evaporating a solution *in vacuo*, he thanked the speaker for it, but had not much hope of its success. Dr. Frankland, Mr. Newlands, and others seemed to have fallen into the common mistake of people living in London of believing that London was everywhere and the rest of the world nowhere. He had often to deal with peculiar waters: but, because in London Dr. Frankland and others had to deal with ordinary waters, they said, "Why not be content with the soap test?" The soap test gave reliable results under certain conditions, and he used it under protest; but he objected to it in many cases as utterly misleading and valueless. With London water it gave constant and fairly accurate results, indicating the calcium present. But when the results were complicated by the presence of notable quantities of magnesium salts the difficulty he had described came in. He should like to know whether Dr. Frankland agreed with Mr. Wanklyn that $2\,MgO = 3\,CaO$ in hardening effect; and, if not, how it was that the soap test gave such different results in the hands of different chemists, both of whom claimed that it was correct. Where one had to deal with a very hard calcareous water, the soap test might give accurate results as stated by Mr. Heron, but it would not give so much information as could be obtained by other means. One had to dilute the water and add the soap solution very slowly, and then go through the process of estimating the hardness again on the water boiled for one hour. Why take all that time and trouble when it might be titrated as easily, more accurately, and in a shorter time by standard acid? There was absolutely nothing learned by the determination of temporary and permanent hardness by the soap test, which could not be ascertained more accurately in a few minutes by titrating the original water with acid. As to the precipitation of calcium compounds by oxalate of ammonium and determining the hardness of the filtrate to estimate the magnesia, as recommended by Mr. Wanklyn, Dr. Frankland had said that no chemist used the process. But he would remind Dr. Frankland that Mr. Wanklyn's book on water analysis was in its fifth edition (a sixth was now in the press), and that a large number of people who made water analyses, but were not skilled chemists, looked on it as their Bible. As long as that state of things existed attention ought to be called to the error, if it were one, as he believed it to be. As to the time for the calcium carbonate precipitation, he had not anticipated that on a small scale it would require so long a time as it did, but in some of his experiments many hours, and in other cases days, were allowed for its complete separation. In the case in which the CO_2 evolved did not correspond with the $CaCO_3$ precipitated on boiling the water, the discrepancy was so large that no error such as Dr. Frankland had suggested would account for it, and, in fact, special means were taken to prevent the result being low. Dr. Frankland having expressed interest in his remark about the presence of alumina in colliery waters, he might mention that he had met with other remarkable constituents, as, for instance, zinc, to the extent of three or four grains per gallon. As to the forms in which acids and bases were combined, he fully agreed that an analyst should always give the data on which he founded his conclusions, and then express the salts according to his fancy, or to the best of his ability. He would like to hear from Mr. Heron how far the hardness of the water he had tested agreed with the soap test before and after boiling, and whether when magnesium was present he had calculated 42 as equivalent to 50 or to 75 of calcium carbonate, as very much depended on that.

Mr. Heron said that his results agreed within 1 grain per gallon, and that the water contained the normal quantity of magnesium salts, gypsum only having been added.

Mr. Allen continued that in such case the point in dispute did not arise. Dr. Frankland had said that waters in the South of England contained carbonate of sodium, and that for such waters his proposed method of determining the earthy salts generally by boiling down with carbonate of sodium would be inapplicable. Had he understood Dr. Frankland correctly?

Dr. Frankland: You titrate for temporary hardness.

Mr. Allen, continuing, said the only difference caused by the presence of sodium carbonate was that the temporary and total hardness would be identical.[*] He presumed that Dr. Frankland would not adopt the plan of another London chemist of extensive experience, and report waters as containing simultaneously calcium sulphate and sodium carbonate. If not, it was evident that a water which contained sodium carbonate must contain all the calcium and magnesium as carbonates. Hence, on boiling down such a water to a small bulk, and filtering off the precipitate, we had, on one side, the earthy carbonates, which, on titration with acid, gave the temporary hardness, and on the other, a solution containing the sodium carbonate of the water, which could be similarly determined by titration with acid. If desired, the earthy carbonates could be calculated to their equivalent of sodium carbonate, and the amount thus found added to that really present in the water. The sodium carbonate could also be deduced from a titration of the original water, subtracting from the volume of acid used that equivalent to the earthy carbonates. Mr. Thorp appeared to like the soap test, and seemed very easy to please, but at the same time admitted it to be empirical. That was precisely his (Mr. Allen's) objection to the soap test. When temperature, time, the mode of adding the soap solution, the manner of shaking, the appearance and duration of the lather, and even the *sound* produced, were all important factors in the result obtained; and when chemists who used the process disagreed to the extent of 50 per cent. as to the hardness caused by magnesia, he thought it was about time for those with a reputation to lose to give up reporting the results of soap tests. It was different if one knew the character of the water, and was accustomed to it day by day. But he was speaking as a professional chemist, knowing nothing of the sample beyond the results he got by analysis; and in such variable waters as he had to deal with, the soap test gave very erratic results. He agreed with Mr. Thorp that analysts ought to adopt the plan of stating in their analyses the constituent indirectly determined. He had seen an analysis of coal in which the specific gravity was inadvertently added in with the other constituents, yet the sum was exactly 100·00. Mr. Heron had spoken about getting results agreeing within one grain per gallon. That was a good analysis. As a rule, one would not find chemists agree so well in determining water containing 50 grains per gallon, say, of sulphuric acid. If they found something between 49 and 51 grains, that was as much as could be expected; at any rate, it was as good work as was usually done.

Mr. W. Crowder then formally introduced for discussion the subject of which notice is given in the Journal for November, viz., "Have any experiments been made to ascertain the quantity of nitrous acid, soluble in sulphuric acid of sp. gr. 1·750 at temperatures ranging between 32° and 120° F.; and what is the *maximum* temperature at which nitrous acid can be economically absorbed in the Gay-Lussac tower during the summer season?" and announced that if time permitted he would open the discussion at the next meeting of the Section.

Liverpool Section.

Chairman: F. Hurter.
Vice-Chairman: A. Norman Tate.

Committee:
E. Bibby.
J. Campbell Brown.
H. Brunner.
E. Carey.
H. Deacon.
T. Fletcher.
H. Gaskell, jun.
S. Hamburger.
J. W. Kynaston.
E. K. Muspratt.
G. Shack-Sommer.
James Simpson.

Hon. Local Sec. and Treasurer:
W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Wednesday, 5th December 1888, at University College, Brownlow Street.

DR. F. HURTER IN THE CHAIR.

MISCELLANEOUS COMMUNICATIONS.

SLIDE RULE FOR REDUCING VOLUMES OF GASES TO NORMAL CONDITION.

BY F. HURTER.

Dr. Hurter, having reiterated a request which their last Chairman had frequently made to the members to bring forward small items of observations which they had made, or little improvements in apparatus, said that, as an example, he would put before them a little apparatus which might be of interest. They were all aware that the numerous calculations involved in the correction of the volume for temperature and pressure were one of the disagreeable features of technical gas analysis. Many ways had been proposed to shorten these calculations or to avoid them altogether. One of these methods consisted in employing a standard volume of gas enclosed in a vessel so graduated that the factor of reduction could at once be read off. He had found that such apparatus was liable to become deranged and was otherwise a little uncertain. He had, therefore, discontinued its use, and returned to calculation from barometric and temperature observations. Instead of using tables he had constructed a slide rule. Slide rules were extremely handy, the only fault being that they became of inconvenient length if they were wanted accurate. A slide rule which would allow to read off four digits of a number directly would be about 42 feet long. The best slide rule he knew, an extremely useful instrument, was Fuller's slide rule, a spiral logarithmic scale, which allowed the fourth digit of a number to be read directly, and the fifth by interpolation. For the purpose of calculating factors for reducing the volume of a gas to normal conditions, there was, however, only a small range of numbers needed, and it was, therefore, possible to construct a slide rule of convenient length and sufficiently accurate for the purpose. The usual range of numbers needed was from about 700 mm. to 780 mm. for the barometer, and from 270° to 300° absolute temperature. On a slide rule, the total length of which would be 16 feet, these figures would be found to occupy a space of only 6 to 7 inches.

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[*] The term "hardness" is here intended to mean the calcium and magnesium salts expressed in terms of $CaCO_3$. The volume of acid neutralised by the original water before boiling will be greater than that required by the deposit on boiling. Hence, in one sense, the total hardness may be said to be less than the temporary, the permanent hardness in a water containing sodium carbonate being a negative quantity.

He showed the slide rule, and explained that by setting the given temperature on the slide opposite the given barometric pressure, the index would at once point to the factor of reduction.

* * *

A NEW ALKALI PROCESS.

BY W. W. STAVELEY.

In his presidential address at Glasgow, Professor Dewar said, "and this leads me to say that we do not necessarily confine ourselves to the discussion of manufacturing processes which are commercially successful. An industrial process may fail of commercial success for various reasons. I hope that we, as a Society, shall never fail to recognise whatever is novel, nor be too narrow in our views of what should be admitted to, or excluded from, the pages of our Journal." Another prominent member of our Society has also quoted the saying of the great master, Faraday, "unsuccessful work ought to be as valuable as successful work."

Encouraged by the above and by the remarks of one or two gentlemen to whom I had submitted my process, I was led to prepare a paper to be read before you. When I remembered that amongst the members of this Section are some of our most eminent technical chemists and manufacturers, I had great diffidence as to the result. Yet I venture to hope that my process may not be without interest to you.

During the last half century many attempts have been made to decompose sulphate of sodium by means of slaked lime. Clausen, in 1852, claimed the use of lime to decompose solution of sulphate of sodium. Mr. David Hill, in the "Chemical News" for April 4, 1873, mentions that in experiments he had made with this process he had never succeeded in getting more than about 1 per cent of the soda in the sulphate, as caustic soda. A. G. Hunter, in 1865, patented an improvement upon this process, claiming to obtain better results by treating the solutions under pressure.

According to Hill, experiments conducted at the Jarrow Chemical Works showed, however, that the result with a steam pressure of 40 lbs. was the causticising of about 6 per cent. of the soda, and under a pressure of 200 lbs. for some hours only 13 per cent. was causticised.

Lessie du Motay took out a French patent in 1871 similar to Hunter's.

From experiments made in Dr. Lunge's laboratory, and quoted by him in his well-known treatise, "it appears that at the ordinary pressure of the atmosphere as much as 28·8 per cent. of the sulphate of sodium can be decomposed if the liquid is very dilute, 180 parts water to one of sulphate; at a pressure of 5 atmospheres, and the proportion of from 25 to 50 water to one of sulphate, 23 to 31 per cent. of the latter could be decomposed." It was this latter statement that caused me to further investigate the action of lime upon sulphate of soda, not with a view of manufacturing soda by this process, but with the view of using the impure dilute caustic soda solution so obtained for the extraction of phenols from tar oils. If a solution of sulphate of sodium, containing 6 to 7 per cent. of soda as caustic, could be obtained, such solution would be suitable for this purpose. And as, after being used for the extraction of phenols, the solution would be neutralised with sulphuric acid, thus reforming sulphate of sodium, the same solution of sulphate of sodium could be used continuously. One ton sulphate of sodium in, say, 25 tons solution, if 25 per cent. of the sulphate were decomposed would give us a solution containing a little over 2 cwts. of soda, Na_2O, or a solution of about 5,000 gallons, containing about $\frac{1}{10}$ths of a per cent. of soda, Na_2O. To obtain a solution containing 6 per cent. of soda we should require to evaporate from the solution about 23 to 24 tons water, which, of course was out of the question. It occurred to me, whilst engaged in experiments with a view to increasing the decomposition, that the reason a better decomposition could not be obtained was, that at the moment of formation of sodium hydrate the reverse reaction takes place, and if some body were present which could combine with the sodium hydrate at the moment of formation, a better result could be obtained. I tried various substances, but although I succeeded in obtaining a better decomposition, the results were not sufficiently promising. I next tried cresol, and found that on agitating a mixture of sulphate of sodium solution and slaked lime, and gradually adding cresol thereto, an almost complete decomposition of the sulphate of sodium into cresylate of sodium was obtained with formation of a precipitate of sulphate of calcium. Knowing, from experience on a large scale, that the cresylate of sodium could be easily decomposed, by means of carbonic acid, into carbonate of sodium solution and free cresol, I, after many quantitative experiments, applied for provisional protection for my process, which, briefly, is as follows: A solution of sulphate of sodium or potassium is heated in a vessel provided with agitating apparatus, and a solution of cresylate of calcium or mixture of cresol and slaked lime is gradually run into the sulphate solution. As a result we have cresylate of sodium in solution, and a precipitate of sulphate of calcium. The cresylate of sodium, after filtration, is treated with fuel or lime-kiln gases, forming carbonate of sodium in solution and liberating the cresols, which float, as an oily fluid, on the surface of the carbonate of sodium solution. The soda solution is evaporated and calcined, the liberated cresols being again used in the decomposition of another lot of sulphate of sodium. In my specification, No. 17,657, of December 21st, 1887, I had described a modification of my process for use in the extraction of phenols from coal tar or other oils. Until the last few years the almost universal method of producing phenols from their oils has been to agitate the oils with a dilute solution of caustic soda, thus forming phenolates of sodium, the phenolates, after separating from the oils, being treated with sulphuric acid, liberating the phenols, which float on the surface of the sulphate of sodium solution. Thus both the sulphuric acid and the soda were lost in the shape of valueless sulphate of sodium solution.

On the 5th of March 1880, Mr. Samuel Clift patented the use of carbonic acid gas for neutralising the phenolates of sodium. Mr. Josiah Hardman subsequently patented the same process, claiming the use of carbonic acid gas obtained in the manufacture of sulphate of ammonia from gas liquor. The solution of carbonate of soda obtained by this process, after separation from the phenols, is causticised, and the caustic soda solution again used for the extraction of phenols from the oils. The process is at work in at least four large tar distilleries. Messrs. Bairds, of Gartsherrie, also use a similar process in the extraction of phenoloids from blast furnace oils.

The waste gases from their blast furnaces, after cooling and extraction of the ammonia and tarry matters contained therein, consist mainly of CO_2, CO, and N gases. They use these waste gases for neutralising phenolate of sodium solution. The gas leaving the apparatus now consist mainly of CO and N, and being richer in combustible gases than the original mixture, is more valuable as a heating gas. It may be interesting here to observe, that not only do Messrs. Bairds recover the ammonia and tarry matters from their waste gases, but they utilise almost all, if not quite all, the gases, after being thus treated, for heating purposes in the manufacture of sulphate of ammonia and the distillation of the oils, &c. My proposal for extracting phenols from coal tar and other oils was as follows: Instead of agitating the oils with a caustic soda solution, I proposed to agitate the oils with a mixture of sulphate of sodium solution and slaked lime, thus forming phenolates of soda and sulphate of lime, the phenolates of soda being neutralised with CO_2 gas, and the resulting carbonate of soda solution, after separation from the phenols, being calcined and sold as soda-ash, the soda-ash so obtained covering the cost of the operation. Or, instead of neutralising the phenolates with CO_2, I used for that purpose sulphuric acid, and again use the resulting sulphate of sodium for another extraction of phenols—thus consuming sulphuric acid and lime instead of, as in the old process, sulphuric acid and caustic soda.

Here I think it only fair to state, that though this part of my patent was passed by the examiner, a process similar to mine had been previously patented by Messrs. West-Knight and Gall on the 21st April 1887, No. 5824. Their process is identical with mine, in so far as they use lime and sulphate of soda to produce phenolates of sodium, and the subsequent use of sulphuric acid for neutralising the phenolates of sodium and liberating the phenols. But they do not claim the use of carbonic acid for neutralising the phenolates of sodium thus obtained. In their provisional specification, however, they do make the singularly impractical proposal to use a mixture of carbonate of sodium solution and slaked lime for extracting the phenols from the oils. Strange that the idea should not have occurred to them to first causticise the carbonate solution by means of the lime, and use the clear solution of caustic soda for extracting the phenols, thus avoiding the introduction of the precipitate of carbonate of lime into the oils and phenolates, and the subsequent difficulty of separating the oils from the carbonate of lime.

Still, to Messrs. West-Knight and Gall must be allotted priority so far as regards the production of phenolate of sodium by the action of sulphate of sodium solution and slaked lime on oils containing phenols. For although I had a note of the reaction in my experiment book before the date of their patent, I never tried the process till the autumn of 1887. Before proceeding to the practical details of my process, since it has probably never occurred to alkali-makers that any other product of coal than ammonia would ever be proposed for use in alkali making, it may be as well if I here give a brief description of the various phenols, and also comment on certain statements, to be found in well-known works, which have a bearing on my process.

The principal phenols known to exist in oils from coal are—

Phenol, C_6H_5HO, B.P. 182° C., fusing point 42° C.

Cresol, C_7H_8O, of which there are three isomers known, viz. :—

- Ortho-cresol, B.P. 185° to 186° C., melting point 31° C.
- Para-cresol, B.B. 198° C., melting point 36° C.
- Meta-cresol, ,, 195° to 200° C., uncrystallisable.

The ordinary cresol or cresylic acid from coal tar is a mixture of the three isomers.

Schulze has isolated alpha- and beta-naphthols from green oil obtained from tar.

Watson Smith (J. Soc. Chem. Ind. p. 738, 1885), found in blast furnace phenols a little phenol, meta cresol, and meta xylenol. There are other higher homologues present in coal tar and blast furnace oils, but as yet they have no commercial value. Messrs. Bairds, of Gartsherrie, manufacture on a large scale, from their blast furnace oils, distilled phenoloids, having the sp. gr. 1·030 at 60° F., and containing 1 to 2 per cent. water, 1 to 2 per cent. hydrocarbon oils, and on distillation yielding about 90° per cent. distillate to a temperature of 240° to 250° C.

Professor Roscoe, now Sir Henry Roscoe, in the first presidential address to the members of our Society in 1881, speaking of the products of coal as yet utilised, said, "Again cresol, the methyl derivative of phenol, though occurring in considerable, but varying, proportions in different coal tars, has received comparatively little attention from manufacturing chemists; other higher homologues exist, but of these nothing has as yet been made."

Miller, in his "Elements of Chemistry," says: "Phenol, when agitated with a solution of caustic potash of sp. gr. 1·060, the carbolic acid mixes freely with the alkaline ley, but a large proportion of the acid separates on dilution."

Calvert has also stated that phenol dissolves in caustic potash, but the quantity dissolved does not increase in proportion to the quantity of caustic potash present. He also states that the phenolates are not definite compounds, but mixtures of phenols and alkalis.

Dr. Lunge also, in his well-known treatise on "Coal Tar and Ammonia," referring to the manufacture of crude phenols, and basing his remarks on statements to be found in the first edition of "Allen's Commercial Organic Analysis," infers that one must not dilute the phenolates of soda too far or the phenols would be liberated, and that a large excess of caustic liquor may reprecipitate the phenols.

This is not so; water or alkali may be added to the crude phenolates solution to any extent without separation of the phenols.

The alkaline phenates are definite compounds, and not, as Calvert says, mere mixtures of phenols and alkalis.

This is clearly pointed out by Allen, in the second edition of his "Commercial Organic Analysis," where he says: "The potassium and sodium salts are readily soluble in water, and the solutions are not decomposed on dilution, potassium phenate, $C_6H_5.OK$, obtained by heating phenol with potassium or with solid caustic potash, crystallises in slender white needles soluble in ether."

In Watt's Dictionary it is stated that phenol may be distilled without alteration over caustic potash or quicklime. Miller makes the same statement that phenol may be distilled unchanged from caustic potash.

My own experience is against these statements. A solution of pure phenate or cresylate of soda or potash may be evaporated to dryness and the anhydrous salt obtained without any decomposition. On increasing the temperature beyond the range of the mercurial thermometer, the anhydrous salt fuses into a perfectly clear syrup, and it is only when the temperature is still further increased that decomposition sets in with separation of carbon and evolution of hydrogen and other gases and formation of oxyacids, but even at a low red heat a part of the phenol remains combined with the alkalis.

Phenol has a stronger affinity for soda than cresol, and will displace cresol from its combination with soda. If a solution of phenol in benzene be agitated with a solution of pure cresylate of soda in water, after agitation the phenol will be found to have displaced the cresol from its soda combination and the cresol will be found in the benzene.

Phenols combine with caustic potash, soda, or lime, with considerable evolution of heat. The phenols unite with the alkalis always in their chemical proportions.

I have made use of this fact occasionally in estimating the causticity of impure solutions where the ordinary indicators could not be conveniently used. As such a test may be useful in some cases in other works, I may state here that the method consists merely in agitating a solution of phenol in benzene with a given volume of the solution, the causticity of which is to be determined, in a graduated measure or burette, allowing to settle a few minutes, and reading off the decrease in the benzene solution or the increase in the caustic solution, which indicates the volume of phenol which has combined with the alkali present. The benzene solution may be made any strength, containing from 10 to 50 per cent. by volume of phenols. It is not necessary to take pure phenols; Calvert's liquid carbolic acid is very suitable. The solution in benzene is standardised by agitating a given volume with a given volume of a caustic solution of known strength. I find a 20 per cent. phenol solution most convenient. Of course it is always necessary to use such a quantity of the phenol solution that the phenol may be in excess; this may be easily ascertained by adding, after agitation and settling, a little more of the phenol solution and re-agitating. If after settling there is no further increase in the caustic solution or decrease in the phenol solution, there is a sufficiency of phenol present. Using Calvert's liquid carbolic acid for making this solution, it will be found that 1 grm. of soda, Na_2O, will equal or combine with about 3 cc. of phenols, *i.e.*, 1 cc. of the phenol solution equals about 0·3 grm. of Na_2O. I do not claim accuracy for this test; I only propose it as a rough test which can be placed in the hands of a workman. With a little experience in reading off it gives results accurate to first place of decimals. I found the test very useful in ascertaining the alkali present in partly causticised solutions of sulphite of soda. I now proceed to the details of my process. In carrying out my invention, the phenoloid compounds of calcium (formed by the union of phenol, cresol, or other high homologues with calcium hydrate), afterwards called calcium phenolates, are treated with a solution of sulphate of sodium or potassium. As a result of the action we have sulphate of calcium precipitated, whilst the phenoloid compounds of sodium or potassium (afterwards called sodium or potassium phenolates) are left in solution. The phenolates of sodium or potassium are now submitted in closed vessels to the action of a current of fuel or lime-kiln gases until the solutions are decomposed with the formation of sodium or potassium carbonates, and the liberation of the phenoloids. On discontinuing the current of gas through the vessels, and allowing the contents to remain undisturbed for some time, there is a separation into two layers, the upper layer consisting mainly of the phenoloid compounds, whilst the lower layer consists of a solution of sodium or potassium carbonates. In order to carry out the process on a manufacturing scale, I proceeded as follows, taking the manufacture of sodium carbonate first, the quantities of each material and the bulk of the solutions being stated as for the production of one ton of pure sodium carbonate or the equivalent weight of a poorer ash.

Eleven cwts. of freshly-burnt lime are slaked, and made into a solution of milk of lime, the bulk of which shall measure about 400 to 450 gallons.

This solution is allowed to cool, and when cold or slightly warm, is gradually added to 430 gallons, or about two tons weight of distilled phenoloids, or a corresponding quantity of crude phenoloids.

The phenoloids best suited for this purpose are those which distil between 190° and 250° C.

We thus have a solution of 830 to 880 gallons calcium phenolates. I may here mention that when slaked lime and phenoloids are mixed according to their chemical equivalents, all the lime does not combine with the phenoloids, a certain proportion of the lime not entering into combination, the proportion varying with lime from different sources. But as in the calcium phenolates solution there is present free phenoloids equivalent to the free lime, this does not interfere with the subsequent part of the process, both the free lime and the free phenoloids taking part in the reaction.

The 830 to 880 gallons calcium phenolates solution are now gradually added to a hot solution of 850 to 900 gallons sulphate of soda solution containing 29¾ cwts. of 95 per cent. salt cake, which salt cake solution is contained in a vessel, which may be open, provided with agitating apparatus. The solution of calcium phenolate is run in during one or two hours, the contents of the vessel being briskly agitated meanwhile. After the whole of the calcium phenolates solution has been run in, the agitation is continued for another hour, the temperature being maintained at 30° to 40° C. from beginning to finish of operation.

At the end of the operation we shall have in the decomposing vessel, supposing 95 per cent. of the sulphate to have been decomposed—and I may mention thst Messrs. Gaskell, Deacon, and Co., who made some laboratory experiments with my process, obtained, I believe, 96 per cent. decomposition—in the decomposer, then, we should have 1,680 to 1,780 gallons total contents, containing soda phenolates equal to 20 cwts. pure soda carbonate and 430 gallons phenoloids, 1·4 cwts. unchanged sulphate of soda, and 25 cwts. calcium sulphate, $CaSO_4$, or about 32½ cwts. $CaSO_4, 2\,H_2O$.

On allowing the contents of decomposer to settle, the insoluble calcium sulphate falls to the bottom, whilst the sodium phenolates remain in solution. In well-conducted operations 70 to 75 per cent. of the sodium phenolates solution may be decanted. The remaining mixture of sodium phenolates and calcium sulphate is now run or pumped into suitable filtering apparatus in the shape of vacuum filters or filter presses.

The calcium sulphate left on the filters is now washed with 600 to 700 gallons hot water, the washing, containing sodium phenolates, being used to dissolve the sulphate of soda for next operation. The sulphate of calcium, after removal from the filters, may be disposed of in the most convenient manner, or treated by a suggested process, which I shall afterwards mention. The sodium phenolates solution is now treated in tall cylindrical vessels with lime-kiln gases till the solution is fully carbonated. The contents of the carbonating vessels are allowed to settle for several hours, when the liberated phenoloids separate as an oily fluid, and float on the surface of the lower layer of solution, which consists of sodium carbonate. The phenoloids are run into the phenoloid stores, and may be again used in the first part of the process. The sodium carbonate solution, which still retains about 1 per cent. of its bulk of phenoloids in solution and suspension, may now be evaporated, and the fished salts calcined in the usual way, the resulting ash being equal in appearance to refined soda-ash. In this case the phenoloids present in the solution of sodium carbonate are in part lost, being carried off with the steam. In order to avoid this a small quantity of sodium hydrate solution is added to the carbonate in the evaporating pan. The free phenoloids are thus converted into phenolates, which are not decomposed on boiling, and in the subsequent operations of evaporating and fishing for soda carbonate, are left in the mother-liquors. The mother-liquors containing soda carbonate, sulphate, and phenolates, along with any sodium chloride and other impurities from the salt cake, may be added to the decomposing vessel just before the finish of an operation. This would thus permit us to use an excess of lime and phenoloids in the decomposing process, and thus increase the probability of a complete decomposition. The excess of lime present would be converted into carbonate, and the excess of phenoloids into sodium phenolates. The presence of free lime in the decomposer at finish of an operation retards the subsequent settling and filtering of the contents.

Or the sodium carbonate solution, instead of being evaporated, may be converted into bicarbonate as follows :—

To the solution is added as much sulphate of soda as it will dissolve at a temperature of 34° C. The mixed solution of sodium carbonate and sulphate is now treated with lime-kiln gases, the solution being maintained at or about 34° C. till sodium bicarbonate is precipitated as a crystalline powder. Of course the sodium carbonate solution could be bicarbonated without the addition of sulphate of soda ; but in this case part of the soda is precipitated as sesqui-carbonate, which is more difficult to deal with than bicarbonate. When bicarbonate ceases to be precipitated, the lime-kiln gases are shut off from this vessel, the bicarbonate crystals removed, drained, and washed with a little water, and calcined in a closed furnace in order to recover the CO_2 gas evolved during the calcining ; or if the CO_2 gas obtained does not cover the extra expense of calcining in closed furnace, the bicarbonate may be calcined in the ordinary calcining furnaces.

From the mother-liquor left in the bicarbonating vessel, on settling, separates out a small quantity of phenoloids ; these may be removed by decantation, or they may be left in the mother-liquors, which are now concentrated in closed boilers, the distillate containing a little phenoloids being used for slaking the lime required in the process, or, if the quantity of phenoloids so recovered by concentrating in closed vessels be not sufficient to cover the extra expense incurred thereby, the solutions may be concentrated in open vessels. The concentrated mother-liquors thus obtained, containing soda carbonate and sulphate, are added to next batch of sodium carbonate that is about to be bicarbonated, or they may be added to the phenolates of soda solution before carbonating. Supposing the decomposition of sodium sulphate into sodium phenolates in the decomposer is not complete, it will be necessary to crystallise out the excess of sodium sulphate periodically from these mother-liquors from the bicarbonator, the sodium sulphate being again used in the process.

Where the process is used for the production of potassium carbonate, the quantities are as follows :—

29½ cwts. of 90 per cent. potassium sulphate are dissolved in 1,400 galls. water. This is heated to 80° or 90° C. There is then run into this solution, gradually with constant agitation, a solution of calcium phenolates, made by mixing 350 galls. cold milk of lime, containing 9 cwt. CaO, with 350 galls. distilled phenoloids. The operation being carried out in the same manner as described for soda carbonate.

As a result we have in the decomposer a total bulk of about 2,100 galls., containing, supposing a 95 per cent. decomposition, phenolate of potash equal to—

20 cwt. carbonate of potassium and 350 galls. phenoloids.
1·3 cwts. unchanged potassium sulphate, and
19 7 cwts. calcium sulphate ; or
24·9 cwts. $CaSO_4(H_2O)_2$ along with the other impurities, potassium chloride, &c. present in the sulphate of potassium.

The contents of decomposer are filtered, the calcium sulphate washed. The potassium phenolates solution is carbonated till there is slight excess of carbonic acid, the solution allowed to settle, and after removal of the phenoloid bodies, the solution of potassium carbonate is evaporated and calcined in the manner as described for sodium carbonate.

It is not necessary, in the first part of the process, that the calcium phenolates solution be first formed before adding to the sulphate of soda or potash solution. The milk of lime may be added to the sulphate solution and the phenoloid run into the agitating mixture ; on the large scale this would probably be the best method. Or the phenoloids and the milk of lime may be added, at the same time, to the sulphate solution in separate streams.

Instead of phenoloids, oils containing phenoloids may be used. In this case it would be necessary to use such a volume of oil as shall contain the quantity of phenoloids required.

In the decomposer, when using oils, we should have, after decomposition, the unacted-upon oils floating on the surface of a layer of phenolate of sodium, the calcium sulphate being in the lower part of decomposer. The drawback, however, to the use of oils is that part of the calcium sulphate precipitate remains intermingled with the oil and the phenolate of soda. I, therefore, only recommend the partial use of oils in order to supply the loss of phenoloids in the process. By using the oils thus, the phenoloids required in the process may be obtained at about 60 per cent. to 70 per cent. less cost than by purchasing.

Having described the details of my process, let us now consider the process and plant required, when applied to the manufacture of about 120 tons soda-ash per week. Working four 5-ton charges in the decomposers each 24 hours, the quantities of materials for each 5-ton charge would be about—

2,200 gallons distilled cresols.
2,200 ,, sieved milk of lime.
4,500 ,, solution containing nearly 7½ tons of 95 per cent. salt cake.

These solutions would be treated in two decomposers about 12 ft. diameter and 9 or 10 ft. deep, about half the quantity being treated in each decomposer, and the operations so arranged that, after each charge in the decomposer is finished and settled and the phenolates decanted, the calcium sulphate precipitate is left in the decomposer along with soda phenolate retained in admixture with it. Into the decomposer is now pumped, on to the calcium sulphate, another charge of salt cake solution; this is thoroughly agitated with the calcium sulphate precipitate for a short time, allowed to settle, when the clear sulphate of soda solution, along with the soda phenolate taken up by it, is decanted and pumped into another decomposer, where it is treated with a fresh charge of calcium phenolates. The calcium sulphate is run on to filter beds or through filter presses and washed as previously described. Thus each batch of sulphate of calcium precipitate can be treated with about 1½ times its bulk of sulphate of soda solution and about twice its bulk of hot water.

The remainder of the operations are as previously described.

The plant required would be as follows:

Phenoloid stores, 15,000 to 20,000 gallons capacity. Old steam boilers are very suitable for this purpose.
Two milk of lime pans, each about 3,000 gallons capacity and provided with agitators and sieves.
Two calcium of phenolates pans, each about 2,500 gallons capacity.
Two sulphate of soda dissolving pans, each 5,000 gallons capacity.
Three decomposers provided with agitators and engine for driving.
Six carbonators, each about 7 ft. diameter and 20 ft. deep.
Filter beds, with arrangements for exhausting, or two of Johnson's large filter presses, each capable of filtering and washing about 30 tons of wet calcium sulphate during the 24 hours.
Concentrators or boiling-down pans to evaporate say 25,000 gallons per 24 hours.
Calciners to calcine about 20 tons ash per 24 hours.
Two air compresssors, each pumping 40,000 to 50,000 cubic feet of gases per hour.

In addition to these would be required steam boilers and pumps for the various solutions, and it would be desirable also, if not necessary, to have stores for soda phenolates and soda carbonate in case of stoppages.

I shall not attempt to give you an estimate of the cost of such a plant. Those of you who are at all interested in the process will be better able than I am to give an opinion on this point.

The most important question in connexion with this process is the loss of phenoloids. This can happen in two ways only. First, by loss through solubility in the carbonate of soda solution; on boiling down the carbonate liquors part of the dissolved phenoloids is carried off in the steam, though only part of it, for the liquor retains traces of phenoloids even down to dryness. To avoid this loss I add, as previously mentioned, sufficient caustic soda ley to combine with the phenoloids present in the carbonated liquors, before evaporating. The free phenoloids are thus converted into phenolates of soda, which are retained in the mother-liquors and returned with them into the first part of the process and are subsequently recovered. Thus the only loss from this source would be the small quantity of phenolate of soda present in the fished salts after draining. Or the carbonate of soda solution might be advantageously concentrated in apparatus constructed on the multiple evaporation system, thus utilising the heat of condensation and by using the distillate for slaking lime and dissolving salt cake, recovering the phenoloids present in the distillate.

The second loss, and this is the most important, is due to the phenolate of soda retained by the precipitated calcium sulphate; but since this is first thoroughly agitated with about one and a half times its bulk of hot sulphate of soda solution, and afterwards washed on the filters with about twice its bulk of water, means should certainly be found of avoiding much loss here. I put the loss of phenoloids in the process at about 20 gallons per ton of soda carbonate produced, though I believe the loss could be ultimately reduced to about 10 gallons.

The phenoloids Messrs. Bairds, of Gartsherrie, are prepared to supply at 8*d.* per gallon, and if required, this one firm alone can supply about half a million gallons annually. But, as previously mentioned, I recommend the use of oils for preparing the phenoloids required to make up the loss in the process. In this way the phenoloids would not cost more than 4*d.* per gallon; but we will put it at 5*d.*

Now let us compare this process with the Leblanc process, leaving the cost of sulphate out of the question, since it would be the same in each case.

In the Leblanc process you would use per ton of ash—

	s.	*d.*	*s.*	*d.*
Two tons coal at	4	6 =	9	0
Limestone			4	6

that is, 13*s.* 6*d.* as the cost of decomposing materials.

In my process you would use—

	s.	*d.*
11 cwts. lime	6	0
20 gallons phenoloids ..	8	4

that is, 14*s.* 4*d.* as the cost of decomposing materials.

In the Leblanc process, however, the two tons of coal, or the waste heat therefrom, serve for evaporating the soda-ash solution after lixiviation. In my process about five or six tons of water would require evaporating. But there is every probability that on the large scale 10 per cent. more ash would be obtained by this process than by the Leblanc, which would compensate for the extra fuel required, so this may be left out.

The cost of calcination would be the same in each case. Thus, the points of comparison are, the cost of decomposing and subsequent lixiviation and partial carbonation in the Leblanc process, and the cost of decomposing filtering, and carbonating, in the new process. Being absolutely without experience in alkali works I cannot offer any opinion on these points. Of course, in the old process, you have now the additional chance of recovering the sulphur from the waste. In my process it would be lost, but the sulphate of lime would not be a nuisance, at least, not a noxious nuisance, and even if it could not be sold, it could in all probability be given away, and there should certainly be a saving in the disposal of waste. Again, a large outlet might be found for the sulphate of lime if it were dried and sold as a disinfecting powder. In this case it would not be necessary to wash the precipitates, the first washing with sulphate of soda solution being sufficient. Even this treatment might not be required. Again, with regard to the calcium sulphate, I beg to make the following suggestion, and if you should smile at the visionary nature of my proposal, I can only plead that some of our eminent men occasionally have visions, and the dreams of one generation are often the accomplished facts of the next. My suggestion is, then, to take advantage of the well-known reaction—

$$MgCO_3 + CaSO_4 = MgSO_4 + CaCO_3.$$

Instead of using lime in the process I propose to use calcined dolomite, the precipitate would then consist of hydrated magnesia and calcium sulphate. This precipitate is suspended in water, and submitted to the action of carbonic acid gas; forming sulphate of magnesia and calcium carbonate. If this reaction were successful the magnesium sulphate solution thus obtained could be mixed with a solution of common salt or brine, and submitted to artificial refrigeration, when double decomposition takes place, producing sulphate of sodium and chloride of magnesium. The Glauber's salts are separated by crystallisation, and worked up by my process into carbonate, and if the Pechiney-Weldon process is as successful and as cheap as it is said to be, the magnesium chloride could be worked by their method for the manufacture of chlorine. The residual oxide of magnesia, if physically suitable, could then be used for mixing with the calcium sulphate precipitate, and in this way the process would start simply with sulphate of soda and lime, avoiding the use of dolomite, except so far as it might be required to make up mechanical loss of magnesia.

This phenol-soda process, as we may call it, is specially applicable to the utilisation of waste solutions containing sulphate or sulphite of soda, the reaction, in fact, proceeding much easier with sulphite of soda than with sulphate. It may be interesting here to state briefly a method by which I propose to utilise the sulphate of soda contained in the waste liquors from copper works. These consist mainly of a solution of ferrous chloride, sodium chloride, and sodium sulphate. I believe that, to the present time, no method of dealing with these liquors has been remunerative. Mr. E. K. Muspratt, in his presidential address, in 1886, said, speaking of these waste liquors: "Unfortunately all the salts used in the calcination process, amounting to over 20,000 tons per annum, is at present lost, and is run away as sodium sulphate in the waste liquors. This drainage from the extracting works coming in contact with chloride of calcium, the waste liquor from the Weldon process in alkali works deposits large quantities of gypsum, which gave rise to a long and expensive law-suit in the Widnes district. To avoid this nuisance the liquors were for a time evaporated and calcined, and the sulphate of sodium, together with a small quantity of ferric oxide, were obtained in a marketable form, but the high price of fuel rendered all these processes unremunerative."

Mr. C. J. Ellis, in a paper read before the Glasgow Section, in 1884, gave the average composition of these liquors from the largest works as, per gallon—3·75 lbs. Glauber's salts, 0·99 lbs. sodium chloride, 0·74 lbs. proto-chloride of iron, 7·0 lbs. water, in a gallon of waste liquor of sp. gr. 1·250.

Mr. Ellis proposed to partially evaporate these waste liquors, and afterwards, by means of refrigeration, obtain Glauber's salts; these salts being treated in a hydro-extractor, washed with sulphate of soda solution, and afterwards calcined and obtained in the form of salt cake.

Messrs. Wigg and Steele, Eng. Pat. 13,722, 1884, propose to treat the waste liquors with an equivalent quantity of the waste chloride of calcium from the Weldon process, when a white bulky precipitate of calcium sulphate is formed. The mass is filter-pressed, washed, and thus forms "pearl hardening," or it is gently heated so as to form plaster of Paris. The clear filtrate from the precipitate is treated with slaked lime in order to precipitate the iron as ferrous hydrate. The dark green precipitate which readily forms is further oxidised by the action of air or chlorine, washed on the filter press, and furnaced, so as to yield the various shades required. By this method neither the sodium sulphate or chloride in the liquors are utilised. Mawdsley and Macfarlane use a solution of calcium sulphide prepared by lixiviating partially-oxidised alkali waste. This solution is added to the waste liquor from the copper works, resulting in a precipitate of proto-sulphide of iron and some free sulphur. The precipitate is then heated in furnaces to recover the sulphur as SO_2.

Mr. C. Wigg, Eng. Pat., 5620, 1885, treats the waste liquors with sulphide of ammonia until all the iron is precipitated; the precipitate is then filtered, dried, and burned in the usual pyrite kilns. The iron peroxide left may be prepared for use as a pigment, and the SO_2 given off recovered in any convenient manner. The filtrate, now consisting of sodium sulphate and chloride and ammonium salts in solution, is passed into apparatus for the formation of sodium carbonate. The ammonium sulphide required in the process is produced by the decomposition of vat waste with an acid, and passing the gas into ammoniacal liquor.

In this process the proto-sulphide of iron is a most difficult precipitate to deal with.

I propose to treat the waste liquors as follows:—The iron is precipitated as ferrous sulphite by means of a solution of sulphite of soda, obtained in a subsequent part of the process. There is a drawback to the use of sulphite of soda for this purpose, viz., it requires twice the theoretical quantity to precipitate the iron. To avoid this I causticise the solution of soda sulphite to the extent of 10 to 20 per cent. In this way 90 to 95 per cent. of the iron is precipitated by the theoretical quantity of soda sulphite. The precipitate of ferrous sulphite and hydrate is filter-pressed, dried, and calcined for pigment. The filtrate, consisting of sodium sulphate and chloride is evaporated, and the sodium sulphate crystallised out. The remaining mother-liquors are further evaporated and fished for sodium chloride, the final mother-liquor being again added to next batch of waste liquors.

The sulphate of soda crystals, without further treatment, are dissolved in water and converted into soda phenolates by means of lime and phenoloids. Part of the soda phenolates is converted by means of sulphurous acid into soda sulphite for precipitating the iron from next batch of waste copper liquor, the remaining soda phenolate being converted into soda carbonate by means of carbonic acid; the liberated cresols in each case being again used in the decomposition of sodium sulphate into phenolates.

A sample of the waste liquors from copper works, which I have recently tested, contained, per gallon of 11·8 lbs., approximately—

0·65 lbs. protochloride of iron.
0·62 lbs. chloride of sodium.
1·25 lbs. sulphate of soda.

4,000 gallons would thus contain—

2,600 lbs. $FeCl_2$, 2,480 lbs. chloride of sodium, 5,000 lbs. sulphate of soda.

These 4,000 gallons are treated with about 1,000 gallons solution, containing 2,600 lbs. soda sulphite, of which about 10 to 20 per cent. has been causticised. The ferrous sulphite is filter-pressed, washed, dried, and calcined, the sulphurous and sulphuric acid given off being recovered.

The filtrate, say 5,000 gallons, containing now about 5,000 lbs. Na_2SO_4, and 4,876 NaCl, is evaporated and cooled to allow the Na_2SO_4 to crystallise out as Glauber's salt, the remaining liquor being further evaporated and fished for common salt.

The Glauber's salts are re-dissolved in about 1,300 or 1,400 gallons bulk.

These 1,400 gallons are treated by my process with about 650 gallons phenoloids and 700 gallons slaked lime, containing about 20 cwts. quicklime.

The resulting phenolates of soda solution, after separation from the calcium sulphate, is now decomposed as previously mentioned, three-fifths of the solution being converted into soda sulphite and two-fifths into soda carbonate. I estimate the loss of phenoloids in treating 4,000 gallons waste liquors as described would be about 30 gallons, and the lime required about 25 cwts.; since the greater part of the sulphur would be recovered, 2 to 3 cwts. sulphur would suffice. The products obtained would be—

14 to 15 cwts. red oxide of iron.
11 to 12 cwts. soda ash.
2 tons common salt.

Whether these products would cover the cost of manipulation you will be better able to judge than myself.

I must now bring my paper to a close. Had I sufficient knowledge of the working of the proposed sulphate of soda-ammonia process, of Messrs. Carey, Gaskell, and Hurter, with which my process is really analogous, I should have liked to compare the two processes. There is certainly a marked difference in the simplicity of the operations and apparatus in my process and the complicated arrangements of the ammonia-soda process. That difficulties would be met with in this process, as in all others, I have no doubt, but if one tithe of the ingenuity and skill were expended on this process that has been expended on the ammonia-soda process, I am fully persuaded that it would more than hold its own with any ammonia process starting with sulphate of soda.

If the process is not a success—and this has not yet been proved—I claim that it approaches nearer to success than any other process of making soda from salt-cake, apart from the Leblanc process. To have even approached this end is something accomplished, and if a mere outsider can bring forth a process worthy the consideration of alkali-makers, surely from within the alkali works salvation will yet come. The resources of the Leblanc process are not yet exhausted.

DISCUSSION.

The Chairman, in opening the discussion, said that if every one who wrote a paper on a new process with a view to publication were as candid as Mr. Staveley in pointing out its advantages and disadvantages, the Society would never have occasion to reject any paper.

After giving a short resumé of the paper, Dr. Hurter went on to say that the process was a most ingenious application of organic agents to the manufacture of soda. Organic agents, such as oxalic acid, had been tried before, but without success. In this case, however, they started with a cheap organic material, which in the hands of his own firm (Gaskell, Deacon, and Co.) had shown itself capable of decomposing sulphate of soda to the extent of 96 per cent. Unless experiments were carried out on a large scale it was impossible to ascertain the loss of phenol in each operation, and such experiments had not been made by his firm.

Dr. Kohn asked Mr. Staveley whether in the decomposition of the sodium sulphate by means of lime, in which he had mentioned that only a small percentage of calcium sulphate was formed, the experiments had been carried on at various temperatures and under varying degrees of dilution, because he was of opinion that these factors would considerably affect the yield of sodium hydrate? Also did he consider that sodium sulphate had any action on the phenol, so as to form, perhaps, sodium phenylate and acid sodium sulphate? were this so the lime would only play a secondary part in the reaction. He (Dr. Kohn) did not regard such a reaction as probable, and it appeared to him, therefore, that the decomposition of the calcium phenylate by the sodium sulphate was of an entirely different nature to the partial decomposition of sodium sulphate by lime, consisting simply of an ordinary double decomposition. There seemed no ground for supposing that caustic soda was formed as an intermediate product.

Mr. James Simpson said that, not being a technical chemist, he felt some diffidence in criticising the process. He, however, failed to see that it would have any commercial advantage over the Leblanc or ammonia-soda processes. He understood that to make a ton of ash by Mr. Staveley's process required 20 gallons of phenol costing about 8*s*. 4*d*., as against 8*s*. or 9*s*. worth of ammonia lost per ton of ash in the ammonia-soda process; while cost of manipulation and pumping of carbonic acid seemed rather greater in Mr. Staveley's process than in the Leblanc process. The main objection was that the manufacture started on an expensive material, viz., sulphate of soda, while the ammonia-soda process started with the much cheaper chloride of sodium.

Mr. E. Carey congratulated Mr. Staveley on having hit upon an entirely novel process. At all events, the material which he used was so outside their usual line—the line of those who were accustomed to ordinary alkali making—that it seemed to him to be entirely novel.

Ingenious as it was, however, he did not think it had much chance of successful competition with the old processes from a commercial point of view. Mr. Staveley had very frankly admitted that his process was not cheaper than the Leblanc process so far as cost of raw materials was concerned, but there was also the labour, and, of course, Mr. Staveley had no large scale experience of the cost of labour by his process. As far as he, Mr. Carey, could remember, speaking "off the book," the cost of labour for converting sulphate of soda into the first form of soda, viz., "salts," by their, the Leblanc, process, was about 3*s.* to 3*s.* 6*d.* per ton. That was a small amount of labour. It struck him from the paper that Mr. Staveley's cost of labour would be more. Mr. Staveley had said that sesqui-carbonate was more difficult to deal with than bicarbonate. He should like to know the reason of this. (Mr. Staveley: "Because it is more pasty.") Then it is simply its mechanical condition. (Mr. Staveley: "Yes.")

Dr. J. Campbell Brown said that during the whole evening a feeling of satisfaction had been present in his mind that manufacturing chemists were showing signs of utilising some of the thousands of compounds which recent researches in organic chemistry had placed at their disposal. Most of these organic compounds had been recently and were still, perhaps, curiosities, but some were now becoming more familiar every day. The number of these was continually increasing, and if manufacturers and their technical advisers would turn their attention to some of the attainable ones, and use them, not only to make dyes and coal-tar products, but also in inorganic transformations, he was sure that the future would yield as rich a harvest as the past. The paper marked the commencement of a new era,—that of the use of organic materials in inorganic industries.

Mr. S. G. Rawson asked whether there would be any loss, other than that of the cresols, in the new process, to counterbalance the present loss of 10 per cent. of the sulphate in its conversion into carbonate by the Leblanc process?

Dr. Hurter said that it was a wonderful thing that it had been reserved for Mr. Staveley to devise a method for making soda by means of phenols, when it came to be considered that the several reactions of his process were known long before. The making of phenolate of lime, the extraction of phenols by means of lime, and the decomposition of phenolate of soda by carbonic acid were well known, but it had remained for an outsider to their trade to combine them into a soda process. This process was one of a series which had occupied the attention of inventors for some time. To use lime in the wet way would be better than to use it in the dry, as in the Leblanc process. Causticising by means of lime in the wet way had been mentioned, but that process had only partially succeeded. Caustic soda might also be produced by the action of lime on soda by causing a solution of bisulphite of calcium to react on sulphate of soda, thus producing bisulphite of soda and sulphate of lime. The bisulphite of soda on being boiled with lime gave an impure solution of caustic soda and an insoluble sulphite of calcium. He believed that it had been so made on a large scale near San Francisco. Mr. Staveley's process also made a soluble lime salt act on sulphate of soda with the production of insoluble sulphate of lime and soluble phenolate of soda. The author's figures were derived from laboratory experience only, and must not be taken as the result of large experiments. Mr. Staveley had stated something about the precipitation of bicarbonate proceeding better in the presence of sulphate of soda. Now they knew that another chemist had proposed to carbonate solutions for the precipitation of bicarbonate in the presence of common salt. He had not investigated the subject, but he did not see why it should be the case, and still less why it should proceed better in the presence of sulphate of soda. With common salt carbonate of soda itself was less soluble, and in brine a concentrated solution of carbonate of soda could not be obtained. It was different with sulphate of soda, which was less soluble in carbonate of soda solution than in water, and he did not quite see what was to be gained by adding sulphate of soda to a solution of phenolate of soda in order to precipitate therefrom bicarbonate of soda, and he should like further information on that point. A comparison had been made with his own process of decomposing sulphate of soda by ammonia and carbonic acid so as to obtain sulphate of ammonia and bicarbonate of soda, and then decomposing the sulphate of ammonia by heating it with sulphate of soda to obtain free ammonia and bisulphate of soda. This comparison hardly appeared appropriate, because his process was really designed to decompose sulphate of soda so as to recover the sulphur in a form in which it could be used again, whereas Mr. Staveley obtained his sulphur in the form of sulphate of lime which was always to be had in large quantities and was not worth much. There was one other point of interest, and that was the use of phenols to estimate the causticity of impure solutions, the test being stated to be accurate to the first place of decimals. He should like to know what Mr. Staveley exactly meant by that, because a method of estimating caustic soda in impure solutions was very valuable indeed to alkali manufacturers, particularly if it would estimate small quantities of soda in presence of large quantities of carbonate and impurities. Being accurate to the first place of decimals, would it be accurate if the percentage of caustic soda was not more than 0·9 or 1·00?

Mr. Staveley, in replying, thanked them for their kind remarks.

Replying to Dr. Hurter, he said, the essential idea was the getting of lime into solution. That would reply also to Dr. Kohn, who said—and, of course, on the face of it, it did appear so—that the main re-action was the re-action of sulphate of soda on phenolate of calcium in solution. But that was not the idea with which he had started. His idea was that at the moment of formation of caustic soda (by the action of lime upon sulphate of soda) the reverse reaction takes place, and hence, unless some body is present capable of combining with the caustic soda as it is formed, slaked lime has but little action upon sulphate of soda. He had worked with various organic bodies, and he had found as a rule that the whole of the lime, in combination or in solution with these organic bodies, was converted into sulphate of lime by means of sulphate of soda, with a corresponding production of soda hydrate.

Replying to Dr. Kohn, he might say that he had tried the process at varying temperatures. At a high temperature they obtained a poorer yield in consequence of the phenolate of soda reacting upon the sulphate of calcium.

In reply to Dr. Hurter, his reason for adding sulphate of soda to the carbonate of soda solution before bicarbonating was, that if a solution of carbonate of soda be carbonated *per se*, the bi-carbonate crystals obtained very often contain large quantities of sesqui-carbonate, which render the subsequent manipulations of the crystals more difficult. Another reason for adding sulphate of soda was that the bicarbonate was less soluble in a solution of sulphate of soda than in water, and hence there would be obtained a greater precipitation of bicarbonate. The sulphate of soda did not assist the formation of bicarbonate, but simply assisted the mechanical part of the process.

The comparison that he had made between the sulphate of soda process of Messrs. Carey, Gaskell, and Hurter was merely with reference to their first process. It had nothing to do with their subsequent decomposition of the sulphate of ammonia. With regard to the process he had mentioned for estimating the caustic soda in impure solutions, he had used it for solutions containing 6 to 10 per cent. of Na_2O, and it gave good results. Phenol is slightly soluble in carbonate of soda solution, and in most other dilute solutions of inorganic salts. But it is more soluble in benzene than in any other solvent, and hence benzene will remove it from inorganic solutions, where it is present in solution only, and not in combination with alkalis.

It certainly was a defect of his process that it started with sulphate of soda, and he was only too sorry it did not start with common salt. As Mr. Carey had said, it was to alkali-makers a novel process, and speaking of the cost of the first operations in the old and new process, he, Mr. Carey, did not see anything in it. He accepted Mr. Carey's opinion on that point. The first operation in his process could not be an expensive one. There was no more difficulty in the operation than there was in making milk of lime, and the apparatus required was as simple as the process. That was the only part of the process of which he had no experience on the large scale, but he had a great deal of experience in the carbonating of soda phenolates.

He was glad to hear Dr. Campbell Brown's remarks. He had been working at cresol now, more or less, for the last three years, and during that time he had discovered many interesting points, and he believed that not only could it be applied to a reaction like that for the purpose of soda manufacture, but, from his own experience, there were many other purposes to which cresol and its combinations could be applied in inorganic chemistry.

Manchester Section.

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Hon. Local Secretary:
J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Tuesday, November 6th, 1888.

DR. SCHUNCK, F.R.S., IN THE CHAIR.

SOME REMARKS ON THE THEORY OF DYEING.

BY DR. E. SCHUNCK, F.R.S.

On taking the chair at this the first meeting for the session of this Section of our Society, I propose, before proceeding to the business of the evening, to address a few words to you on a subject of technical interest, as is customary on such occasions. I propose this evening to offer some remarks on the theory of dyeing, *i.e.*, on the principles on which the art of dyeing depends. I have chosen this subject because it is one with which I am tolerably familiar, and also because it is one of comparatively limited scope, and may therefore, as regards its general outlines at least, be discussed within the time at my disposal. I must warn you, however, not to expect from me the enunciation of any new or striking views. I shall simply endeavour to give an account of the opinions that have been and are at present held with regard to the subject referred to.

The art of dyeing may be described as the art of imparting colours of various kinds to animal or vegetable fibres or tissues of such a degree of fixity as not to be removable by mere washing with water or mechanical friction. In order that a material of any kind may be dyed it must be porous, *i.e.* capable of receiving colour within its substance and not merely on its surface. When the colour lies on the surface only, the object is stained or painted, not dyed. A piece of slate could not be dyed, because slate is not porous, it could only be painted; a piece of wood, on the other hand, might be dyed, with especial facility indeed, when it is impregnated with colouring-matter or tannin. A blot of ink on a stone surface gradually becomes darker on drying and exposure to the air, but the result is merely a superficial stain; applied to cotton or linen, however, ink (*i.e.*, ink from galls) penetrates into the interior of the fabric and there becoming changed by exposure to the air, acts as a true dye. When ultramarine or any other pigment is fixed to any fabric by means of coagulated albumen, the fabric cannot in the true sense be said to be dyed any more than the paper of a printed book in the places that appear black or the canvas serving as the basis of an oil painting can be called dyed. If ultramarine could be produced by impregnating a tissue with some material and then allowing it to be acted on by some other material, so that the colour should be produced within the substance of the tissue, then the latter might be said to be dyed with ultramarine. Whether an object which is to be dyed should not only be porous but should also be of organic origin, and have, moreover, either as regards the whole or the minute parts of which it consists, an organic structure, is a point on which it is difficult to pronounce a decided opinion.

The process of dyeing is a purely artificial one—it never takes place in nature, so far as I know. The colours which we see adorning various animal or vegetable organisms are due (when not caused by the peculiar structure of the superficies) to substances situated in the interior of each organism and appearing through the generally colourless epidermis or cuticle, but in no way combined with the matter of which the organs or their contents consist. The green colour of fresh leaves and the various colours of flowers are due to substances contained in the cells which may easily be removed by water or spirits of wine, leaving the structure colourless. The colouring-matter of blood, too, seems to exist in the animal organism in a free and uncombined state. The most important and useful colouring-matters of vegetable origin employed in the arts do not preexist as such in the organism, they are produced from so-called "chromogens," mostly colourless substances formed by the plant, which by appropriate treatment yield colouring-matters such as the dyer can use. To this class belong the colouring-matters of indigo, madder, and orchil. No one looking at a leaf of *Indigofera* or any indigo-yielding plant would suspect in it the presence of any colouring-matter beyond the ordinary leaf-green or chlorophyll, but let the leaf be frozen or subjected to mechanical injury of any kind so as to destroy its vitality, then the colourless chromogen of the leaf or indican begins to decompose, yielding blue indigo, which, as it is being formed, colours and dyes the tissues with which it is in contact. Changes of a similar character are observed during the formation of other colouring-matters.

The process of dyeing being, as I maintain, an entirely artificial one, one in which vitality plays no part, and which must depend solely on physical and chemical principles, it seems strange that in spite of the great advances made by science and its applications during the last fifty years, the subject should still be involved in obscurity, and that we should still be without a satisfactory theory of dyeing. This state of things may be owing to several causes. In the first place, when an art like that of dyeing has attained to a high degree of perfection through the exertions of generations of practical workers—as may be seen in the case of the Turkey-red dye which was produced ages ago of an excellence as regards brilliancy and permanence such as cannot even in our days be surpassed—we are apt to rest content with the results achieved without troubling ourselves about the principles involved. Compare in this respect the art of dyeing with that of photography. The latter art arose in scientific days; it was founded on a knowledge of chemical principles, and almost every step in its progress has received some kind of scientific explanation. Secondly, the art of dyeing deals largely with compounds derived from animals and plants, so-called organic substances, bodies of a complex nature, the mere external properties of which in a state of purity, as well as their behaviour towards reagents, were until recently quite unknown. Thirdly, the materials or fabrics to be operated on and dyed are of a still more complex nature even than the colouring-matters which serve to dye them; their constitution is unknown, they may even be mixtures of several substances which cannot be separated one from the other by any known process. Moreover, they are not only organic in constitution, *i.e.*, consisting of C, H, and O with or without N, but they are also organised, *i.e.* they possess a structure derived from the organisms of which they at one time formed a part, and it is therefore possible that different portions, such as the internal and external surfaces of the individual fibres of which they consist, may act differently. It is scarcely surprising, therefore, that to such questions as these: —Is the process of dyeing a purely chemical process? If not, is it merely mechanical, or do chemical and mechanical causes concur in producing the effects observed? or is there perchance some principle involved in the operation of dyeing of which we are at present ignorant?—that to such questions no definite answers can be returned.

The first to propose what may be called a theory of dyeing was Hellot, who says in his "Art de la Teinture" (1750):—"I believe we may lay it down, as a general principle of the art of which I treat, that the whole invisible mechanism of dyeing consists in dilating the pores of the body to be dyed, in depositing in them the particles of a foreign substance, and retaining them there by a kind of cement, which neither rain-water nor the rays of the sun can alter, in choosing colouring particles of such tenuity that they may be retained properly encased in the pores of the substance, opened by the heat of boiling water, then contracted by cold, and, moreover, coated by a kind of varnish, which the salts employed in preparing the stuffs had left in the pores; from this it follows that the pores of the fibres of wool, which we have formed or mean to form into stuffs, ought to be cleansed, enlarged, varnished, and then contracted, so that the colouring particle may be retained like a diamond in the beasel of a ring." Another author belonging to the same period, Le Pileur d'Apligny, explained the phenomena under consideration in a similar manner, laying particular stress on the different size of the pores in the fibres of wool, silk, and cotton, as explaining the differences in the behaviour of these fibres to colouring-matters. Considering that at the period when these authors wrote, chemical science as distinct from alchemy could scarcely be said to exist, it can hardly be matter for surprise that they should have adopted a purely mechanical theory of the phenomena of dyeing. To this, perhaps even an earlier, period we owe the term "mordant," as applied to substances used to fix colouring-matters on fibres, and supposed to act by their power of eating into the material to be dyed and fitting it for the reception of colouring-matter. The name has been retained, though the notion on which it was founded has been given up and is now ridiculed, simply because it is convenient to have a definite name, however inappropriate, for a distinct thing.

Bergman and Berthollet, who belonged to a later period, when chemical science had advanced considerably and who were themselves distinguished chemists, entirely rejected the views of their predecessors, and in their works on dyeing set up a new theory, according to which the fixation of colouring-matter on animal and vegetable fibres is a purely chemical process. Bergman seems to have been the first who referred the phenomena of dyeing entirely to chemical principles. Having dyed wool and silk in a solution of indigo in sulphuric acid, he attributed the effects that he observed in this operation to the precipitation occasioned by the greater affinity subsisting between the wool and silk and the blue particles than between the same particles and the acidulated water. Referring to this view of Bergman, Berthollet makes the following remarks:—"This is the proper method of considering the phenomena of dyeing; they are true chemical phenomena, which ought to be analysed, like all those that depend upon the action which bodies exert in consequence of their peculiar nature. Colouring particles have chemical properties which distinguish them from all other substances; they have affinities which are peculiar to themselves; in consequence of these affinities they combine with acids, alkalis, metallic oxides, and some earths. We may compare the compounds that are formed to neutral salts, which possess properties different from those of their component parts, but in which one of the component parts may become superabundant." These are the views that we should expect from a chemist of that period relative to the phenomena of dyeing. Berthollet makes no distinction between the two cases of the fixation of colouring-matter on tissues, in the one case with and in the other without the intervention of a mordant; in all cases there was a chemical union either of combined or uncombined colouring matter with animal or vegetable fibre. To Berthollet, who had less precise notions of chemical combination than we have, never admitting, for instance, that bodies united in definite proportions, such views presented no difficulty. To him, probably, the fixation of indigo on tissues in dyeing was as much a case of chemical combination as the union of sulphuric acid with potash. I am not sure whether he would not have considered the removal of colouring-matters from solutions by means of animal charcoal as due to chemical affinity.

Similar views to those of Berthollet will be found in other works of that period on dyeing. Dr. Thomas Henry, of Manchester, says (Considerations on Different Materials as Objects of the Art of Dyeing):—"The whole business of dyeing is indeed so truly a chemical process, or rather a combination of several chemical processes, that I am convinced the invention, or at least the principal improvements of the fundamental parts, must have proceeded from men skilled inchemistry." The same notions will be found in Bancroft's "Philosophy of Permanent Colours." We owe to Bancroft the terms *substantive* and *adjective* colouring-matters, the former being such as "require no basis or *mediating* substance to fix them upon other objects," the latter those "whose durability depends chiefly, if not exclusively, upon the intervention of some basis." These terms might, I think, with advantage be retained.

In his elaborate memoirs on dyeing, Chevreul gives expression to opinions very similar to those of his predecessors. He does indeed admit that dyes may be of three kinds, one in which the colour adheres mechanically to the tissue, another in which it is fixed in virtue of chemical attraction, and a third kind where the colour is fixed partly by affinity, in part only mechanically; but when we come to read attentively what he says, we find that he considers the colouring-matter in the first case to lie simply in the interstices of the tissue, just as dust would in the crevices of a wooden board, whereas in the second case, which is that of a dye in the true sense, chemical affinity, and that only, comes into play. One quotation from Chevreul's eighth memoir on the chemistry of dyeing will suffice to show on what, in his opinion, the effects produced in dyeing processes depend. He says:—"I may remark that while permitting the expression *mordant* in the language of the workshop, I would banish it entirely from the language of science, not only because it is wanting in precision, but also because it might in some cases lead to confusion. In every case of dyeing, therefore, due to affinity, *I only take into consideration a tissue and a coloured substance more or less complex which combines with it in virtue of forces which we call chemical.*" How very wide Chevreul's definition of chemical affinity must have been, may be inferred from what he states in his ninth memoir. "I have proved," he says, "by experiment, that charcoal combines with sulphide of sodium, with bases, and with hydrochloric acid in virtue of chemical affinity."

In his eleventh memoir (1861) Chevreul repeats what he had advanced in previous memoirs, viz., that "the coloration of tissues may take place, not only in virtue of affinity, but also in virtue of their impregnation by a coloured powder introduced mechanically into the interstices of the filaments." The latter kind of coloration manifestly differs very widely from that produced by a colouring-matter like indigo, which unites, it may be mechanically or by surface attraction, with the substance of the tissue, and does not merely lie in interstices.

Persoz devotes a chapter of his "Traité de l'Impression des Tissus" to this question, but without arriving, so far as I can see, at any definite conclusion. Persoz asserts that there is no essential difference between cohesion and affinity; that the force which causes two bodies of different properties, such as a metal and oxygen, to combine, is the same as that which unites two bodies of similar properties, such as copper and zinc, the difference being merely one of degree. When two bodies placed in simple juxtaposition combine, it is because they have the same atomic volume. In the case of the fixation of colouring-matters, a chemical compound, such as indigo-blue or a madder-lake, having been formed, it is only necessary that it should in the nascent state be placed in immediate juxtaposition with the tissue for the two to unite to form a dyed fabric. The conclusion to be drawn from the facts mentioned by Persoz would seem to be this: that the union of a colouring-matter with a base or mordant is caused by chemical affinity, whereas the fixation of the compound on vegetable or animal fibre is mechanical. The removal of a colouring-matter from a watery solution by means of charcoal is not due, according to Persoz, to the same cause as the combination of colouring-matter with a metallic oxide. This is no doubt true, but on the other hand it is not easy to see in what respect charcoal and fibre differ in their behaviour to colouring-matters; the difference is only one of degree, and if we are not particular as to definition, we may say that both act in virtue of their affinity for colouring-matter.

Views differing very widely from those previously held were made known in a series of memoirs, "On the manner in which Cotton unites with Colouring-matter," by Mr. Walter Crum, published in the years 1843-63. After alluding to the opinions of his predecessors on the principles involved in the fixation of colouring-matters, Mr. Crum says:—"Cotton wool in the bleached state may be considered as pure woody fibre or cellulose. It is one of the most inert of vegetable bodies. In the textile fabric it is capable of having incorporated with it, in all proportions, a multitude of different substances without changing its own or their physical or chemical characters, except by holding them against mechanical efforts to wash away or otherwise to separate them, but yielding them up to their proper solvents as readily as they could be taken from a surface of glass." After comparing the attraction exerted by cotton fibre for colouring-matters to that of charcoal for gases and bodies held in watery solution, he proceeds to say that substances applied to cotton as dyes, or for the purpose of attracting dyes, become fixed in the cotton fibre in two different ways, viz., 1, they are attracted and precipitated from their solutions by the pores of the cotton; or, 2, they enter these pores in combination with an acid or other solvent, and in a state of solution, and are there fixed, not by an effect of porosity, but by the subsequent removal of this solvent, or by other means which renders them insoluble in water. To the processes comprised under the first heading, of which dyeing with indigo affords an example, Mr. Crum paid but little attention, confining himself principally to those of the second class. In illustration of his views, he takes the case of dyeing cotton black or purple with madder, which consists in the main in applying an iron mordant, usually ferrous acetate, to the tissue, where it is fixed in the form of ferric oxide, before entering the dye-bath. Having confirmed the statements of previous observers to the effect that cotton fibres, when examined under the microscope, are found to consist of tubes having interior cavities more or less large, he maintains that in the first part of the process alluded to the ferrous acetate solution enters the cavities, after passing through the walls of the tubes, and the fabric being allowed to dry, and then exposed to an atmosphere slightly warm and moist, the acetic acid gradually escapes, in proportion as oxygen is absorbed, and the iron, in the state of an insoluble peroxide, remains. "But as insoluble matters cannot pass into the interior of the fibre from without, so, when a substance has once entered that fibre or its pores in a state of solution, and has become precipitated within these enclosures, it is equally impossible for the precipitate to return. It is entrapped within the body of the fibre or its tissue, and becomes fixed there. It will be seen that this precipitation and imprisonment of the oxide is no case of attraction, either chemical or mechanical. It is a case of chemical decomposition, in which the cotton acts the part only of a vessel to receive the materials. The same solution spread thinly over glass, and placed in similar circumstances, undergoes the same decomposition. The cloth having been thus furnished with its mordant, is first passed through hot water, &c., after which it is ready to be dyed. For that purpose it is made to traverse, for a couple of hours, a vessel of water through which madder in powder has been distributed. Heat being gradually applied, the colouring-matter of the madder dissolves slowly, and passes into the fibre which encloses the oxide of iron, and there unites with it. The resulting compound is the purple lake. This last process is a purely chemical one, in which the oxide of iron forms a true combination with the colourable matter of the madder, the cotton attenuating the iron to a prodigious extent, and placing it in circumstances the most advantageous for forming a lake with this dyestuff." When aluminium acetate is employed in place of ferrous acetate similar changes take place, alumina being left in the cavity of the fibre, and the tissue acquiring a red colour on dyeing with madder. After applying aluminium or ferric chloride containing a large excess of alumina or ferric oxide respectively to cotton, there remains, after simply steeping and washing, sufficient alumina or ferric oxide for dyeing purposes. This, according to Mr. Crum, is due to the crystalloid portion of the mordant, the aluminium or ferric chloride, diffusing through the wall of the fibre into the surrounding water, while the colloid hydrated alumina or ferric oxide remains within, gelatinised either spontaneously or by the traces of saline matter which are always present. In the so-called "dead cotton," which is simply immature cotton, no cavity can be seen under the microscope in the interior of the fibre. For this reason, according to Crum, this kind of cotton will not take any colour when subjected to the same process as ordinary mature cotton. Appended to Mr. Crum's last memoir are several plates, showing the appearance of dyed cotton fibres of various colours, and illustrating his meaning in the clearest manner.

These views of Crum, which remind one somewhat of those held by Hellot more than a century ago, were subjected to a somewhat severe criticism by Persoz, some of whose objections are certainly well founded, though others are of little importance. It is certain that Crum's labours, whether we agree with his conclusions or not, form a valuable contribution to the theory of dyeing. For myself, I confess that I do not feel so much impressed by Crum's exposition, on again reading his papers, as I was when they first appeared. On examining Crum's figures of dyed cotton fibres carefully, it will be found, I think, that some of the features do not correspond very exactly with his theory. In the first place, the colour does not, in all cases, lie solely in the cavity of the fibre, but is, to a great extent, uniformly diffused through its entire substance. Secondly, in those cases in which the coloured particles are found in the cavity only, they do not form a uniform layer on the sides of the cell, as would have been expected, but are seen in the shape of granular masses or clots, just as if some coagulation or precipitation of the mordant had taken place previous to dyeing. When a solution of aluminium acetate is evaporated on a glass plate, a residue is left in the form of a transparent gum-like pellicle adhering to the glass. We should expect the same thing to take place when a solution of the salt contained in a fibre of cotton is evaporated; the residue left, after drying, would adhere to the sides of the cavity, and the dyed fibre would show a uniform distribution of colour throughout its interior. Thirdly, unbleached cotton, according to Crum, takes up more colour than the same cotton bleached, a fact which, it seems to me, cannot easily be explained in accordance with his theory. Fourthly, unripe cotton fibre, so-called dead cotton, though it cannot be dyed in madder colours, does take up the colouring-matter of safflower, and there being, in this case, no cavity, it must be the substance of the fibre itself which is dyed. I cannot help thinking that in the dyeing of cotton the foreign substances accompanying the cellulose, which are to some extent removed during the process of bleaching, play some part. Of these substances I described several more than 20 years ago. They consisted of fatty matters of several kinds, colouring-matters, pectic acid, and small quantities of an albuminous substance.

It is quite possible that some of these substances may, as well as the cellulose, take up colour during the process of dyeing. Let us suppose—not at all an extravagant assumption—that cotton fibre contains within its cavities some kind of calcareous soap; this, when it comes into contact with aluminous or iron mordants, would at once form soaps containing alumina or ferric oxide, and these compounds would, in dyeing with madder, take up colouring-matter (as similar compounds prepared artificially do in Turkey-red dyeing), the dyed fibre presenting then an appearance, under the microscope, perhaps such as is seen in some of Crum's figures. The albuminous substance might also play some part in cotton-dyeing, especially in cases where substantive colouring-matters are employed. Should this subject, that, namely, of the manner in which cotton fibre unites with colouring-matter, be taken up again, I would suggest that the cotton be subjected to the action of various solvents before commencing the dyeing experiments. Of these solvents many can now be obtained in commerce which were formerly only seen in laboratories. Let a quantity of raw unspun cotton of good quality be taken and treated, first with carbon disulphide or petroleum ether, then with alcohol or ether, then with boiling water, then with hydrochloric acid, lastly with caustic alkali. After the use of each solvent let a dyeing experiment be made and let the dyed fibre be carefully examined under the microscope, the substance or substances removed by each solvent being also examined. It would then be seen whether any of these foreign substances play a part, and if so, what part in the dyeing process. As a final experiment, the residual cellulose might be dissolved in Schweizer's liquid, reprecipitated, and then treated in various ways in order to see whether it would receive dyes in the same way as cotton fibre itself. The interesting discovery of Witz, who has converted cellulose by the action of bleaching powder into a body, which he calls oxy-cellulose, and which behaves to colouring-matters in a different manner to cellulose, shows that it is advisable to conduct such experiments as these with unbleached and untreated material.

Experiments of this kind may appear trivial and unimportant to the mere Philistine, but intelligent technologists are aware that important results often flow from investigations having no immediate practical aim.

The dyeing of woollen fabrics has had much less attention paid to it, so far as the principles involved are concerned, than that of cotton dyeing, partly perhaps from the latter being a more modern art, and therefore less bound by routine and rules handed down from former times. Quite recently, however, an account of some remarkable experiments on woollen dyeing by Dr. Knecht, of the Bradford Technical College, has appeared, which promise, if continued, as I hope they may be, to revolutionise the whole subject. Dr. Knecht finds that wool and silk dyed with rosaniline and chrysoidine do not take up the colouring-matter as such, but only the base, the ClH being found afterwards in the dye liquor undiminished in quantity, and in combination with ammonia, from which he infers that the colour of the wool or silk is formed by double decomposition between a compound contained in the fibre and the rosaniline salt. Dr. Knecht has moreover obtained by the action of sulphuric acid on wool a base of very peculiar properties. A solution of this base in sulphuric acid gives with most of the acid coal-tar colours richly-coloured precipitates, insoluble in water, but soluble in alkalis, from their solutions in which they are reprecipitated by acids. Here we have a veritable dyeing process going on in a liquid without the intervention of any basis in the shape of fibre or tissue, and at the same time a real chemical process, though one of a very unusual character. Dr. Knecht very justly remarks that facts such as those made known by him speak strongly in favour of the chemical theory of dyeing. It remains to be proved that the peculiar lake-producing substance described by him pre-existed in the fibre itself, and was not produced in the process to which the wool was subjected. All who take an interest in the subject must hope that these researches may be continued; in the able hands of Dr. Knecht they are sure to lead to valuable results.

There is a portion of this subject to which in conclusion a few words may be devoted. I mean the permanence shown by our dyes when exposed to light, air, and other destructive agencies. In this respect, as we all know, modern dyes are far inferior to those of former times. Chevreul made a vast number of experiments on the stability of the dyes produced in his day on exposure to the action of light, heat, air, and steam, the results being given in his "Recherches Chimiques sur la Teinture." Chevreul discovered minute differences as regards the stability of the same dye according to the material employed, whether of wool, silk, or cotton. Still greater differences were observed, when different mordants were employed in combination with the same colouring-matter, but much greater differences, as might be expected, when *cœteris paribus* distinct colouring-matters were made use of, although in the latter case Chevreul found it impossible to uphold the distinction formerly so much insisted on between dyes called "grand teint" and those called "petit teint." If the same careful method of experimenting were employed in the examination of modern dyes the results would doubtless be interesting.

Modern tinctorial chemistry has succeeded in preparing for employment in the arts a number of very useful colouring-matters. The dyes obtained by their use are mostly very brilliant—unfortunately they are also extremely fugitive. This is in some respects a disadvantage. It is of little consequence, as Chevreul observes, whether the colour of ladies' dresses is permanent or not, since here it is only brilliancy and lustre that are sought, but with the hangings of rooms, which should last some time, the case is different. Let a room be decorated and furnished as regards design and colouring so as to satisfy the requirements of taste, then how great the disappointment and vexation when we find the colour of the window curtains, where exposed to the sun, fading away, not uniformly, but in streaks, so as entirely to destroy the harmony of colouring which at first prevailed. Accidents such as this which now frequently occur make us sigh for the good old-fashioned dyes of former days.

Then again, if the taste in design and colouring of the present day is of a character to render the fabrics to which it is applied worthy of preservation as specimens of our workmanship, something will have to be done to render our colours more permanent, for it is pretty certain that many of the fabrics of to-day will in course of time appear nearly colourless. Much, I am convinced, could be done by our tinctorial chemists in producing dyes of more stable character, if it were worth their while to do so. Some time ago I exhibited to this Section some specimens of a very permanent dye obtained from chlorophyll, one of the most fugitive of colouring-matters. The permanence in this case was due to the use of cupric oxide, any other base such as zinc oxide would have yielded a fugitive dye. I refer to this, not as being a matter of any practical importance, but as showing what may be done by using an appropriate mordant. With regard to water-colour drawings, as to the permanence of which much discussion has of late taken place, I can only say that I think it would be wise for artists to use only such pigments as are prepared from mineral substances. If, as seems to be the case, even indigo-blue disappears in time from the surface of water-colour drawings, there can be little hope of any other colouring-matter of organic origin resisting the action of light and air on lengthened exposure.

The subject of dyeing in relation to colouring-matters on the one hand, and to the material to be dyed on the other, presents much that is exceedingly interesting from a theoretical point of view. The time at my disposal on this occasion has only permitted me to refer to some of its aspects.

Meeting held Tuesday, December 4th, 1888.

THE STANDARD TEMPERATURE OF SYKES' SPIRIT TABLES.

BY BENJAMIN DERHAM, M.D.

Our sole definition of proof spirit is contained in the following extract from the Act 58 Geo. III. c. 28, "That an hydrometer, called Sykes' hydrometer, had with great care been completed, and had by proper experiments made for that purpose, been ascertained to denote as proof spirit that which at the temperature of 51° Fah. weighs exactly twelve-thirteenth parts of an equal volume of distilled water." The specific gravity of distilled water at 51° is, according to Gilpin and Blagden's experiments, 1·00063; twelve-thirteenths of this is ·92366, which is therefore the specific gravity of proof spirit. Now, since a gallon of distilled water weighs 10 lbs., the specific gravities multiplied by 10, that is with the decimal point placed after the first figure on the left, thus 8·25, represent the weight in pounds of one gallon of their respective spirits. One gallon of proof spirit accordingly weighs 9·2366 lbs. It is true that the specific gravities in Gilpin and Blagden's tables are compared with distilled water at 60°, whilst the gallon of distilled water weighs 10 lbs. at 62°; hence, in order to convert Gilpin's specific gravities into exact expressions of the pounds weight per gallon, it would be necessary to multiply them by 1·0002, the specific gravity of distilled water at 60°, as compared with distilled water taken as unity at 62°. But since the correction is quite insignificant, and its neglect does not in any way affect my argument, inasmuch as my results would be just the same if I dealt with abstract measures and proportional weights, instead of gallons and pounds weight per gallon, I shall, in order to avoid unnecessary complication of my subject, employ Gilpin's specific gravities, punctuated as described, as expressions of the "pounds weight per gallon."

It is desirable in the next place to emphasise the fact that the proof gallon, as the legal standard unit of measure and strength, exists only at the temperature of 51° Fah. We find an illustration of this important point in the analogous definition of the imperial gallon. The imperial gallon is the volume occupied by 10 lbs. of distilled water at 62° Fah. In this definition a definite weight of a specified liquid at a given temperature determines the bulk; at no other temperature than 62° Fah. will 10 lbs. of distilled water measure one gallon. In the definition of the proof gallon the order is simply inverted, and a given bulk, that of the gallon, at a stated temperature, determines the specific weight of proof spirit, namely, 9·2366 lbs. per gallon. In both definitions the temperature is an essential factor. If it were permitted to consider the standard proof gallon as ascertained at any other temperature than 51° Fah., it is evident that if we retained the same weight of spirits their bulk would vary, and would be either greater or less than one gallon; and on the other hand, if we adhered to the bulk of one gallon as the essential quality of the standard unit, the weight of the spirits would vary; and since spirits which are proof at 51° vary in specific gravity from ·9324 at 30° to ·9109 at 80°, on this assumption the gallon of proof spirit might vary in weight, within these limits of temperature, from 9·324 to 9·109 lbs. We would in fact be confronted with the absurdity of a variable standard, one for every degree of temperature, at the caprice of the individual, and the design of the legislature would be defeated, which was to supply a standard unit of measure and strength for revenue purposes. To return to our analogy, it would be just as reasonable to say that because 10 lbs. of distilled water vary in bulk at different degrees of temperature, the bulk of the imperial gallon also varies. It is plain, therefore, that in the definition of the proof gallon as of the imperial gallon, an exactly ascertained weight, bulk, and temperature are equally essential and invariable factors. It may appear to be superfluous to insist that a standard, to have any utility, must be invariable: but these preliminary remarks are rendered necessary by the fact that some recent writers on this subject have overlooked this essential quality of a standard, and have deemed themselves at liberty to consider the value of the proof gallon as determined by the specified spirit at other temperatures than 51° Fah. "Proof at 60°," they write, has a specific gravity of ·9198; and misled by the identity of the spirit to assume an identical value for the same bulk at a different degree of temperature, they proceed to construct tables of strengths on this new basis; for it is plain that as far as the legal standard is concerned the spirit is no longer proof at 60°, since one gallon at that temperature weighs only 9·198 lbs. instead of 9·2366 lbs. Consequently, tables of strengths, founded on the value of "proof at 60°," do not comply with the conditions imposed by the statute, and are necessarily erroneous. I am desirous here to emphasise that although I may be compelled by the exigencies of my argument to employ, whilst combating, the expression "proof at 60°," I condemn the expression as fallacious, and repeat that "proof," as the legal standard of value, exists only at 51°. It is also alleged that there is an ambiguity in the wording of the statutory definition, which allows of various interpretations, namely, that the temperature at which the distilled water is to be taken is not mentioned. If we were to confine our attention to the text of the definition alone, I do not think that there would be any reasonable doubt that the temperature 51° was also intended to apply to the distilled water, for the definition would be vain and meaningless on any other supposition; but if there be any doubt, it will be removed by the following considerations. The chief object of the statute was to establish the employment of Sykes' instrument and tables; not merely to furnish a definition of proof spirit, in compliance with which instrument and tables should subsequently be constructed, but to adopt and legalise an instrument and tables which were already constructed and calculated in accordance with an exactly determined standard, which the statute only incidentally defines. Now the sanction of the system certainly includes the standard upon which the system is founded. Any ambiguity, therefore, which is alleged to exist in the definition of the standard will be conclusively removed by a demonstration that the standard proof spirit of Sykes' hydrometer and tables possesses a specific gravity $\frac{12}{13}$ths of that of distilled water at 51° Fah.

By its invariable construction, Sykes' hydrometer indicates proof spirit at temperature 51° Fah. with the sixty weight attached, and $\frac{92}{100}$ths of the scale submerged, and the accuracy of the proof point is verified in the following manner. The instrument, with the sixty weight attached, must be floated in distilled water at 51° Fah., and a small weight, one-thirteenth of the then total weight, be placed on the top of the stem; then the hydrometer, if correct, should sink to the proof indication, so that whilst measuring the same bulk, the weight of instrument and weight, when floating at the proof point in proof spirit, is just $\frac{12}{13}$ths of the weight of instrument and weights when floating at the same point in distilled water at 51° Fah. Hence, by the invariable construction of Sykes' hydrometer, proof spirit has at 51° Fah. a specific gravity $\frac{12}{13}$ths of that of distilled water also at 51°; and as I have already shown, the standard thus established at 51° cannot exist unchanged at any other temperature. Finally, the illustrations I shall produce will clearly demonstrate that the value I have assigned to proof spirit, which is indeed the commonly accepted value, is the basis upon which Sykes' tables are calculated; for that estimate alone of the proof gallon furnishes exactly, at the appropriate temperature, the strength adopted by Sykes as the uniform strength pertaining to a spirit at all temperatures, which no other estimate of the proof gallon will supply. The plain and natural interpretation therefore of the statutory definition, corroborated by the evidence afforded by Sykes' hydrometer and tables, of equal authority to the definition itself, unequivocally establish that the legal proof gallon weighs 9·2366 pounds.

Sykes, in the construction of his tables, deliberately ignored the expansion and contraction of spirits due to variations of temperature; and having selected a temperature and calculated for that temperature the strength of a spirit, otherwise the ratio it bears to the standard spirit at 51°, assumed that that strength remained constant at all degrees of temperature. This is an important point, and the nature of Sykes' error should be clearly apprehended. A glance at any of the tables I exhibit will illustrate my meaning. The fourth column entitled the "true strengths" exhibits the ratios of the specified spirit at various degrees of temperature to the standard spirit at 51°. One of these strengths only Sykes adopted as the appropriate strength of the given spirit at all degrees of temperature. In consequence of the adoption in the statute of temperature 51°, in the definition of proof spirit, it is commonly stated and believed that the strengths contained in Sykes' tables are those belonging to the several spirits at 51° Fah. I have, however, lately subjected Sykes' tables to a careful examination, and find that this opinion is erroneous, and that the temperature to which Sykes' strengths pertain, which we may call "the standard temperature of Sykes' tables," is 55°, or the mean of the range of temperature covered by his tables, which extend from 30° to 80°. In the course of the following demonstration of this truth, I shall employ only the data afforded by Gilpin's experiments, upon which Sykes' tables are founded.

It will be first necessary to ascertain the weight of Gilpin's pure spirit in one gallon of proof spirit. By reference to Gilpin's tables at the temperature of 51° Fah., it will be seen that proof spirit, which has specific gravity ·92366, comes between ·923154 and ·926048, which correspond to mixtures of 100 parts by weight of Gilpin's pure spirit, and 80 and 85 parts by weight of water respectively. At this part of Gilpin's tables, the specific gravities corresponding to successive equal increments of 5 parts by weight of water, differ by diminishing intervals; consequently a quadratic equation, comprising three terms of the series, will fix more exactly than a simple proportion the exact mixture of spirit and water constituting proof spirit. The following three terms include the specific gravity of proof spirit.

Temp.	Sp.=100; W.=75	Sp.=100; W.=80	Sp.=100; W.=85
51°	·920074	·923154	·926048

Let $75 + x =$ weight of water corresponding to proof spirit; x, being greater than 5, and less than 10. Then employing an ordinary method of interpolation we obtain the following quadratic:—

$$3·72\,x^2 - 634·6\,x = 3586$$

Whence $x = 5·85152$.

And $75 + 5·85152 = 80·85152$ parts by weight of water, which mixed with 100 parts by weight of Gilpin's pure spirit, constitute proof spirit at 51°.

Now, as we have already seen, the specific gravities of Gilpin's tables, multiplied by 10, represent the weight in pounds of one gallon of their respective spirits; and these weights in all the columns of Gilpin's table, after the first which is devoted to the pure spirit, correspond to definite mixtures of 100 parts by weight of pure spirit and 5, 10, 15, &c. parts by weight of water. Hence the following proportion will furnish the weight of Gilpin's pure spirit in one gallon of any specified spirit.

"As the total weight of spirit and water is to the weight of pure spirit in the mixture, so is the weight of one gallon of the specified spirit to the contained weight of pure spirit."

Applying this to proof spirit—

$$180·85152 : 100 :: 9·2366 : 5·1073 \left\{\text{pounds of Gilpin's pure spirit in one gallon of proof spirit.}\right.$$

By a similar proportion, the weight of Gilpin's pure spirit contained in one gallon of any specified spirit is ascertained; and it is evident that if the weight of pure spirit so determined be divided by 5·1073, the quotient will be the equivalent value of one gallon of the specified spirit in gallons of proof spirit. For example, the specific gravity of the mixture of 100 parts by weight of pure spirit and 5 parts by weight of water at 30° is ·84995. One gallon, therefore, weighs 8·4595 lbs.

Hence—

$$105 : 100 :: 8·4995 : 8·0948 \left\{\text{pounds of Gilpin's pure spirit in one gallon.}\right.$$

$$\text{And } \frac{8·0948}{5·1073} = 1·585 \text{ gallons of proof spirit.}$$

And 100 gallons are equivalent to 158·5 gallons of proof spirit. In the notation adopted in Sykes' system, this value per cent. becomes a convenient expression of the strength applicable to any quantity of the spirit, consequently the spirit in the example selected is said to be 58·5 overproof.

Each of the tabular illustrations I exhibit deals with one column of Gilpin's original table, comprising the specific gravities of a definite mixture of pure spirit and water, for each fifth degree of temperature from 30° to 80° inclusive. Each specific gravity is treated in the manner shown in the example selected, and the strengths so ascertained are the true strengths, inasmuch as they express the actual and commercial value of the several spirits at the various temperatures. The following short explanation will make the tables easily intelligible; which contain in:—

Column I.—The specific gravities of certain definite mixtures of Gilpin's pure spirit and water at each fifth degree of temperature from 30° to 80° inclusive.

Column II.—The pounds weight of Gilpin's pure spirit in one gallon of the given spirit; the method of obtaining this value is shown above.

Column III.—The equivalence in proof spirit of one gallon of the given spirit; being the quotient obtained by dividing the values contained in column II. by 5·1073, the pounds weight of Gilpin's pure spirit in one gallon of proof spirit.

Column IV.—"The true strengths," overproof in the examples selected; expressing the number of gallons, exceeding 100, to which 100 gallons of the given spirit are equivalent.

Column V.—Syke's strengths; which should be uniform at every degree of temperature if the principle of the tables had been exactly complied with, but which exhibit slight discrepancies owing to errors of experiment.

TABLE I.

Pure Spirit = 100 Parts by Weight. Water = 0 Parts by Weight.

Temperature.	I. Gilpin's Sp. Gravities.	II. Weight of Pure Spirit in One Gallon.	III. Proof Spirit equivalent to One Gallon.	IV. True Strengths.	V. Sykes' Strengths.
				Overproof.	Overproof.
30°	·83896	8·3896	1·643	64·3	62·0
35	·83672	8·3672	1·638	63·8	62·0
40	·83445	8·3445	1·634	63·4	61·9
45	·83214	8·3214	1·629	62·9	62·0
50	·82977	8·2977	1·625	62·5	62·0
55	·82736	8·2736	1·620	62·0	62·1
60	·82500	8·2500	1·615	61·5	62·1
65	·82262	8·2262	1·611	61·1	62·2
70	·82023	8·2023	1·606	60·6	62·2
75	·81780	8·1780	1·601	60·1	62·1
80	·81530	8·1530	1·596	59·6	62·0

TABLE II.

Pure Spirit = 100 Parts by Weight. Water = 5 Parts by Weight.

Temperature.	I. Gilpin's Sp. Gravities.	II. Weight of Pure Spirit in One Gallon.	III. Proof Spirit equivalent to One Gallon.	IV. True Strengths.	V. Sykes' Strengths.
				Overproof.	Overproof.
30°	·84995	8·0948	1·585	58·5	56·0
35	·84769	8·0732	1·581	58·1	56·2
40	·84539	8·0513	1·576	57·6	56·1
45	·84310	8·0295	1·572	57·2	56·1
50	·84076	8·0072	1·568	56·8	56·3
55	·83854	7·9842	1·563	56·3	56·3
60	·83599	7·9618	1·559	55·9	56·3
65	·83362	7·9392	1·554	55·4	56·3
70	·83124	7·9166	1·550	55·0	56·2
75	·82878	7·8931	1·545	54·5	56·3
80	·82631	7·8696	1·541	54·1	56·3

TABLE III.

Pure Spirit = 100 Parts by Weight. Water = 10 Parts by Weight.

Temperature.	I. Gilpin's Sp. Gravities.	II. Weight of Pure Spirit in One Gallon.	III. Proof Spirit equivalent to One Gallon.	IV. True Strengths.	V. Sykes' Strengths.
				Overproof.	Overproof.
30°	·85957	7·8141	1·530	53·0	50·6
35	·85729	7·7935	1·526	52·6	50·7
40	·85507	7·7734	1·522	52·2	50·8
45	·85277	7·7524	1·518	51·8	50·8
50	·85042	7·7311	1·514	51·4	50·9
55	·84802	7·7093	1·509	50·9	50·9
60	·84568	7·6880	1·505	50·5	50·9
65	·84334	7·6667	1·501	50·1	50·9
70	·84092	7·6447	1·497	49·7	51·0
75	·83851	7·6228	1·492	49·2	50·9
80	·83603	7·6003	1·488	48·8	50·9

TABLE IV.

Pure Spirit = 100 Parts by Weight. Water = 15 Parts by Weight.

Temperature.	I. Gilpin's Sp. Gravities.	II. Weight of Pure Spirit in One Gallon.	III. Proof Spirit equivalent to One Gallon.	IV. True Strengths.	V. Sykes' Strengths.
				Overproof.	Overproof.
30°	·86825	7·5500	1·478	47·8	45·5
35	·86587	7·5293	1·474	47·4	45·7
40	·86361	7·5096	1·470	47·0	45·7
45	·86131	7·4897	1·467	46·7	45·8
50	·85902	7·4697	1·463	46·3	45·9
55	·85654	7·4491	1·459	45·9	45·9
60	·85430	7·4287	1·455	45·5	45·9
65	·85193	7·4081	1·451	45·1	45·9
70	·84951	7·3870	1·446	44·6	45·9
75	·84710	7·3661	1·442	44·2	45·9
80	·84467	7·3450	1·438	43·8	45·8

TABLE V.

Pure Spirit = 100 Parts by Weight. Water = 20 Parts by Weight.

Temperature.	I. Gilpin's Sp. Gravities.	II. Weight of Pure Spirit in One Gallon.	III. Proof Spirit equivalent to One Gallon.	IV. True Strengths.	V. Sykes' Strengths.
				Overproof.	Overproof.
30°	·87585	7·2987	1·429	42·9	40·8
35	·87357	7·2797	1·425	42·5	40·9
40	·87134	7·2612	1·422	42·2	41·0
45	·86907	7·2422	1·418	41·8	41·0
50	·86676	7·2230	1·414	41·4	41·1
55	·86441	7·2034	1·410	41·0	41·1
60	·86208	7·1840	1·407	40·7	41·1
65	·85976	7·1647	1·403	40·3	41·0
70	·85736	7·1447	1·399	39·9	41·1
75	·85493	7·1244	1·395	39·5	41·1
80	·85248	7·1040	1·391	39·1	41·1

TABLE VI.

Pure Spirit = 100 Parts by Weight. Water = 25 Parts by Weight.

Temperature.	I. Gilpin's Sp. Gravities.	II. Weight of Pure Spirit in One Gallon.	III. Proof Spirit equivalent to One Gallon.	IV. True Strengths.	V. Sykes' Strengths.
				Overproof.	Overproof.
30°	·88282	7·0626	1·383	38·3	36·3
35	·88059	7·0447	1·379	37·9	36·4
40	·87838	7·0270	1·376	37·6	36·4
45	·87613	7·0090	1·372	37·2	36·5
50	·87384	6·9907	1·369	36·9	36·5
55	·87150	6·9720	1·365	36·5	36·6
60	·86918	6·9534	1·361	36·1	36·7
65	·86686	6·9349	1·358	35·8	36·6
70	·86451	6·9161	1·354	35·4	36·6
75	·86212	6·8969	1·350	35·0	36·6
80	·85966	6·8773	1·347	34·7	36·5

Table VII.

Pure Spirit = 100 Parts by Weight. Water = 30 Parts by Weight.

Temperature.	I. Gilpin's Sp. Gravities.	II. Weight of Pure Spirit in One Gallon.	III. Proof Spirit equivalent to One Gallon.	IV. True Strengths.	V. Sykes' Strengths.
				Overproof.	Overproof.
30°	·88921	6·8401	1·339	33·9	32·0
35	·88701	6·8232	1·336	33·6	32·2
40	·88481	6·8062	1·333	33·3	32·2
45	·88255	6·7888	1·329	32·9	32·2
50	·88030	6·7715	1·326	32·6	32·2
55	·87796	6·7535	1·322	32·2	32·3
60	·87568	6·7360	1·319	31·9	32·3
65	·87337	6·7182	1·315	31·5	32·3
70	·87105	6·7004	1·312	31·2	32·3
75	·86864	6·6818	1·308	30·8	32·3
80	·86623	6·6333	1·305	30·5	32·2

Table VIII.

Pure Spirit = 100 parts by weight. Water = 35 parts by Weight.

Temperature.	I. Gilpin's Sp Gravities.	II. Weight of Pure Spirit in One Gallon.	III. Proof Spirit equivalent to One Gallon.	IV. True Strengths.	V. Sykes' Strengths.
				Overproof.	Overproof.
30°	·89511	6·6304	1·298	29·8	28·0
35	·89294	6·6144	1·295	29·5	28·1
40	·89073	6·5980	1·292	29·2	28·1
45	·88849	6·5814	1·289	28·9	28·2
50	·88626	6·5649	1·285	28·5	28·1
55	·88393	6·5476	1·282	28·2	28·2
60	·88169	6·5310	1·279	27·9	28·3
65	·87938	6·5139	1·275	27·5	28·2
70	·87705	6·4967	1·272	27·2	28·4
75	·87466	6·4790	1·269	26·9	28·3
80	·87228	6·4613	1·265	26·5	28·2

Table IX.

Pure Spirit = 100 Parts by Weight. Water = 40 Parts by Weight.

Temperature.	I. Gilpin's Sp. Gravities.	II. Weight of Pure Spirit in One Gallon.	III. Proof Spirit equivalent to One Gallon.	IV. True Strengths.	V. Sykes' Strengths.
				Overproof.	Overproof.
30°	·90054	6·4324	1·259	25·9	24·1
35	·89839	6·4171	1·256	25·6	24·2
40	·89617	6·4012	1·253	25·3	24·2
45	·89396	6·3854	1·250	25·0	24·4
50	·89174	6·3696	1·247	24·7	24·5
55	·88945	6·3532	1·244	24.4	24·4
60	·88720	6·3371	1·241	24·1	24·4
65	·88490	6·3207	1·238	23·8	24·5
70	·88254	6·3039	1·234	23·4	24·4
75	·88018	6·2870	1·231	23·1	24·5
80	·87776	6·2697	1·228	22·8	24·5

These examples, which are not selected, but are taken consecutively, clearly demonstrate, first, that Sykes' proof spirit possesses sp. gr. ·92366; for no other value which can be assigned to proof spirit, at all conforming to the statutory definition, will furnish the strengths of Sykes' tables, and, since the legal sanction of the tables necessarily includes the standard upon which the tables are founded, the legal proof gallon weighs 9·2366 lbs. Second, that the strength adopted by Sykes as the uniform strength of a spirit at all temperatures is that pertaining to the spirit at 55° and not 51°, as commonly believed. The correspondence in most of the examples between Sykes' strengths and the true strengths is exact at 55°, and nowhere differs by more than one-tenth per cent. at that temperature; and this trifling difference is owing to the inevitable error of experiment, incurred in the subsequent determination for another purpose, of the specific gravities corresponding to the indications of Sykes' hydrometer, through which we must trace the connection between Gilpin's specific gravities and Sykes' strengths. At 51°, on the other hand, the divergence is so conspicuous in every instance, as to conclusively negative the supposition that Sykes selected the strength corresponding to 51° as the uniform strength of a spirit at all degrees of temperature.

Accepting it as demonstrated that the strength of a spirit adopted by Sykes as the uniform strength at all temperatures is that corresponding to 55°, it may be of interest to know how the true strengths at all temperatures may be obtained from Sykes' own tables and the specific gravity table annexed to them. In Sykes' tables the same expression of strength always denotes the same spirit; hence, by noting the corresponding indications, and turning to the specific gravity table, we ascertain the specific gravity of the spirit at the various temperatures. If G be the specific gravity of a spirit at a specified temperature, other than 55°, and G_1 the specific gravity of the same spirit at 55°, it is easily shown that one gallon of the spirit at the specified temperature will occupy a bulk represented by the fraction $\frac{G}{G_1}$ when the spirit is brought to temperature 55°. Consequently, if S be the factor expressing the true strength at 55°, the equivalent of this altered bulk at 55° will be—

$$S \times \frac{G}{G_1} \text{ gallons of proof spirit,}$$

which, multiplied by 100, at once furnishes the true proof equivalent of 100 gallons of the spirit at the specified temperature.

For example, according to Sykes' tables, spirit having a strength of 41 overproof, possesses, at temperature 75°, sp. gr. ·8551; and at temperature 55°, sp. gr. ·8646: and, as the notation implies, the factor expressing the strength at 55°, that is, the equivalence in proof spirit of one gallon of the given spirit, is 1·41; therefore—

$$\text{One gallon at } 75^\circ = \frac{\cdot 8551}{\cdot 8646} \times 1{\cdot}41 = 1{\cdot}394 \text{ gallons of proof spirit.}$$

Or the true strength at 75° is 39·4 overproof. This value exactly corresponds with that derived directly from Gilpin's tables in the manner previously shown; and a similar coincidence, allowing occasionally for experimental errors, will be found to exist in every instance. This in itself is a sufficient demonstration of the truth of my contention, that the strengths adopted by Sykes for the uniform strengths of his tables are those pertaining to temperature 55°; for similar coincident results cannot be obtained on any other assumption.

Additional proof that the strengths of Sykes' tables are those properly belonging to 55° is hardly required; still, the evidence afforded by the preceding demonstrations is confirmed by the reflection that Sykes, having resolved to adopt a uniform strength for all temperatures, would naturally select the mean temperature of the series with which he was dealing, with a view to minimising, as far as possible, the inequalities springing from his erroneous assumption; and thus, by exactly balancing the tabular errors of excess against those of deficiency, would hope to obtain an ultimate equilibrium of overcharge and undercharge.

I shall now consider the question of loss to the revenue in the light thrown by this discovery upon the operation of Sykes' system. A glance at the illustrations will show that, at all temperatures below 55°, the strengths, according to Sykes' system, are less than the true strengths, from which it follows that at those temperatures the estimated value of a given quantity of spirit, in gallons of proof spirit, is less than it should be; consequently, at all temperatures below 55°, the revenue incurs a loss. In a paper read before the London Section of this Society on April 9th last, I have shown that the mean temperature of spirits taken out of bond for consumption in the United Kingdom is probably less than 46° Fahr. Adopting the estimate contained in that paper, that duty is annually paid upon the equivalent of 40,000,000 proof gallons, and that the average strength is 25 overproof, the basis of our calculation will be 32,000,000 gallons at 25 overproof. Since the bulks of the same weight of spirit at different degrees of temperature are proportional to the reciprocals of the specific gravities, and the specific gravity of spirit, 25 overproof at 55° is ·8885, and at 46°, ·8926.

$$\frac{1}{\cdot 8885} : \frac{1}{\cdot 8926} :: 1 : \cdot 9954 \left\{ \begin{array}{l} \text{Contracted bulk} \\ \text{of one gallon} \\ \text{at } 46^\circ. \end{array} \right.$$

$$\text{and } 32{,}000{,}000 \times \cdot 9954 = 31{,}852{,}800.$$

showing an apparent deficiency, owing to contraction, of 147,200 gallons. But these are 25 overproof. Therefore 147,200 × 1·25 = 184,000 proof gallons, upon which the duty lost by the present revenue system is 92,000*l*. This is not the largest estimate of loss to the revenue which would be warranted by the meteorological conditions of the United Kingdom, but I am fully justified in maintaining that it cannot be less than that amount. The defenders and apologists of Sykes' system forget that a very great difference exists between the present state of the spirit trade and that which it occupied in Sykes' time. It is only of late years that the system of warehousing spirits has sprung up and grown to such an extent that considerably over one year's supply is stored in the warehouses of the United Kingdom, so that spirits, before passing into consumption, have abundance of time to assume the mean temperature of the warehouse in which they are stored. In Sykes' day the warehouse system had not been introduced, and the assumption that the average temperature of recently distilled spirits would be 55°, was not, perhaps, an unreasonable one. But since the development of the warehouse system, what was previously a reasonable assumption is now no longer tenable or defensible; and the persistent employment of Sykes' instrument and tables, under the altered modern conditions, which were not contemplated when Sykes' method was adopted, must necessarily occasion the loss to the revenue which I have pointed out.

In conclusion I must remark that my demonstration that 55° is the standard temperature of Sykes' tables, only applies to Sykes' original work. Sykes' strengths did not exceed 62 overproof; whereas, in the tables more recently published, the strengths are given to 70 overproof. This small portion, from 62 to 70 overproof, has been added by another hand, and its author has evidently proceeded in ignorance of the fact that Sykes had selected as the uniform strengths of spirits those pertaining to temperature 55°. The strengths of this added portion are consistent with either of the two opinions, which I have conclusively shown to be fallacious, namely, that the strengths of Sykes' tables are—

First.—Those pertaining to the several spirits at 51°, and based upon the correct standard of proof spirit, one gallon of which weighs 9·2366 pounds; or

Second.—Those pertaining to the several spirits at 60°, and based upon that arbitrary and erroneous value of "proof at 60°" to which I have already adverted, one gallon of which weighs 9·198 pounds.

Each of these assumptions furnishes nearly identical expressions of strengths, which nevertheless correspond to very different values. There is nothing paradoxical in this, for it is evident that the ascertained ratio of the value of any given spirit to a selected standard spirit, each at a given temperature, would be nearly but not quite the same at any other temperature; the only discrepancy would be occasioned by the difference in the rates of expansion of the two spirits, which is too small to be material, at least in the expansions from 51° to 60°. Hence it is evident that if we were to ascertain the strengths pertaining to certain spirits at 51°, based on the correct value of proof at 51°, which weighs 9·2366 pounds per gallon, their expressions would nearly coincide with those of the strengths pertaining to the same spirits at 60°, and based upon the value of "proof at 60°," which weighs 9·198 pounds per gallon. It must not, however, be inferred that because the expressions of strength are nearly identical in each case, it is a matter of indifference which estimate of the value of proof spirit is acted upon, for the standard unit—the proof gallon—is heavier in one case than the other, so that from the same expressions of strength we would derive very different estimates of real value according to the proof standard adopted.

Neither of the foregoing assumptions, I repeat, will account for the strengths of Sykes' tables, properly so called, though either of them may have been adopted in calculating the limited number of strengths from 62 to 70 overproof. I am disposed to believe that the first of the two suppositions was acted upon, since the selected standard of proof conforms to the legal definition, and is that which is generally accepted; the error consisting only in adopting the strengths appropriate to 51° instead of 55°, if it were intended that the added portion should be in harmony with the rest of the tables.

The second supposition involves a purely arbitrary estimate of the proof gallon, for which no warrant can be found either in the statute or in the constitution of Sykes' hydrometer and tables. But with regard to this hypothesis, I cannot omit to call your attention to the following argument:—Let us concede that those who advocate that the proof standard should be fixed at 60°, are justified in their interpretation of the statutory definition; that accordingly the proof gallon weighs 9·198 pounds, and that the revenue strengths are those pertaining to the several spirits at 60°, for neither 51° nor 55° will even approximately furnish the revenue strengths on this basis; then since, as the illustrations abundantly demonstrate, the lower the temperature the greater the strength, at all temperatures below 60° the selected strengths appropriate to 60° would be less than the actual strengths at those temperatures. At all temperatures below 60°, therefore, the Revenue would incur a loss, which would amount to 150,000*l.* per annum, or over 50,000*l.* in excess of my estimate; and this loss would be also inflicted in a proportionate degree upon the wholesale dealer and manufacturer.

THE EXAMINATION OF COMMERCIAL CARBOLIC ACID AND OF DISINFECTANT POWDERS MADE THEREFROM.

BY ROWLAND WILLIAMS, F.I.C., F.C.S.

According to my experience, most of the so-called commercial carbolic acid contains very little real phenol, but consists mainly of cresylic acid and still higher homologues.

Cresylic acid is said, however, to possess even greater antiseptic properties than carbolic acid, and may, therefore, be used in the place of the latter for all ordinary sanitary purposes.

As no uniform method of examining the carbolic acid liquids and powders employed for disinfectant purposes seems to exist, I thought it might lead to good results if I brought this subject before the Society of Chemical Industry, by promoting a discussion among manufacturers, analysts, and others interested in the matter.

Commercial Carbolic Acid.—The specific gravity of this article generally lies between 1·04 and 1·05.

Useful information is frequently obtained by fractional distillation of a measured quantity of the sample, and observation of the boiling point, specific gravity, and other properties of the different fractions.

Mr. Charles Lowe, the well-known manufacturer of pure and commercial carbolic acid preparations, recommends that 1,000 grains measure of the sample should be distilled from a retort without any special condensing arrangement. After the water has come over, 10 per cent. by volume of the succeeding oily fluid is collected; then the receiver is changed and the distillation continued until 625 fluid grains of anhydrous acid have passed over. What remains in the retort consists essentially of cresylic acid and higher homologues of carbolic acid. The 62·5 per cent. fraction, which contains varying amounts of carbolic and cresylic acids, is further examined as to its solidifying point.

This process is, I imagine, chiefly applicable to the better qualities of liquid carbolic acid, but is also useful in many cases with the ordinary commercial acid, especially as regards the determination of water.

Neutral tar oils may be detected and estimated with a fair degree of accuracy by shaking a measured quantity of the sample with twice its volume of a 10 per cent. caustic soda solution in a graduated tube. In the absence of tar oils a perfectly clear solution is obtained, but if present their percentage is indicated by the proportion of liquid insoluble in the alkaline solution.

The amount of water varies considerably in different samples, some being practically anhydrous, while others contain comparatively large percentages of water.

Several methods have been proposed for the determination of water in commercial carbolic acid. Bach suggests shaking a measured quantity with half its volume of saturated salt solution.

Muter and De Koningh (Analyst, Vol. 13, page 194) shake with four times its bulk of saturated salt solution and note the decrease in volume of the carbolic acid. Muter and De Koningh also state that excess of water may be ascertained by agitating a measured quantity of the sample with three times its volume of benzol, when it should dissolve to a clear solution if there be no such excess. I have tried all these methods and find them to be quite unreliable and misleading.

In order to test their value I carefully prepared three liquids in the following manner:—

First.—To some recently distilled anhydrous cresylic acid 5·8 per cent. of water was added.

Second.—6 per cent. of water was introduced into a mixture of pure carbolic and cresylic acids.

Third.—To a similar mixture 3·8 per cent. of water was added.

These preparations were then submitted to the salt and benzol tests, and also to the simple distillation test already referred to, when the following results were obtained:—

——	Salt.	Benzol.	Distillation.
	Per Cent.		Per Cent.
First mixture (5·8 per cent. water	1·3	Turbid.	5·1
Second mixture (6 per cent. water	2·0	Turbid.	5·6
Third mixture (3·8 per cent. water	2·5	Clear.	3·5

From these results it will be seen that agitation with salt solution fails to indicate anything like the real percentage of water. It will also be noticed that the mixture containing nearly 4 per cent. of water remained clear when shaken with three times its volume of benzol, and further experiments on this point showed that about 4 per cent. of water is the smallest proportion which can easily be detected by the benzol test. On the other hand, it is somewhat remarkable to find that by simple distillation of the different mixtures from a retort without any special condenser, very fair results were obtained, being on the average about one half per cent. too low.

It is evident, therefore, that the distillation method is the most accurate of the processes at present in use for the determination of water in commercial carbolic acid, and this is the method upon which I myself rely. Commercial carbolic acid sometimes contains rather an objectionable amount of sulphuretted hydrogen, and the attention of the analyst ought always to be directed to this point. If necessary, the percentage may be ascertained by some simple modification of the well-known lead acetate method. Below are given a few of the results which I have obtained during the examination of various samples of commercial carbolic acid:—

——	Original Sp. Gr.	Sp. Gr. of Second Distillate.	Boiling Point of Second Distillate.	Appearance of Second Distillate.	Water.	Tar Oils.	Sulphuretted Hydrogen.
			° F.		Per Cent.	Per Cent.	
Sample No. 1	1·051	..	388	Colourless.	4·6	0·7	Trace.
„ No. 2	1·047	..	385	Faintly yellow.	2·1	Trace.	Large.
„ No. 3	1·045	..	383	„	6·1	1·3	Trace.
„ No. 4	1·046	1·048	383	Colourless.	5·8	None.	None.
„ No. 5	1·050	1·052	365	„	1·7	..	„
„ No. 6	1·048	1·049	381	„	3·0	„	Trace.
„ No. 7	1·036	1·038	389	Faintly pink.	Trace.	..	Moderate.
„ No. 8	1·044	1·046	383	Faintly yellow.	„	..	Large.
„ No. 9	1·041	1·041	385	„	1·3	„	..

Carbolic Acid Powders.—In the case of powders, the basis of which is silica, or some similar substance incapable of combining with carbolic or cresylic acids, the percentage of tar acids is, I believe, usually determined by the majority of chemists by distillation of a weighed quantity of the sample in a dry retort without any special condensing arrangement. This process gives fairly accurate results, generally rather too low, however, owing to loss either by decomposition, or by imperfect condensation of the acid, or by both. Moreover, the distillation method, besides being of a somewhat crude character, is decidedly inconvenient for use in laboratories where a considerable number of samples of carbolic powder have to be simultaneously examined. On this account, for the last year or two, I have endeavoured to devise some simple process which would yield accurate results, and be applicable to a large number of samples at the same time.

My first experiments were directed to the extraction of the tar acids from disinfectant powders by means of suitable volatile liquids, such as ether and alcohol, with subsequent evaporation of the solvents at the lowest possible temperature, but, although the greatest care was taken, more or less of the acid was invariably dissipated, even at the gentle heat employed during the process. I next turned my attention to some body capable of combining with the tar acids, the solution of which could then presumably be evaporated without any risk of loss. It naturally occurred to me that as soda and potash combined in the desired manner, with formation of the corresponding carbolates and cresylates, caustic soda would be the simplest reagent to employ, and, on making the experiment, I found it to answer the purpose admirably.

Just about the time when I had successfully worked out this process, Muter and De Koningh published the details of a very similar method (Analyst, Vol. 13, page 193), but as their method seems to me unnecessarily elaborate in more than one point, perhaps I may be permitted to describe in full my own simple mode of procedure. I place a fairly large quantity of the sample, say 600 grains, in a stoppered bottle, add 3.000 grains strong alcohol (methylated spirit allowed to stand over carbonate of potash and redistilled is very suitable for the purpose), and digest for an hour or two, with frequent shaking. Then I pass the liquid through a double filter, and transfer two-thirds of the whole to a 10-oz. porcelain basin. Now add 300 grains of a 10 per cent. solution of caustic soda, and evaporate the alkaline liquid until all the alcohol has been driven off and the fluid measures only a few hundred grains. Transfer to a long narrow tube capable of holding 1,000 grains, and very carefully graduated into 500 divisions. If the alkaline solution is at all turbid it must be filtered and again concentrated, previous to being transferred to the graduated tube.

One hundred grains of strong hydrochloric acid are next added and the liquid then saturated with common salt. After mixing well and allowing to cool to 60° Fahrenheit, the volume of tar acids may be read off with considerable accuracy. As the specific gravity of these acids usually lies between 1·04 and 1·05, I ascertain their approximate weight by adding on one-twentieth to the volume. For example, if 400 grains of a 15 per cent. carbolic powder has yielded 56 grains measure of tar acids, the exact percentage will be $\frac{56 + 2{\cdot}8}{4} = 14{\cdot}7$ per cent. I always examine the separated tar acids still further by shaking with twice their volume of a 10 per cent. soda solution, and noting whether they dissolve to a perfectly clear fluid.

In cases where the tar acids exist in combination—with lime, for instance—the process requires a slight modification, which an experienced analyst can easily carry out.

I may mention that I have proved the essential accuracy of the above process by experiments on two samples of carbolic powder, respectively containing 15 and 20 per cent. of tar acids, which had been most carefully prepared in my laboratory. The results were as follows:—

	Added.	Found.
	Per Cent.	Per Cent.
Sample No. 1	15	14·8
„ No. 2	20	20·0

These figures show that the process may be relied upon, while for simplicity and comparative rapidity it leaves nothing to be desired.

DISCUSSION.

Mr. J. Carter Bell said he had had some experience in the examination of carbolic acid disinfecting powders. The process which he adopted for determining the amount of free carbolic acid contained in disinfecting powders was that instead of using a glass retort he used a small conical copper vessel, suggested to him by Mr. George E. Davis, and into this he placed 50 grms. of the powder which had silica for its base, and distilled according to the directions given by Messrs. F. C. Calvert and Co. some years ago, which were as follows:—"Weigh 1,000 grains of powder and place it in a small tubulated retort. Heat the retort gradually, until the liquid distillate ceases to drop (a brisk heat is required towards the end of the operation). Collect the distillate, which will condense in the tube of the retort, in a graduated cylinder grain measure, and allow it to settle for one hour, when the amount of oily liquid and water may be read off. The oily liquid should represent the amount of carbolic acid; and, to determine if it consists of carbolic acid, to one volume of it add two volumes of a solution of pure caustic soda, 14° Twaddell's hydrometer, temp. 60° Fah., which will entirely dissolve the carbolic acid. If any remains undissolved, it will probably consist of either heavy or light oil of tar, the most frequent adulterants of carbolic acid, and in some cases entirely substituting it. The above process will, if carefully worked, give within ½ per cent. of the amount of carbolic acid really contained by the powder."

Mr. Watson Smith said he had been connected with a tar distillery for some years, and knew something of the way in which crude carbolic acids were analysed and valued. The method in this case bore considerable analogy as to purpose, to the old method of assaying copper by the dry method in Swansea and Redruth, in so far as it was intended to be a method representing the practical yield of useful product that could be gained in the manufacture, in this case of white crystallised carbolic acid. This method was agreed upon and entered in the contracts, as he well remembered. In such a case, and similar cases, a method giving with scientific accuracy the precise amount of phenol present, might be but of secondary value, and those who based accusations against the *bonâ fides* of manufacturers in such cases as these, simply did not know what they were talking about.

Mr. Thomson said he should like to know whether Mr. Williams had made any test with regard to the use of bromine water as a precipitant for carbolic and cresylic acids, as this reagent might possiby be used for the estimation of these substances. In reply to Mr. Carter Bell he believed there never were any disinfecting powders which contained anything more than a very small quantity of carbolic acid. Carbolic acid is much more valuable than cresylic acid. The latter is also a better antiseptic for the ordinary putrefactive organisms, but it has a much more objectionable smell, and it is cresylic acid which is generally employed for the manufacture of carbolic acid powders.

Mr. Williams in reply said he had not made any special experiments on the antiseptic properties of cresylic acid as compared with carbolic. In either the "British Medical Journal" or the "Lancet" there was recently a paper on the subject in which it was stated that cresylic acid is decidedly superior in this respect. In reply to Mr. Thomson he had occasionally tried the bromine process, but had not obtained good results by its use. With regard to Mr. Bell's remarks, although the distillation method for determination of the tar acids in disinfectant powders might answer for one or two samples, he was certain that the alcohol extraction process which he had described would be found more convenient in the case of a large number of samples.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Second Meeting of the Session was held in the Rooms, 14, St. Andrew Street, Edinburgh, on Wednesday, 5th December 1888.

PROFESSOR CRUM BROWN, D.SC., F.R.S., IN THE CHAIR.

ON THE DETECTION AND ESTIMATION OF CAUSTIC ALKALI IN PRESENCE OF ALKALINE CARBONATES.

BY LEONARD DOBBIN, PH.D., F.R.S.E.

It is well known that Nessler's test for ammonia depends upon the action of free ammonia upon the double potassium and mercuric iodide in alkaline solution. As Nessler's reagent contains a large quantity of caustic potash, it is immaterial whether the liquid to be tested contains free ammonia or ammonium salt (as the latter yields free ammonia by the action of the caustic potash), always provided that the solution be dilute, because the formation of the characteristic colouration is entirely prevented by the presence of ammonium salts in any considerable quantity. It is not generally known, however, that the alkalinity must be due to the presence of alkaline hydrate, and not of alkaline carbonate. Thus a solution of the double iodide prepared in the usual way and mixed with even a large quantity of solution of sodium carbonate remains quite colourless on the addition of ammonium chloride; whilst an abundant brown precipitate is produced on the addition to this mixture of a few drops of caustic potash solution or of lime water. As no reference could be found to a method of estimation of caustic alkali in presence of carbonate based upon this difference of behaviour, the point was considered worthy of investigation.

A testing reagent was prepared by dissolving about 5 grms. of potassium iodide in water, adding mercuric chloride until a permanent precipitate was just produced, then adding 1·3375 grm. of ammonium chloride, and making up to one litre. On keeping, a small quantity of red precipitate settled to the bottom. This solution was prepared, as indicated, with a known weight of ammonium chloride for a particular purpose. It is believed that a solution containing about 1 grm. of ammonium chloride per litre is a very suitable one to employ. The reagent gave no colouration or precipitate on addition of sodium or potassium carbonate, but it formed a delicate test for caustic alkali when used in a particular manner. It was found that caustic potash did not produce any colouration in the liquid until a sufficient quantity had been added to convert the whole of the ammonium chloride present into potassium salt and free ammonia (at least KOH for every NH_4Cl), the reason for this probably being the ready solubility of the well-known brown precipitate in solution of ammonium chloride. The test can, however, be made one of very great delicacy by using a reagent containing only a very small proportion of ammonium chloride.

An endeavour was made to estimate the quantity of caustic alkali contained in a solution by adding the latter to an iodide solution containing a known quantity of ammonium chloride, until a permanent yellow colour was just established. Although the mean of a series of very carefully made trials gave a result which very closely corresponded with the known strength of alkali solution (NH_4Cl requiring NaOH), yet the difficulty of noting the exact point at which a yellow colouration, permanent for a few minutes, was established, was so great as to render the method practically unworkable. Under these circumstances it was considered worth trying whether a method of quantitative estimation by comparison of intensity of colour could be worked out, analogous to that employed in estimating ammonia in dilute solution by means of Nessler's reagent. For this purpose a standard solution of caustic soda free from carbonate was prepared by adding a weighed quantity (2·5963 grms. of sodium to recently boiled and cooled distilled water, and making up to 1 litre of liquid. Then into each of a number of narrow flat-bottomed tubes (smaller than those usually employed for performing Nessler's test) quantities of this caustic soda solution were put differing from each other by 0·1 cc., and so chosen as to range on both sides of and include the quantity necessary to produce the most suitable colour for comparison. To each of these 5 cc. of the standard ammonium chloride and double iodide solution was then rapidly added and the liquids thoroughly mixed. By proceeding in this way a yellow colouration only was obtained, and the formation of a precipitate was avoided except when the excess of solution of alkali was considerable. After standing for not longer than two or three minutes the colours were examined and a suitable one chosen, the absence of precipitate being carefully attended to. The quantity of caustic soda necessary to produce this intensity of colour was easily calculated. By proceeding afterwards to produce the same intensity of colour when using a solution of unknown strength, the strength of the latter could be estimated. Care was taken that the total volume of liquid in each tube should be the same, and tubes of as nearly as possible uniform diameter were employed. It was found in this way that the quantity of caustic alkali in a solution could be estimated rapidly and with a high degree of accuracy, which was not in the least interfered with by the presence of alkaline carbonates or sulphates. It was found best to use the solutions to be tested very dilute, and care must be taken to avoid the formation of any precipitate when comparing tints. It was ascertained that the quantity of caustic alkali required to produce the same intensity of colour in solutions containing the same quantity of ammonium chloride varied appreciably although only very slightly with the quantity of double iodide present, more being required when the quantity of the latter was greater.

The method is, unfortunately, not applicable to solutions which contain sulphide, as the darkening due to the formation of mercuric sulphide interferes with the yellow colouration. For use as a qualitative test for caustic alkali a very delicate reagent may be prepared in a few minutes by simply taking a small quantity of solution of mercuric chloride, adding potassium iodide until the red precipitate just redissolves, and then adding a drop of ammonium chloride solution.

DISCUSSION.

Mr. Tatlock said the subject of indicators for use in volumetric analysis was a very important one, and of late years there had been before the country, from various sources, the means by which very small quantities of caustic alkalis in presence of large amounts of alkaline carbonates could be determined. Those present were all familiar with the method of Winkler and Thomson for determining small quantities of caustic alkali in presence of large proportions of alkaline carbonate. But it seemed to him that this was a new departure altogether. He was not prepared to hear of any method by which such a minute quantity of caustic potash could be detected and determined in presence of much carbonate without the use of some indicator. This method was not only original but very simple in its application. It looked as if this new departure might turn out exceedingly useful, especially where small proportions were required to be detected. He would ask Dr. Dobbin what was the range of its applicability for determining the proportion of caustic alkali in presence of alkaline carbonate, where the former existed to the extent of, say, from 1 to 2 per cent.

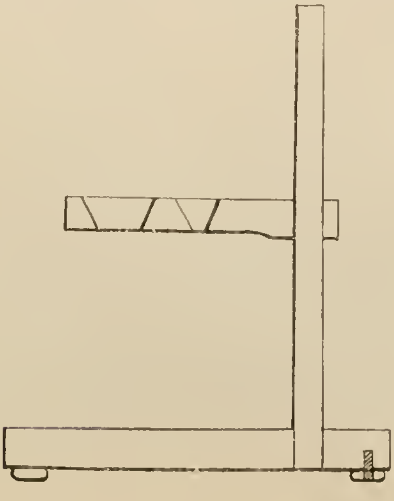
Dr. Dobbin, in reply, said that the precipitate could not be formed until the whole of the ammonium salt had been converted into free ammonia. He did not think that the solubility of the precipitate in ammonium chloride solution sufficiently explained the prevention of the reaction. In regard to Mr. Tatlock's question as to the determination of 1 to 2 per cent. of caustic alkali in carbonate, he had experimented with a small quantity of caustic in presence of much carbonate, but had been unable to detect any difference in the reaction. He made a standard solution of caustic soda, and mixed it with greatly varying quantities of carbonate, but did not find this to affect the coloration. He might say, however, that as a quantitative test he did not think it superior to many other tests that had been suggested, but as a qualitative test, the presence of caustic alkali can be found out very rapidly.

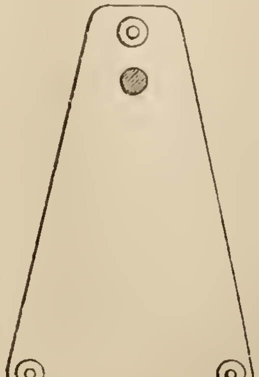
NOTE ON FILTER-STANDS.

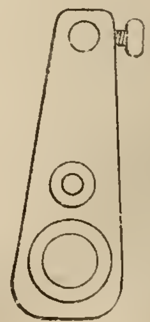
BY D. B. DOTT, F.R.S.E., F.I.C.

While great improvements have been effected on the finer kinds of laboratory apparatus within the past few years, and instruments of precision have been carried to great perfection, the simpler yet essential appliances have been rather neglected. Among these latter may be counted filter-stands. As ordinarily constructed, they have three principal defects. Firstly, they are made to stand on a flat wooden base, or, what amounts to the same thing, they are made to stand on four feet. Whence it results, either from an original defect in the workmanship or, more often, from the wood having warped, that the apparatus stands unsteadily. With such a filter-stand one frequently finds that just as the filter is being filled, on account of the alteration in the centre of gravity of the system, there is a sudden jerk, by which some of the liquid is thrown up on the sides of the funnel; and generally there are all the inconveniences of a shaky piece of apparatus. Secondly, the opening in the arm for the support of the funnel is always either too large for small funnels or too small for large funnels. Thirdly, the openings are rarely made at the proper angle of 60°, but are more often simply cut straight through, with perpendicular sides, the result being that the funnel has a tendency to fall to one side.

The filter-stand before you has been devised to remedy these defects. As is done with optical instruments, it is made to stand on three feet to ensure steadiness. Stability can never be relied on in a four-footed instrument, as even although it is truly made, the least irregularity in the table will render it unsteady. The arm has been pierced with two holes, so as to make it suitable for both large and small funnels, and the bevelling of the holes has been done as nearly as possible at the correct angle. Filter-stands should never be varnished. The tendency of varnish is to cause the moveable parts to become fixed, and it is besides acted upon by many of the solutions in constant use. The best plan is to rub over all wooden apparatus with a little boiled linseed oil, which sufficiently preserves the wood, and renders it non-absorbent.







DISCUSSION.

Mr. Beilby thought that for funnels of any considerable size it would be a great advantage to have the support counterbalanced, so that it could be more easily moved up and down.

Professor Crum Brown said that everybody who was a disciple of Sir William Thomson knew the benefit of having three legs for a support of anything, but it was surprising how slow such a theory found its way into practical use, and he felt indebted to Mr. Dott for reminding him of it. As Mr. Dott had said, his communication was short, but it was none the less welcome, for it was just from such practical matters as this which Mr. Dott had brought up, that much was to be learned.

Newcastle Section.

Chairman: T. W. Stuart.

Vice-Chairman: P. P. Bedson.

Committee:

Alfred Allhusen.
G. T. France.
G. Gatheral.
John Glover.
T. W. Lovibond.
John Pattinson.
H. R. Procter.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
C. H. Ridsdale.
J. E. Stead.

Hon. Local Secretary and Treasurer:
J. T. Dunn, The School, Gateshead.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the Durham College of Science, Thursday, December 6th, 1888.

MR. T. W. STUART IN THE CHAIR.

INFORMAL COMMUNICATIONS.

Mr. T. W. Lovibond made a communication on a rapid method of determining the amount of inversion in solutions of invert sugar adapted for use by brewers. He said that the problem had only of late years become of great importance to brewers since they had begun to invert their own sugars. As long as they purchased invert sugar from a good firm they could rely on a satisfactory inversion.

The old plan of testing by Fehling's copper solution is lengthy, tedious, and, excepting in skilled hands, most inaccurate. For a long time past he had used the polarimeter for this purpose, first a cheap transition tint instrument made by Zeiss, and latterly Bayley's shadow instrument, made by Field, of Birmingham, and brought before the notice of the London Section by Mr. Heron in November last. His rapid method, adapted for practical daily use in the brewery rather than for obtaining the greatest accuracy, is to take the specific gravity by means of a good saccharometer, dilute to a density of 1038·6, corresponding to 10 per cent. of sugar in solution, and examine in the polarimeter. As a 10 per cent. solution is taken, the specific rotation is obtained by multiplying the observed angle by five, but when solutions of other densities are employed, the ordinary formula must be used. The amount of inversion is easily obtained from the specific rotation by ascertaining how far this differs from the specific rotation of cane sugar on the one hand and invert sugar on the other. Mr. Lovibond exhibited the process of decolourising a dark sugar solution, using basic acetate of lead, sodium sulphite, and alumina cream in small quantities. When the sugar is inverted by the acid process there is no difficulty in filtering out the precipitate, but when Tompson's inversion process, by means of yeast, is employed, this is practically impossible. In this case it is better to add a few drops of tannin solution and a few drops of common finings (isinglass), when all turbidity will quickly subside and the clear solution can be decanted or drawn off by means of a pipette. He said that this method of examining invert sugar solutions could be applied in from 15 to 30 minutes.

After some questions had been asked and answered and the working of the instrument had been examined by the members, a vote of thanks was passed to Mr. Lovibond for his interesting demonstration.

* * *

Obituary.

JOSEPH JAMES COLEMAN, F.R.S.E., F.I.C., F.C.S.

CHAIRMAN OF THE GLASGOW AND SCOTTISH SECTION.

The present session of the Scottish Section will carry sad memories with it, for while the members of the Section are still grieving over the recent death of Dr. Wallace, a new sorrow has come to them in the decease of their esteemed Chairman, Mr. J. J. Coleman, which occurred at Bearsden, near Glasgow, on the 18th of December.

Mr. Coleman, who was born in 1838, was the son of a pharmaceutical chemist of Lincolnshire, but was left fatherless when about ten years of age. In the course of the next few years he became connected with a business of the same kind as his father's in the town of Halifax, and being naturally of a studious and scientific turn of mind, he attended several classes in the Mechanics' Institution of that town, and received high awards of merit for his proficiency in chemistry and other branches of science. He soon gave evidence of scientific attainments of a high order, for at the Oxford meeting of the British Association (in 1860) he communicated two papers to the Chemical Section, one of which, dealing with important relationships between the atomic weights and volumes of the elements, was honoured with a place in the "Proceedings" for that year. This seems to have influenced him in becoming a teacher of science, as he afterwards held for several years the position of science tutor in three leading educational institutions, one of which was the famous training college at Chester, which at that time had the Rev. Dr. Rigg for its principal.

About this time, when the manufacture of paraffin oil in Scotland had become a pronounced success in the hands of the late Dr. James Young, there was discovered in Flintshire, not far from Chester, a rich bituminous material, which under suitable treatment was found to yield the same products as the Boghead coal worked at Bathgate, and Mr. Coleman left Chester to erect and manage a work for the manufacture of mineral oil in Flintshire. News of his skill soon reached Glasgow, and the directors of Young's Paraffin and Mineral Oil Company offered him a post in their service as an expert to carry out experimental investigations, in the hope that some of their "waste-products" might be turned to profitable account, and that certain of their marketable products might be made more remunerative. He accepted the post, and was not long in showing his employers that they had been fortunate in their choice. As an example of the numerous improvements he devised, it may be mentioned that he showed that the uncondensed gases produced in the distillation of bituminous shale were, when subjected to great pressure and low temperature, capable of yielding highly volatile liquid hydrocarbons, having great solvent power for many substances, and serviceable for producing illuminating gas when ordinary coal gas was not obtainable. He also turned his attention to the improvement of lubricants, and again with marked success.

In dealing with the uncondensed gases from the shale retorts, Mr. Coleman invented a machine for producing the necessary low temperature and great pressure by mechanical means. This invention led to the development of a close intimacy between himself and Sir William Thomson, who has always been quick to appreciate new departures in physics and mechanics, and a result of this intimacy was that Mr. Coleman was consulted by Mr. James Bell, of Glasgow, the well-known shipowner and importer of fresh meat from the United States. The method of refrigerating fresh meat in the holds of the Atlantic steamers by circulating through the meat-chambers air cooled by passing over extensive surfaces of block ice was expensive and occasionally very inefficient, and Mr. Coleman was requested to devise some thoroughly efficient means of mechanical refrigeration. He eagerly entered into the spirit of Mr. Bell's suggestion, and in order that he might devote his undivided attention to the solution of the problem, he quitted the service of Young's Company. Before long the problem was solved, and some ten years ago the first Bell-Coleman mechanical dry-air refrigerator was fitted up in one of the Anchor Line steamships; while very soon after many of the other vessels of the same line were also supplied with refrigerators. In a few years the demand for these refrigerators became very great, and the Bell-Coleman Company supplied a large number of machines.

About four years ago Mr. Coleman retired from active business pursuits, and settled down at Bearsden, in the vicinity of Glasgow, where he built, in connexion with his residence, a spacious laboratory, which was eventually equipped in a way unequalled in any other private laboratory in Scotland. Here it was his intention to carry on original investigations in chemical and physical science, and so long as constitutional delicacy would allow him he did some excellent work, the results of which were in most cases communicated to various learned societies. A highly important portion of this work was done in conjunction with his intimate friend Professor McKendrick. Mr. Coleman was for nearly 20 years an active and efficient member, and for some time a vice-president, of the Philosophical Society of Glasgow, in whose "Proceedings" there are numerous valuable papers of his authorship. To the Institution of Engineers and Shipbuilders in Scotland, and to the Royal Society of Edinburgh—with both of which he was connected—to the "Philosophical Magazine," and to the British Association he also contributed papers, and a memoir on "Dry-air Refrigerating Machinery and its Applications," which he communicated to the Institution of Civil Engineers five or six years ago, brought him one of the highest awards in the gift of the Institution. On the formation of the Scottish Section of our Society, Mr. Coleman was chosen Hon. Treasurer, which post he continued to occupy until April 1887, when he was unanimously elected Chairman of the Section. While the delicate state of his health prevented him from taking always that active part in the promotion of the welfare of the Section and the Society which, it was his most earnest desire to assume, he contributed several valuable papers to the Journal, and all the past and present office-bearers of the Section can testify to the advantage derived from his advice and his hearty co-operation in every movement tending to develop the usefulness of the Society. He was also one of the Governors of the Glasgow and West of Scotland Technical College, and took the keenest interest in the question of technical education for chemists.

Mr. Coleman for long suffered from a complication of ailments, the most exhausting of which was chronic asthma; but his true scientific enthusiasm enabled him to persevere in his investigations at all costs, and in the fifty short years of his life he has done scientific work which will be remembered by succeeding generations. For some time before his death he was almost entirely confined to the house, and it was a source of keen regret to him that he was not able to be present at the annual meeting of the Society in Glasgow this year, after doing all in his power to ensure the success of the meeting. Possessed of a most original and highly-cultured mind, and gifted with the true spirit of the investigator, Mr. Coleman was a man of modest and retiring disposition, and his kind-heartedness and amiability brought him many warm friends.—G. G. H.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Corrosion of Sheet-iron. Muck. Chem. Zeit. **12**, 1299—1300.

Small growths are mentioned as having occurred in a boiler for three-fourths its length from the feed-pipe. They consisted chiefly of oxide of iron and contained also lime, magnesia, silica, sulphuric acid, and carbonic acid. The plates were in these places eaten to a depth of 2 mm.

The gases dissolved in the water are supposed to influence the formation, seeing that it occurs where the water is coolest, whereas in those places where the water has lost its air no such corrosion takes place.—T. L. B.

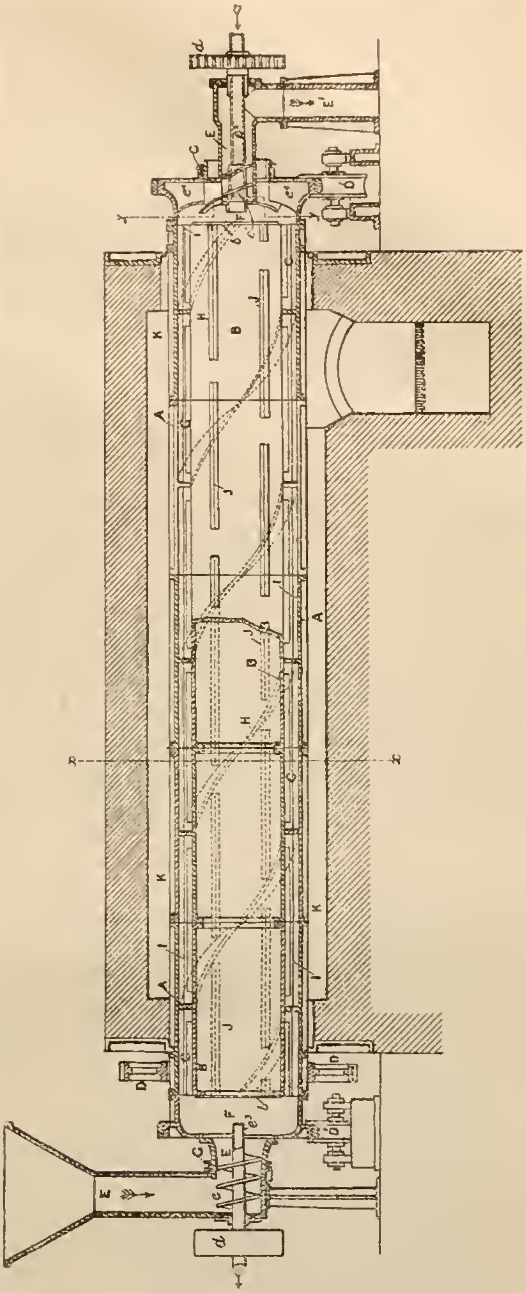
PATENTS.

Improvements in Filters. P. Everitt, London. Eng. Pat. 9606, July 7, 1887. 8*d*.

The filter consists of a cylindrical porcelain or earthenware receiver, in which is suspended an annular, conical, porous vessel, with the space packed with charcoal or carbon. An outlet pipe at the base of this inner vessel conducts the filtered water, passing through into the interior of the filtering cell, to the outside of the receiver, where it may be drawn off as required.—C. C. H.

Improvements in Apparatus for Treating Solids by Gases, also applicable to other purposes. L. Mond, Northwich. Eng. Pat. 10,957, August 10, 1887. 8*d*.

This invention will be more readily comprehended by reference to the accompanying drawing. A is a cylinder carrying in its interior a concentric cylinder B, closed at both ends, forming with A an annular space C. The cylinders so connected are enclosed in a furnace K, and the projecting ends formed into a curb resting on rollers D^1, D^1, and driven by a spur wheel D or other suitable device. The hopper E, with suitable conveyor *e*, driven by pulley *d*, introduces the solid material, which, after its passage through the apparatus, is removed by the conveyor e^1 and outlet E^1. The gas to be used enters the apparatus at F, through the hollow conveyor e^2, traversing the apparatus in a direction contrary to that of the solid, and leaving at F^1, through the conveyor e^3. In order to secure intimate and continued contact of the solid and the gas, the interior of the cylinder A is provided with helical blades H, and also longitudinal ribs I, forming buckets on the outer cylinder A, as well as other ribs on the exterior of the inner cylinder B shown at J. The material lifted by the shelves I is carried to the upper part of the apparatus during a revolution, and then falls to the bottom on to the shelves J, by which it is, on the other side, again lifted, and falls back on to other of the shelves I and so on. The helical blades H increase the length of the path of the solid through the cylinder. The patentee claims the combination of the various parts forming the whole for the purpose substantially as described.—C. C. H.



Improvements in Treating Asbestos to obtain Filter Mats and other Fabrics and Sheets therefrom. C. Jackson, Nottingham. Eng. Pat. 12,179, September 8, 1887. 6*d*.

Finely divided asbestos fibre is projected or blown into a chamber, together with a spray of varnish, *e.g.*, copal varnish or linseed oil. The fibre thus coated subsides on to a travelling belt or apron at the lower part of the chamber. The sheet so formed is lightly pressed, removed, and stoved at a temperature of 300° F. A medium of closer texture can be made by passing the open sheet through heated rollers, or by one or more coatings of varnish and subsequent pressing and stoving.—C. C. H.

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*.	½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*.......	1*d*.
„ 1*s*. 6*d*., „ „ 2*s*. 4*d*.......	1½*d*.
„ 2*s*. 4*d*., „ „ 3*s*. 4*d*.......	2*d*.

Improvements in Centrifugal Apparatus for separating Liquids of different Density or Specific Gravity. H. H. Lake, London. From O. S. Anderson, Copenhagen. Eng. Pat. 14,231, October 19, 1887. 11*d*.

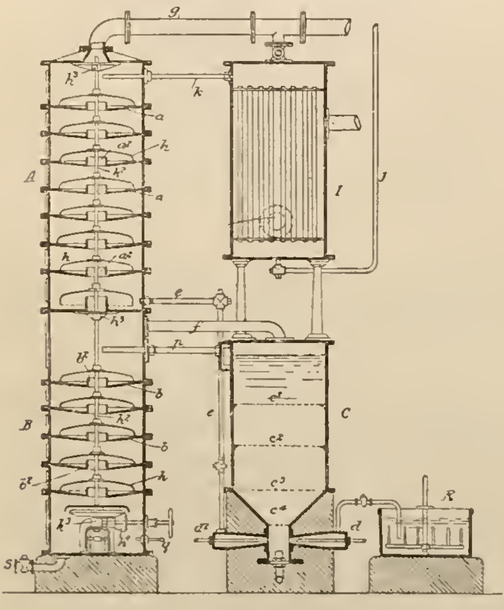
This invention, as applied to the separation of cream from milk, principally includes the use of an inverted steel drum supported on its upper face, and with an opening below, and carried upon a vertical shaft at a point above the highest shaft-bearing. The fresh milk enters the drum through holes in the upper face, whilst the separated cream runs off into the casing below, over the edge of the neck around the opening in the lower part of the drum. The separated milk is scraped up by a specially constructed tube which rotates with the drum, and is dropped into an annular vessel placed within the casing under the drum, whence it is discharged through a spout. The whole can be taken to pieces for cleaning.—B.

Improvements in Distillatory Apparatus for Use in Chemical Operations. W. T. Walker, London. Eng. Pat. 16,805, December 6, 1887. 8*d*.

This invention refers to apparatus in which liquids are evaporated in shallow layers upon steam-heated discs superimposed on each other. The upper surface of each hollow disc is provided with a raised spiral ridge forming a channel leading from the centre to the circumference. The liquid to be evaporated is led on to the first disc near the centre, and travels all around the spiral channel towards the circumference, where a tube allows it to drop on to the next lower disc, on which it travels in a similar channel towards the centre, and the operation is repeated as often as may be required. The discs may be dished in alternate directions to assist the movement of the liquor along the channels, and they are provided each with a large centre hole forming a flue for the escape of the vapours. All discs are fitted with steam and water connexions, and the whole may be enclosed in a non-conducting jacket.—B.

An Improved Apparatus to be used in Chemical Operations where it is required to drive off from Liquids volatile Constituents thereof. W. T. Walker, London. Eng. Pat. 16,806, December 6, 1887. 8*d*.

The apparatus is designed for driving off volatile products from liquor by means of steam brought into direct contact with it, firstly alone, and afterwards in the presence of an agent, such as lime, for instance.



It consists of a first column A, mounted upon and communicating with a second column B, and separate tank C, in which the action of the agent (such as lime) is obtained. This tank C is provided with sieves c^1, c^2, c^3, situated at different elevations, the coarsest being undermost and the finest uppermost for the purpose of preventing the frothing up of the liquor. The lower part c^4 of this tank C is inclined or funnel-shaped, and has opening into it two steam injectors *d* and d^2, by one of which (that at *d*) the lime or other agent from the mixer R is injected, and by the other of which (that at d^2) the liquor which passes by a pipe *e*, leading from the first column A, is injected, so that the liquor and the lime or the like are agitated together, and brought into intimate contact. The upper part of the tank C leads by a pipe *f* into the upper part of the second column B. The first column A has an escape pipe *g* for the steam and vapours to the saturator wherein is contained the acid or other matter; for example, sulphuric acid where the object is to form sulphate of ammonia in treating gas liquors. The first and second columns A and B are divided into chambers by the plates *a* and *b*, each provided with central short pipes a^2 and b^2 for the steam to rise through, and serving also as overflow pipes for the liquor to flow down from chamber to chamber. The pipes a^2, b^2, are covered by hoods *h* for causing the steam to pass through the liquors, and these hoods are all fastened to a vertical shaft or rod h^2, passing down through both columns and mounted in bearings h^3, so that it, with the hoods *h* affixed, can be lifted or lowered in order to vary the openings which the hoods present for the passage of the steam and gases, or so that the said rod and hoods can be rotated by means of gear wheels as at h^4, and thus any obstruction can be cleared away or prevented. The tank C, in which the lime or other agent acts, supports a tubular heater I, through which the liquor passes on its way to the first column A by the pipe *k*. The liquors thus passed into the first column A meet the steam rising direct through, and then pass by the pipe *e*, and are forced by the injector d^2 into the lower part of the tank C, into which lime or other agent is at the same time forced from the lime mixer R by means of the other ejector *d*, so that the liquors and the lime or the like are brought into intimate contact. The steam and gases pass by the pipe *f* from the top of the tank C into the upper part of the second column B, and thence ascend through the first column A on their way to the outlet from the first column to the saturator. The liquors overflow from the tank C, and pass by the pipe *p* into the second column B, into the lower part of which steam is admitted by the pipe *q*, and this steam with the gases separated in the second column pass up through the first column also on their way to the outlet. The liquors from which the volatile products have been expelled pass off by the outlet *s*.—B.

Improvements in Apparatus for separating Liquids from Solid Matters suspended therein. J. S. Sawrey and H. Collet, London. Eng. Pat. 17,712, December 24, 1887. 8*d*.

This arrangement refers to tanks fitted with numbers of sloping and perforated partitions, along which the liquid is made to travel in alternate directions, the deposit being drawn off at the bottom.—B.

Improvements in or relating to Filter Presses. L. Gismondi, Marseilles, France. Eng. Pat. 1921, February 8, 1888. 8*d*.

The improved filter press resembles an ordinary hydraulic packing press. Fluted and perforated plates rest on the table above the ram, and on these the material to be pressed is placed, enclosed in telescopic frames fitting into each other. The fixed head forms a receiver, through which the material is introduced into the frames before mentioned.

—C. C. H.

Improvements in Receptacles for Liquid Carbonic Acid and for other Fluids under Pressure. A. Knoop, Minden, Germany. Eng. Pat. 7559, May 23, 1888. 6*d*.

The nature of the improvements is shown in the accompanying figures, which represent one modification of the improved construction of the vessels used for the purposes specified. The ends of such receptacles are stayed by tubes running from end to end, which likewise serve for the conveyance of the heat required for the vapourisation of the liquid.
—C. C. H.

Fig. 1.

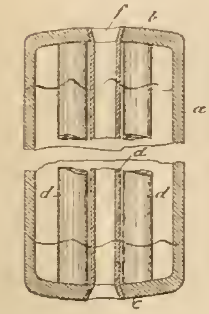
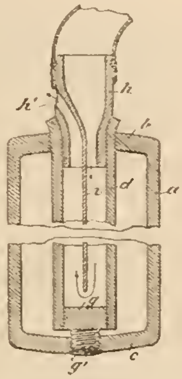
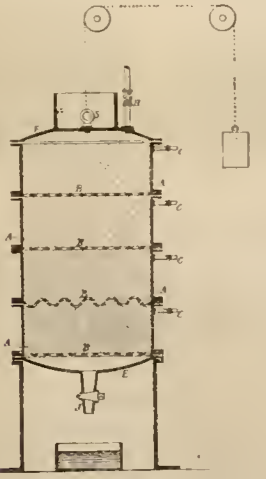


Fig. 2.



Method and Apparatus for Washing or Treating with Liquids Granular Substances or Substances in a state of Magma. C. D. Abel, London. From Langen and Hundhausen, Grevenbroich, Germany. Eng. Pat. 10,655, July 23, 1888.



A number of vessels A with perforated bottoms B, which may be corrugated, are superposed on each other on a base E, and closed by a cover F, and a testing-cock C is fitted to each section. Each vessel is filled with the crystal or magma to be operated on, and the washing liquid is introduced through H, and passes down the column, finding an exit at J. When the upper vessel has been sufficiently washed air is blown through the column from the top, displacing the liquid into the lower sections; the upper sections are removed, and another introduced at the bottom of the series and the washing resumed, and so on, each section arriving at the top for its final washing.—C. C. H.

Improvements in and relating to Filtering Apparatus. C. J. Bühring, Hamburg, Germany. Eng. Pat. 3848, March 14, 1887. Amended August 14, 1888. 8*d*.

(This Journal, 1887, 813.) The emendation consists in the deletion of the second claim, viz.:—That relating to the three-way cock.—C. C. H.

Improved Means to be Employed in the Purification of Water and other Liquids, and the Preparation and Treatment of Materials therefor. C. J. Bühring, Hamburg, Germany. Eng. Pat. 7619, May 25, 1887. Amended August 14, 1888. 6*d*.

Animal charcoal is deprived of its mineral constituents by washing first with acid and afterwards with distilled water; it is then mixed with liquid glue into a paste and spread in layers on sheets of woven asbestos previously heated. After the sheets have been subjected to hydraulic pressure, they are heated in a closed furnace out of contact with air, and the sheets so obtained used for the purpose of water filtration.

The second claim is now withdrawn:—"The treatment and purification of charcoal substantially as and for the purpose herein-before described."—C. C. H.

Improvements in Apparatus for the Filtration of Liquids. R. Pol, Heidelberg, Germany. Eng. Pat. 16,054, November 22, 1888. 8*d*.

The apparatus consists of a cylindrical tank or vessel containing shelves, the space between which is tightly packed with asbestos fibre; the lower part of the vessel forms a reservoir for the filtered liquid. A dished plate carries on a nozzle a silk gauze bag which serves to arrest the finest particles of solid matter.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Improvements in Coke Ovens. Dingl. Polyt. J. **270**, 1—11.

The oven devised by Bauer has been introduced at Le Creusot Works. The accompanying drawings (Figs. 1 and 2) will show the construction of an oven such as would be used for an ordinary bituminous coal. The coking spaces are arranged radially around a central shaft, the products of distillation are drawn off and pssscd through the condensing plant, and the residual gases brought back, passed under the oven up through a heated brickwork chamber in the centre of the oven into horizontal flues running at the sides of the coking spaces. Here they are burnt by a current of air which has also been heated by being drawn through heated spaces in the inner ring of the oven between the coking spaces and the above chamber. For a semi-bituminous coal the ovens are built much higher, with narrower coking spaces, and higher still for coals which are but little bituminous. It is possible to obtain a good coke by this system from a mixture of 50 per cent. of anthracite and 50 per cent. of caking coal, and to collect sufficient tar from the volatile products to pay the working cost, the same mixture in the older types giving a bad coke and no tar. At Le Creusot works a mixture of 50 to 55 per cent. of anthracite and 50 to 45 per cent. of semi-bituminous coal is employed, and the coke obtained contains 92 per cent. of large coke, 4 per cent. of coke smalls, and 4 per cent. of fines and dust.

In the horizontal form of oven designed by Quaglio, the vertical chambers between the coking spaces are not separated, as in the ordinary way, into a number of channels, but are perfectly free for their whole length, except for the supports passing from one wall horizontally to the other. There being a number of these present, the flame is split up by them, and an equal distribution of heat produced.

Fig. 1.

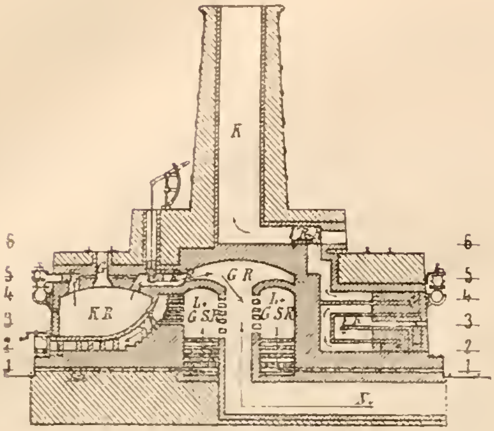


Fig. 2.

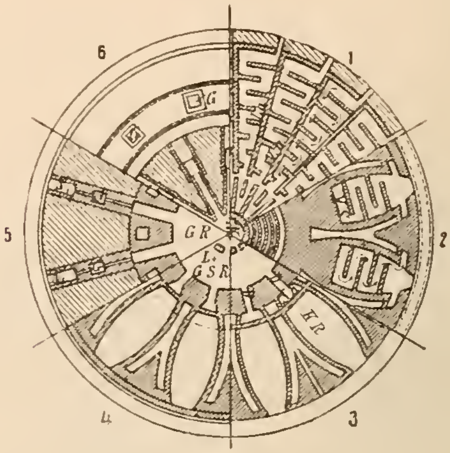


Fig. 3.

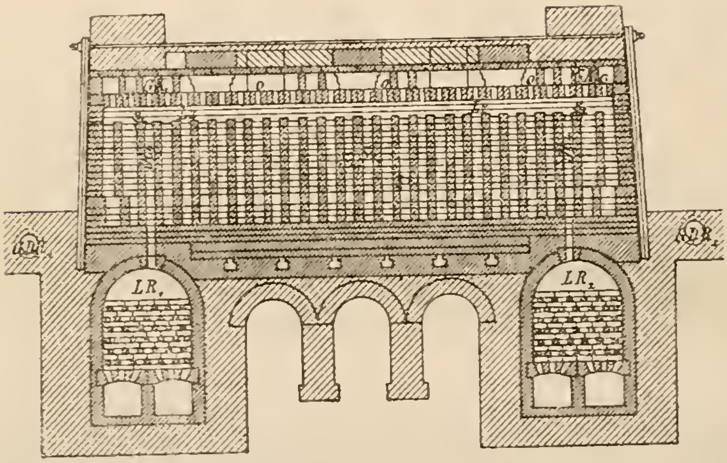
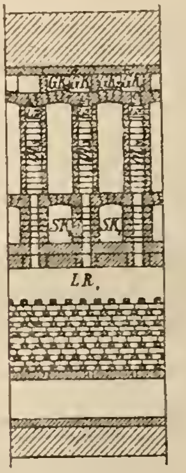


Fig. 4.



A new form of Otto oven with regenerative chambers (Figs. 3 and 4) is also described, in which arrangements are introduced to enable the temperature to be increased at will at any part where the working of the oven would appear to render such increase of temperature necessary. The drawings fully explain the principle of these ovens.

Other forms of ovens are those of Röchling, Herberz, and Rose. Herberz superheats the air used for the combustion of the gaseous products in channels or tubular conduits placed above the coking spaces, the heat for such purpose being obtained by a separate gas-fire. The Rose oven consists of a series of retorts, and is mainly intended for the distillation of residues, and principally for the purpose of producing tar and oil between the temperatures of 300° C. and 500° C. The apparatus consists of three long tubular retorts, two of them side by side and the third underneath and between them. The material is fed in at one end of the upper retorts from a hopper, and by a mechanical contrivance is kept disintegrated and made to travel to the other end, where it falls down a shoot into the lower and larger retort, where, by a similar arrangement, it is pushed along and ejected at the other end of that. The retorts are heated by the combustion of waste gases or other fuel underneath them. Otto's beehive oven is also shown, where the air supply is heated by passing through chambers built between the rows of ovens in the flues, which chambers are themselves heated by the waste heat of the products of combustion.

With regard to the question whether it pays to collect the by-products in making coke, Otto points out that the oven, combined with the necessary condensation plant, costs from three to four times the amount required for the construction of an ordinary form of oven without condensation plant, so that the increased cost of plant is a matter to be taken into careful consideration.—A. W.

PATENTS.

Improvements in Regenerative Gas Furnaces with Gas Producers. C. D. Abel, London. From F. C. Glaser, Berlin, Germany. Eng. Pat. 109, January 3, 1888. 1s. 1*d*.

The producers (preferably two in number) are built close against the furnace. This preserves the initial heat of the gas, which, after passing through a small cleansing chamber, is mixed with heated air, and burns on the furnace hearth. On each side of the furnace, and below the floor, is a regenerator of the usual kind, which alternately receives heat from the escaping products of combustion and gives it up again to the air-supply, the necessary cocks and valves being provided for reversing the directions of the currents at will. Provision is made for keeping the regenerators hot when the furnace is off work. The way through the furnace can be closed, and the gas (mixed with air) admitted directly to the regenerators. Full drawings are attached.—A. R. D.

An Improvement in Bunsen Burners. O. Imray, London. From C. A. von Welsbach, Vienna, Austria. Eng. Pat. 5722, April 17, 1888. 6*d.*

The object of this invention is to provide a circular Bunsen flame with internal as well as external air-supply. The gas passes first through a thin perforated plate into a cavity provided with lateral openings for the admission of air. The gaseous mixture next travels upwards through a tube expanding in its upper portion to a diameter equal to that of the desired flame. Here is placed wire gauze to promote mixture and distribution. The mingled air and gas finally ascends an annular passage between two tubes, the inner one of which widens outwards towards the top, and is closed at the bottom, except where it communicates with the outside air by a number of small passages crossing the annulus.—A. R. D.

Improvements in Apparatus for Treating Bodies at a High Temperature. A. R. Pechiney, Salindres, France. Eng. Pat. 18,041, May 3, 1888. (Date of first foreign application, November 17, 1887.) 11*d.*

These improvements have reference to the relative movements of the regenerative burner and furnaces described in Eng. Pat. 9225 of 1885 (this Journal, 1886, 471). Instead of having, as there specified, a movable burner to heat successively a series of furnaces, it is now proposed to arrange the furnaces in pairs back to back upon a turntable, so that each may be presented in turn to a practically fixed burner. Or the furnaces may stand apart with the burner situated on a turntable between them. Whichever arrangement be adopted an ordinary fireplace may be substituted for the regenerative burner.—A. R. D.

Improvements in Apparatus for Detecting and Announcing the Presence of Explosive Gases in Mines or other Places. F. Bosshardt, Manchester. From J. Molas, Paris, France. Eng. Pat. 12,313, August 27, 1888. 8*d.*

A very sensitive skin diaphragm carries two light strips of silver foil. Immediately above each strip is a pair of electrical terminals. The construction of the apparatus is such that the increase of pressure due to an accumulation of firedamp, for example, only takes effect on the underside of the diaphragm. This is slightly raised in consequence, and the silver strips, connecting the terminals, establish two electric currents which ring a peal of bells and maintain an incandescent light. The apparatus is said to be sensitive to six parts of explosive gas with 94 parts of atmospheric air.
—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Mineral Matter in Natural Petroleums. J. A. Le Bel. Bull. Soc. Chim. 1888. 359—361.

Until the author, working in conjunction with Müntz, discovered the presence of 11 per cent. of ash in the black colouring matter of an oil of Egyptian origin, this colouring matter (called "asphaltène" by Boussingault) used to be regarded as an oxidised organic compound. In the ash above-mentioned were found iron, lime, and sulphur. Since then Markownikow and Oglobine have found, in the ash of petroleum from Baku, lime, iron, alumina, copper and traces of silver. The first of these may have been taken up from the strata in which the oil found its last resting-place, but the presence of copper and silver would seem to point to a contact, at some time, with strata lower than these. It was in reference to the Baku product that Mendelejew propounded his famous theory that petroleum was formed in the deep strata of the earth by the action of water upon the matter there present, in which case the presence of such metals as iron, copper, and silver, is not remarkable. This hypothesis is further confirmed in the author's opinion by the non-saturated constitution of the hydrocarbons composing the oil, and also by the very frequent presence of sulphur.

An attempt to isolate the "asphaltène" of Russian petroleum was a failure. After concentrating the colouring matter of a litre of residue into a small fraction, and igniting, an amount (12 milligrammes) of ferro-calcic ash was obtained, insufficient for analysis.

From the virgin oil of Fschungnelek, in the Crimea, an "asphaltène" was obtained giving 6 per cent. of an ash so readily fusible as to seem to indicate the presence of silica, but this research was abandoned through want of sufficient material.

The asphaltic limestone of Lobsann contains a bitumen yielding hydrocarbons that very much resemble those of the Russian petroleums in their high specific gravity. The author extracted the powdered limestone with naphtha, evaporated to a small bulk, and precipitated with amyl alcohol. The black resinous matter thus obtained was redissolved in naphtha, again precipitated with the alcohol, and finally washed with ether. The "asphaltène" so obtained yielded 5·4 per cent. of ash containing 13 per cent. of silica, 17 per cent. of oxide of iron, and traces of manganese. The remainder consisted chiefly of lime and sulphate of lime, the large proportion of lime appearing to have been taken up from the calcareous gangue in which the bitumen was found. Here, again, the presence of silica (which cannot be supposed to have been dissolved by the petroleum) is an argument of great weight in favour of Mendelejew's theory. This Lobsann "asphaltène" contains 4·9 per cent. of sulphur, which is sufficient to combine with all the silicium as sulphide.

"Asphaltène" extracted from the natural oil of Colomea in Galicia (analogous to the American petroleums) yields no ash at all. The author thinks that ash containing "asphaltène" is only to be found in those oils which contain non-saturated hydrocarbons.—A. R. D.

PATENTS.

Improvements in Retorts for Use in Making Charcoal or for like Operations. E. R. Cook and J. W. Ingham, London. Eng. Pat. 17,938, December 30, 1887. 8*d.*

This invention consists in fitting vertical or approximately vertical retorts with a moveable false bottom, supported at the required height by a rod capable of passing through the discharge lid or cover. The cover is held in position by a screw and crossbar in the usual way, and the inner end of the screw has a conical head which is turned so that it fits into and tightly closes the aperture in the cover, at the same time forming a rest for the rod supporting the false bottom. When the crossbar is let down the cover falls upon rods or rails suitably placed, while the supporting rod drops through the aperture in the cover and effects the lowering of the false bottom. The improvements simplify the operation of discharging, and provide for the adjustment of the working length of the retort.—A. R. D.

Improvements in the Method of making Charcoal from Peat and other Materials, and at the same time Recovering the Volatile Matters therefrom. W. A. Byrom, London. Eng. Pat. 3310, March 3, 1888. 6*d.*

Previous to distillation the peat is dried by blast-furnace gases in a suitable chamber, and at a temperature not exceeding 212° F. It is then heated in retorts, preferably externally fired, the heating agent consisting in this case of the permanent gases produced by the distillation, together with so much blast-furnace gas as will suffice to keep the temperature in the retorts between 700° and 900° F. The charcoal produced is mixed with a small proportion of the heavy oil obtained from the condensible products of distillation, and moulded into blocks for use in the blast furnace.
—A. R. D.

Improvements in Apparatus for Obtaining Bye Products in the Manufacture of Hard Coke. J. Jameson, Newcastle-on-Tyne. Eng. Pat. 13,329, September 15, 1888. *6d.*

For the horizontal T-irons specified by the inventor in Eng. Pat. 14,551 of 1884 (this Journal, 1885, 669), he now substitutes vertical irons standing in recesses of the brickwork of the false floor of the oven. The irons are to be furnished with a thin mushroom head to keep dust from falling into the gas passages, such head being sunk slightly below the surface of the floor, so as to offer no obstruction to a rake. The iron is, further, to be of a section differing from that of the recess, and is to taper from top to bottom. In order to secure the tightness of the true floor, some cooling medium is interposed between this and the false floor. This may consist of an arrangement of pipes for the circulation of water or air, or of a water surface contained in an iron cistern continually replenished by connexion with an outside vessel.—A. R. D.

IV.—COLOURING MATTERS AND DYES.

On Brasilin. C. Schall and G. Dralle. Ber. **21**, 3009—3017.

To prepare the tetramethylether of brasilin, 100 grms. are dissolved in alcohol of 98 per cent., and 30·26 grms. of sodium, dissolved in absolute alcohol, are added, when an abundant separation of sodium-brasilin of a pale red colour takes place. Now 206·84 grms. of methyliodide are added, and the mixture is well shaken and left for 40—50 hours at a temperature of 60°—70° C. The completion of the reaction is indicated by the disappearance of the sodium-brasilin, and by the change of the pale red into a bright brown colour. After pouring the mass into water, the ether is precipitated, recrystallised from alcohol with addition of animal charcoal, and finally obtained in white crystals, melting at 138°—139° C. It cannot be distilled, not even under reduced pressure, without decomposition.

As a by-product of the foregoing reaction, brasilintrimethylether is obtained. The crude brasilintetramethylether is dissolved in ether, and shaken with dilute caustic soda, containing 1—2 per cent. of sodium hydrate. The alkaline solutions are neutralised and then shaken with ether. The ether is treated with bicarbonate and then with carbonate of soda, and it is finally allowed to evaporate. On addition of caustic soda to the residue, the white sodium salt of the trimethylether is obtained, which is washed with ether-alcohol, dissolved in little water, and then the ether is precipitated from its aqueous solution by carbonic acid. Stronger acids, for instance, hydrochloric acid change the ether into a brownish mass. The ether contains three-quarters of a molecule of water; its formula is $C_{16}H_{11}O_5(CH_3)_3 + \frac{3}{4} H_2O$. Its acetyl-compound is soluble in alcohol, and melts at 95°—97° C. The trimethylether appears to melt at 74° C. Ferric chloride produces in its alcoholic solution a dull brownish colour, whilst it does not react with the tetramethylether.

Action of bromine on the tetramethylether of brasilin:—

If 1 mol. of bromine in 10 parts of acetic acid be allowed to act on 1 mol. of tetramethylbrasilin, a pale red solution is obtained, from which, when poured into water, a white body is precipitated. Crystallised from dilute alcohol it forms long white prisms, melting at 180°—181° C., of the formula $C_{16}H_9BrO_5(CH_3)_4$. If an excess of bromine is used a body is obtained of the formula $C_{16}H_8Br_4O_5(CH_3)_4$: *dibromotetramethylbrasilindibromide.* Bromine acts also on brasilin itself, and forms a *tribromobrasilindibromide,* $C_{16}H_{11}Br_3O_5Br_2 + 2 H_2O$.

If 27 grms. of brasilin are dissolved in 150 cc. of water and 10 cc. of caustic soda, and if through this solution a current of air be passed for 36 hours, the red brasilin in colour is changed into a brown. On addition of acid and after extraction with ether, a brown fluorescent ethereal solution is obtained, which is washed with sodium bicarbonate and water, and then allowed to evaporate. Small light brown needles are obtained after recrystallisation from alcohol, melting at 271° C. The analytical figures give the formula $C_{20}H_{14}O_9$. Ferric chloride produces in the dilute alcoholic solution a faint violet colouration.—A. L.

On Nitroso-Resorcinol Dye-Stuffs. S. v. Kostanecki. Ber. **21**, 3109—3114.

The nitroso-phenols dyeing mordanted fibres are distinguished for the great fastness of the colours thus produced. The author prepared some isonitroso- compounds from azo-colouring matters.

Nitroso-phenylazoresorcinol—

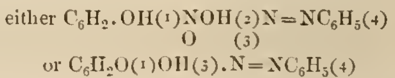
$$C_6H_5N:NC_6H_2(O.NOH)OH$$

1 mol. of phenylazoresorcinol is dissolved in dilute alkali. 1 mol. of sodium nitrite added and the mixture poured into dilute sulphuric acid, which is kept cool and well stirred. Nitroso-phenylazoresorcinol is separated as a brownish-red, finely divided precipitate, which, when recrystallised from boiling alcohol, explodes at 168° C. It is insoluble in cold water, little soluble in hot water and ether, easily soluble in benzene and still more so in chloroform. Alkalis dissolve it with a brownish-yellow colour, in concentrated sulphuric acid it is soluble with an olive-green colour. Fibres mordanted with iron are dyed olive green by it. Similar bodies were obtained by treating the combinations of *o*- and *p*-toluidine, commercial xylidine, pseudo-cumidine, *m*- and *p*-nitraniline, amido-azobenzene, and naphthionic acid with resorcinol, with nitrous acid.

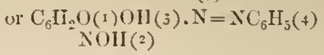
Nitroso-pseudo-cumylazo-resorcinol—

$$C_6H_2(CH_3)_3N:NC_6H_2(O.NOH)OH$$

decomposes at 190° C. It is soluble in chloroform, dissolves in alkalis with a brownish-yellow, in concentrated sulphuric acid with a brownish-red colour. When nitroso-phenylazoresorcinol is reduced with tin and hydrochloric acid, aniline hydrochloride and diamidoresorcinol is formed, the latter being identical with diamidoresorcinol, which Fitz obtained by reduction of dinitrosoresorcinol. It crystallises with 1½ mols. of water. The formula of nitrosophenylazoresorcinol must therefore be—



either $C_6H_2.OH(1)\underset{O}{N}OH\underset{(3)}{(2)}N=NC_6H_5(4)$



or $C_6H_2\underset{NOH(2)}{O(1)OH(3)}.N=NC_6H_5(4)$

Experiments to nitrosate the two known phenyldisazoresorcinols failed. Phenyldisazophloroglucinol containing two azo- and three hydroxy- groups yielded on treatment with nitrous acid a nitroso body, capable of dyeing mordanted fibres.

Phenyl-azo-nitrosoresorcinol—

$$C_6H_5N=NC_6H_2(O.NOH)OH$$

was obtained by combining diazobenzenechloride with nitrosoresorcinol in a carbonate of soda solution. From alcohol it crystallises in golden plates, decomposing without melting at 225° C., soluble in alkalis with a reddish-yellow, in concentrated sulphuric acid with an olive-brown colour. It dyes mordanted fibres, but much more weakly than the isomeric nitroso-phenylazoresorcinol. On reduction with tin and hydrochloric acid it yields the same diamidoresorcinol as its isomeric compound.—A. L.

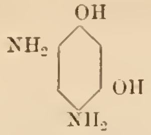
On the Isomeric Phenyldisazoresorcinols. S. v. Kostanecki. Ber. **21**, 3114—19.

The author obtained when preparing phenylazoresorcinol γ-phenyldisazoresorcinol as a by-product, which contains the substituting groups in the ortho-position to each other, Wallach prepared α- and β-phenyldisazoresorcinol. Wallachs α-compound was reduced and a diamidoresorcinol obtained, different from the one above described. It was purified by its difficultly soluble sulphate, which crystallises with 2 mols. of water. Nietzki and Schmidt prepared from it first dihydroxyquinone, and then nitranilic acid—

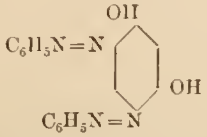
$$C_6.O(OH)(NO_2)(O)(OH)(NO_2);$$

$$[O:OH:NO_2:O:OH:NO_2=1:2:3:4:5:6]$$

Its constitution must therefore be—



and the constitution of Wallach's α-phenyldisazoresorcinol—



The author further proved the identity of Typke's diamidoresorcinol obtained from dinitroresorcinol with the one obtained from Wallach's α-phenyldisazoresorcinol.

Preparation of the Isomeric Phenyldisazoresorcinols.—The mixture of 2 mols. of diazobenzenechloride and 1 mol. of resorcinol are either poured into an excess of dilute alkali or into a solution of sodium acetate or carbonate. In the former case when caustic alkalis are used Wallach's α-phenyldisazoresorcinol, in the latter Liebermann and Kostanecki's γ-phenyldisazoresorcinol is obtained. To prepare phenylazoresorcinol with theoretical yield the mixture of 1 mol. of diazobenzenechloride and 1 mol. of resorcinol is poured into an excess of dilute alkali, which must be well stirred.—A. L.

The Colouring-Matters obtained from Diamidoethoxydiphenyl Sulphonic Acid. A. Feer. Bull. Soc. Ind. de Mulhouse, 1888, 488—490.

Parahydroxyazobenzene sulphonic acid is ethylated by treatment with ethyl bromide and caustic soda. The resulting derivative treated with stannous chloride is reduced according to the equation—

$$C_6H_5.N:N.C_6H_3:(SO_3H)(O.C_2H_5)+2\,H= NH_2.C_6H_4.C_6H_2:(OC_2H_5)(SO_3H)(NH_2).$$

The compound is diazotised, and the tetrazo-derivative treated with phenols or amines, in the molecular proportion 1:2. The resulting colours, yellow, red, and violet, dye cotton directly in an alkaline bath. They are less fast than the corresponding derivatives of benzidine.—C. F. C.

PATENTS.

The Production of Coloured Compounds or Colouring Materials. C. A. Bennert, Hebburn-on-Tyne. Eng. Pat. 14,646, October 27, 1887. 6*d.*

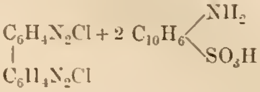
Two hundred parts by weight of nitronaphthalene are heated to about 210° C. (410° F.), and 45 parts by weight of flowers of sulphur are gradually added, the mixture being well stirred and care being taken that the temperature does not rise above 210° C. The melt evolves sulphurous acid and gets finally so thick as not to allow of further stirring. On cooling it becomes brittle, and is, when powdered, almost black. For purification the powdered melt is treated with hot methylated spirits until nothing more is taken up by this solvent from the residue. The main product is extracted with hot carbon bisulphide. It forms a green solution, which leaves, after evaporation of the solvent, a dark mass. This product is not uniform—it may be separated by means of hot petroleum spirit into a more bluish substance, soluble in petroleum spirit, and into a more greenish body, insoluble in it.

These compounds are sulphonated with five parts by weight of sulphuric acid containing 20 per cent. of anhydrous sulphuric acid at 45°—60° C. (113°—140° F.), and converted into salts.

The author calls these products naphthylthiazine and naphthylthiazine-sulpho acids.—A. L.

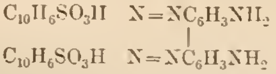
New or Improved Dyes and Process for the Production thereof. Worms, Leipzig, Germany. Eng. Pat. 17,466, December 19, 1887. 6*d.*

The contents of this patent are a reversion of the making of the benzopurpurin series of colours. Instead of combining tetrazo-diphenyl chloride with naphthylamine sulphonic acids—



$$\begin{matrix} C_6H_4N_2Cl \\ | \\ C_6H_4N_2Cl \end{matrix} + 2\,C_{10}H_6\begin{matrix} \diagup NH_2 \\ \diagdown SO_3H \end{matrix}$$

he combines two mols. of diazo-sulphonaphthalene with one mol. of benzidine, the latter being preferably suspended in alkali. Thus, products are obtained of the following chemical constitution—



$$\begin{matrix} C_{10}H_6SO_3H & N=NC_6H_3NH_2 \\ & | \\ C_{10}H_6SO_3H & N=NC_6H_3NH_2 \end{matrix}$$

These bodies can be further diazotised and combined with amines and phenols and their sulphonic acids. Instead of benzidine, toluidine diamido stilbene, &c. may be used, instead of naphthionic acid a list of the known amines is given, to replace this compound.—A. L.

Improvements in the Production of Yellow and Brown Colouring-matters or Dyestuffs. R. Nietzki, Basel, Switzerland. Eng. Pat. 17,583, December 21, 1887. 6*d.*

Ten parts of metanitroaniline are dissolved in 40 parts of hydrochloric acid (20° B.) and 150 parts of water—when cold 5·4 parts of sodium nitrite are added, and the thus obtained diazo-compound is combined with 10 parts of salicylic acid dissolved in 150 parts of water and 25 parts of calcined soda. Instead of using metanitroaniline, nitronaphthylamine, nitrotoluidine, nitroxylidine may be used; if instead of salicylic, α-oxynaphthoic acid be used, brown instead of yellow colouring-matters are obtained. The derivatives of α-oxynaphthoic acid are, however, not sufficiently soluble, and instead of combining metanitroaniline with it the author takes orthonitroaniline sulphonic acid instead. (Nietzki and Benkiser, Ber. 18, 294, this Journal, 1885, 276.)—A. L.

A Manufacture of New Azo-dye Stuffs. C. D. Abel, London. From "The Actiengesellschaft für Anilin-Fabrikation," Berlin, Germany. Eng. Pat. 17,952, December 30, 1887. 6*d.*

These colouring-matters are prepared by the action of a salt of dinitro-diazo-benzene on the mono- or di-sulphonic acids of α- and β-naphthylamine in presence of sodium acetate or other suitable alkaline salt. The dinitro-diazobenzene salt is prepared in the ordinary method from Gottlieb's dinitro-aniline [$NH_2 : NO_2 : NO_2 = 1 : 2 : 4$] m.p. 180° C. The following method is used for obtaining a purple azo-dye. 26·5 parts by weight of the sodium salt of Brönner's β-naphthylamine mono-sulphonic acid (obtained by heating Schäffer's β-naphthol mono-sulphonic acid with ammonia under pressure) are dissolved together with 20 parts of dry sodium acetate in about 500 parts of water. On mixing this in the cold with a cold aqueous solution of 25·7 parts of dinitro-diazo-benzene nitrate, or a corresponding quantity of any other of its salts, the dye-stuff at once separates out as a dark purple precipitate. It dyes wool and silk purple from an acid bath, and dissolves readily in boiling water with this colour. This solution gelatinises on cooling if an alkali be added to it. The dry powder dissolves in concentrated sulphuric acid with an orange colour. If the Brönner's β-naphthylamine sulphonic acid be replaced by other α- or β-naphthylamine sulphonic acids, red, brown, or purple colouring-matters are obtained. The same shades are also obtained if the β-naphthylamine sulphonic acid is replaced by 34·8 parts by weight of the sodium salt of any of the α- or β-naphthylamine disulphonic acids. A purple dye-stuff is formed by the action of dinitro-diazo-benzene on the β-naphthylamine disulphonic acid obtained by heating β-naphthol disulphonic acid R with ammonia under pressure. The black powder formed dissolves easily in water with a dark red colour, dyes wool and silk deep purple from an acid bath and dissolves in concentrated sulphuric acid with a dark crimson colour. The patent claims, 1. The manufacture of azo-dye stuffs from dinitro-diazo-benzene and the mono- and disulphonic acids of α- and β-naphthylamine. 2. The dye-stuffs so produced. 3. The use of the above dye-stuffs.—T. A. L.

Process for the Production of Sulpho-acids of Diphenylamine. C. D. Abel, London. From G. C. Zimmer, Mannheim, Germany. Eng. Pat. 170, January 4, 1888. 6*d*.

The process given by Merz and Weith (Ber. **6**, 1513) for sulphonating diphenylamine, whereby two isomeric monosulphonic acids are obtained, consists in heating 5 parts of the base with 6 parts of sulphuric acid to 150°—170° C. The action is incomplete and some disulphonic acid is formed which interferes with the separation. The method proposed is as follows: 100 kilos. of diphenylamine and 50 kilos. of sulphuric acid 66° are heated for 12—24 hours at 140°—150°. There is no advantage in using a higher temperature. The mass when cold is extracted with hot water which dissolves the sulphonic acids, and the unaltered diphenylamine can be used in a fresh operation. The sulphonic acids are converted into their barium, calcium, or sodium salts, preferably the latter, or the melt may be directly extracted with sodium bicarbonate or caustic soda sufficient to neutralise it. The solution of the sodium salts is evaporated until a drop solidifies on a glass rod, when on cooling, crystals separate out which consist mainly of the α-sulphonic acid. The mother-liquor is evaporated to dryness and extracted with 90—95 per cent. alcohol, when the β-acid is left as a residue. The same method can be used for purifying the α-acid obtained above. The α-acid reacts more readily with diazo-salts than the β-, and the colouring-matters produced crystallise more easily. Both acids dissolve in concentrated sulphuric acid with a very slight brown colouration. Solutions of the free acids are turned dirty green by oxidising agents, such as ferric chloride and permanganate.—T. A. L.

Process for separating the so-called β-Naphthylamine-δ-sulphonic Acid from the so-called β-Napthylamine-β-sulphonic Acid. C. D. Abel, London. From "The Actiengesellschaft für Anilin-Fabrikation," Berlin. Eng. Pat. 687, January 16, 1888. 6*d*.

The method depends upon the difference in solubility in water of the copper or lead salts of the β- and δ-acids, those of the former being almost insoluble in cold water. 20 parts of the sodium salt of the mixture of the two acids are dissolved in 300 parts of water and mixed with 10 parts of copper sulphate dissolved in 20 parts of water. On cooling, the copper salt of the β-sulphonic acid can be filtered off, the free δ-sulphonic acid being obtained by adding a mineral acid to the mother-liquor. An alternative method is to add copper sulphate solution to the solution of the mixture so long as a precipitate of the copper salt of the β-sulphonic acid is formed. The δ-acid is purified preferably by recrystallising its barium salt. In place of copper sulphate any other soluble copper or lead salt may be employed.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Note on Wild Silk. C. Grosseteste. Bull. Soc. Ind. Mulhouse, 1888, 534.

The obtaining of silk from the silkworm (*bombyx mori*) dates in China from periods about 2600 B.C.; the industry was introduced into Constantinople towards the sixth century A.D., was not brought to France till the fourteenth century, and was brought to England by the French Protestants, on account of the revocation of the edict of Nantes.

The use of wild silk, treated in spinning as hemp, was known in India at a very remote period. It was the migration of the people which caused the industry to fall into neglect, from which it did not entirely recover for 40 years, when a disease of the silkworms annihilated nearly all the magnaneries of Europe.

It was the worm of the *Ailanthus* which was first reared in France and was successful. The cocoons, though heavy were spun irregularly, and were almost impossible to reel. Nevertheless, about the year 1855 plush and velvet were made in France of wild silk.

The natural history of silk is the same for all species. From the egg laid by the moth a caterpillar issues, which feeds on leaves of certain plants, each after its kind (mulberry, oak, hazel, the castor oil plant, etc.). This larva develops and secretes a light thread, with which it covers itself during the next stage of its existence. When all the silk is secreted, it is transformed into a chrysalis, which remains in its cell or cocoon till it has changed into a moth; then, with the aid of a fluid, which softens the end of the cocoon, it pushes aside the fibres, using its legs and wings sufficiently to make its way out. The insect only lives a few days.

The silk of the *bombyx mori* is the only kind called "commercial silk." Its eggs are an object of considerable importation from India into France, and are worth 30 to 40 francs per ounce (T. Wardle). As to the wild silk imported from the Indies, it is produced by different species of worm, of which the principal ones are: the worm of the oak (*Antheræa pernye*), which supplies France with about 6,000 bales of silk annually, and the castor-oil worm or "tussur," of which nearly all the silk imported into Europe is consumed in England (*Antheræa mylitta*).

In addition to these two kinds there is an abundance of silk in South America, Africa, and Australia which is not used in manufacture at all.

Most of these worms spin large cocoons, but for a long time the reeling has offered serious difficulties on account of a kind of cement forming an external coating, which can only be softened imperfectly, in such a manner that the reelers make a useless waste. A more suitable method has been proposed recently whereby the cocoons can be reeled entirely, and an even thread drawn from them. This operation is carried out in the Indies, except for English importation, when the cocoons from Bengal are received whole, dried and pressed, yielding a yellow silk, very strong and elastic, and suitable for sewing-thread or weaving, though not so white as that from China.

The bleaching of wild silk has also been undertaken satisfactorily. The silk of the mulberry worm—in the first instance, yellow or green—is bleached by soap; but this is not the case with wild silk, which generally parts unwillingly with its brown colour, because it is in the interior and complete for each fibre, whilst in the former it is only on the exterior. It is observed that when the uncultivated worm spins, the silk is at first white till the cocoon is complete, and it then becomes darker and darker, according to the amount of tannin contained in the food.

After many vain attempts wild silk has at last been bleached successfully by first impregnating it with hydrogen peroxide and then drying. It is possible now to impart to this silk the most delicate tints; it has already been established in the series of textile fibres.

In 1886 its production was estimated to be about 16 million kilos., of which 22½ per cent. were produced in Europe (18·5 per cent in Italy, 4 per cent. in France), and the manufactured product was valued at about 2,000,000,000 francs (425,000,000 for France, 250,000,000 for Germany, 125,000,000 for England). The United States, in spite of the prohibited right of import (50 per cent. of the value), have produced about 190 millions of manufactured silk.

Actually three-fourths of the silk employed in Europe and America is provided by China, India, and Japan. France derives seven-eighths of her supply from abroad; it is also a matter of great interest to follow the progress of acclimatisation of the Chinese silkworm, the silk of which is used on such a large scale for French manufacture.

Wild silk was first valued in London at 14*s.* to 18*s.* a pound (T. Wardle); then, in 1882, the average price for cocoons was 12·5 francs, and for waste 13 francs; later, in 1885, 10·50 francs for cocoons, 7·50 francs for waste. Wild silk will find considerable sale, because day by day the consumption in the silk trade increases for inexpensive goods; again, the fibre being larger and more elastic than that of ordinary silk, it is admirably adapted for goods of certain classes, as stockings, jerseys, and surtouts; the Paris lacemakers use it in considerable quantities; Roubaix makes its furniture with it; the great warehouses their velvet furniture, their moirés, their plushes, and the handkerchiefs of Lyons. It is also noteworthy that wild silk is suitable for the selvages of silk or mixed fabrics.

The elasticity, size, and strength of the fibre of wild silk recommend it especially for mixed fabrics. It possesses considerable tensile strength. Wild silk is now obtainable of a perfect regularity, and its bleaching as well as its dyeing offer no further difficulties, and it may perhaps be classed among fibres of the first order.—W. S.

Chemical Constitution of Wool. P. Richard. Meeting of Soc. Ind. de Mulhouse, September, 1888.

The behaviour of wool towards colouring-matters shows that it acts as an amido-acid—towards acid colours it is basic, and towards basic colours, acid.

The author's experiments tend to support this view.

Wool was laid in a solution of sodium nitrite (15 grms. per litre) for 24 hours at a temperature of about 15°. At the end of this time the wool had attained a straw colour. After now being washed and taken through strongly alkaline sodium phenate, it was dyed a reddish-brown; resorcinol, with excess of caustic soda, gave a granite-red; pyrogallol, with excess of caustic soda, red-brown; α-naphthol gave a granite-red; β-naphthol, brown.

Moderately concentrated hydrochloric acid modifies the colours. If the wool, after treatment in the nitrite bath, be steeped in ammoniacal water for 24 hours to correct acidity, the colours obtained with phenols are still the same as those obtained above, only a little darker. It is thus clear that the fibres have undergone, with the nitrite, some change, which renders them capable of combining with phenols, as the diazotised amines do. This change is, moreover, quite different from that effected by nitrating and then colouring orange with alkalis, in which case no colour changes are obtained with phenols.

The natural hypothesis is that a diazo-compound of the wool is obtained, but one which is much more stable than the ordinary diazo-compounds. Boiling with hydrochloric acid does not completely destroy it. After this treatment, however, it may be dyed with diazonaphthalene chloride, and this seems as though there were liberated in the fibre a phenol, produced by the decomposition of a diazo-compound with boiling water.

Exactly the same holds for silk as for wool.—T. L. B.

PATENTS.

A Process or Method of preserving Timber, Linen, Cotton, Flax, Jute, and similar Fabrics from Decay, and making them Non-inflammable. K. McLea and R. Punshon, London. Eng. Pat. 15,382, November 10, 1887.

The materials are steeped in a hot or cold solution containing 10 parts of calcium chloride and 90 parts of ammonium phosphate.—E. J. B.

A New or Improved Manufacture of Vegetable Fibre from Wood. E. C. de Bollemont, Rethel, France. Eng. Pat. 19,093, June 21, 1888. 8*d.*

By means of a large number of very sharp knives or scrapers made from thin steel bands, such as are used for springs, the surface of a block of wood is scored with a number of fine lines. Immediately behind the knives, which are placed very close together, a planing iron is fixed, which removes the scored surface of the block in the form of a number of very fine fibres. The bundle of knives requires to be very carefully adjusted, so that all the edges are in the same plane. To do this a special arrangement is necessary, which is fully described and illustrated. The wood fibres possess great tensile strength and flexibility, and may be employed as a substitute for hemp in cords, string, carpets, &c.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Recent Progress in the Chemical Technology of Textile Fabrics. O. N. Witt. Dingl. Polyt. J. **270**, 273—278.

The bleaching of woollen fabrics is now almost exclusively performed by means of hydrogen peroxide. It has become a recognised fact that some other body which has a slight decomposing action upon the peroxide must be present during the bleaching. Köchlin recommends the use of sodium bisulphite for this purpose. The fabrics are steeped in the hydrogen peroxide, allowed to remain rolled up for a short time, and then passed through sodium bisulphite. The white colour thus produced is very perfect, and in some cases so brilliant that the bleaching must be stopped, as a perfectly white colour is not desirable for wool.

A method for the recovery of soap from the colour-baths of silk-dyeing works has been described by Gionoli. The soap is precipitated with sulphate of iron, and the iron-soap produced, after filtration and washing, is decomposed by dilute sulphuric acid under a pressure of $\frac{1}{2}$ to $\frac{3}{4}$ atmosphere.

The search for new antimony salts to take the place of tartar-emetic has resulted in the production of a number of double fluorides of antimony. One of them, $SbF_3(NH_4)_2SO_4$, has been patented by E. de Haen (this Journal, 1887, 727), and contains 47 per cent. of antimony oxide; the other, made by Rud. Kopp & Co. (*ibid.*, 1888, 566), has the composition SbF_3NaF, and contains 66 per cent. of antimony oxide. Both are cheaper than tartar-emetic, and are said to give good results. The same firm manufactures a chromium fluoride of the formula $Cr_2F_6 + 8H_2O$. It is a dark green powder, and seems to be easily decomposed by the fibre. It is used chiefly as a mordant for wool.

The fixation of chromium by woollen fabrics has been experimented upon by E. Knecht. As the result of his observations he finds that the quantity of chromium fixed by the cloth depends upon the concentration of the solutions employed. In presence of sulphuric acid more chromium is fixed than from pure bichromate. Sodium bichromate yields up more chromium to the wool than the corresponding potassium salt. The addition of tartaric acid has no influence on the quantity of chromium fixed by the fibre. Chrome alum gives up twice as much chromium to wool as bichromate, but the chromium is taken up in a less suitable form. The quantity of chromium taken up by wool from potassium bichromate increases with the time of contact and with the temperature. The chromium is removed chiefly in the form of chromic acid, the bichromate being reduced to chromate.—H. T. P.

Theory of Cotton Bleaching. A. Scheurer. Bull. Soc. Ind. Mulhouse, 1888, 399—438.

The introduction of the "Mather" keir into Alsace has reopened the question of the most effectual mode of carrying out the alkaline treatment in cotton bleaching. After tracing the historical development of the process which has held its own for 50 years, viz., lime boiling, followed by the soda-rosin "bowk," with more particular reference to the controversial papers on the subject appearing in the Bull. Soc. Ind. Mulhouse during the years 1829—1839, the author gives a detailed account of his recent investigation of the saponification of fatty bodies in contact with cotton cloth. Of such fatty bodies he selected as typical, in point of degree of resistance to saponification, (1) tallow, (2) the fatty constituents of the raw cotton fibre, (3) cotton-seed oil. The method of experimenting was as follows:—Pieces of unbleached cotton cloth of 100 sq. cm., after receiving in the centre a drop of the oil to be investigated, were boiled in the alkaline solution contained in a glass flask, or, in the case of temperatures exceeding 100°, were placed in iron tubes and then in a pressure-boiler, which was heated by means of an oil-bath. In the latter case, therefore, there was no circulation of the alkaline liquid. At the conclusion of the treatment the pieces were well washed, dried, and examined by floating them on cold water. Incomplete saponification at any part was revealed by the tardy penetration of the water. The times necessary for complete saponification by various alkaline solutions at the two temperatures of 100° (with circulation) and 120° (without circulation), respectively, are given in the subjoined table:—

Temperature 100°.

Weight of Reagents in 1,000 cc.	Time necessary for Saponification.		Ratio of Times (Time taken in Caustic-rosin boil = unity).	
	Tallow.	Cotton Fats.	Cotton Fats.	Tallow.
	Hours.	Hours.		
10 grms. of caustic soda 2½ „ rosin	6	6	1	1
60 „ barium hydrate	3½	3½	0·6	0·6
10 „ lime	12	6	1	2
5 „ caustic soda 2½ „ rosin	18	18	3	3
5 „ caustic soda..	34	18	3	5·7
10 „ „ „ ..	34	18	3	5·7
10 „ soda ash (Solvay)	58	32	5·3	10
10 „ soda ash ... 2½ „ rosin	62	36	6	10
20 „ soda ash	33	14	..	..
5 „ soda ash .... 7½ „ caustic soda	32	13	..	..

Temperature 120°.

Weight of Reagents in 1,000 cc.	Time necessary for Saponification.		Ratio of Times (Time taken in Caustic-rosin boil = unity).	
	Tallow.	Cotton Fats.	Cotton Fats.	Tallow.
	Hours.	Hours.		
5 grms. of caustic soda	16	4	..	..
10 „ „ „ ..	16	4	..	..
5 „ „ „ . 2½ „ rosin........	8	4	..	..
10 „ caustic soda. 2½ „ rosin	8	4	..	..
10 „ lime	4	2	..	..

The most important points elucidated by these results are as follows:—Sodium hydrate acts with twice the rapidity of its equivalent of carbonate, and the rapidity is not sensibly increased by increasing the proportion of the reagent from 5 to 10 per 1,000. The addition of rosin increases the rapidity; in this case, however, it is further increased in the proportion 3:1 by increasing the alkali from 5 to 10.

The rapidity of the action of lime is noteworthy. The increased rapidity of action of the solutions at the higher temperature is also to be observed.

The saponification of cotton-seed oil in contact with the fibre is relatively rapid: a solution of 10 grms. of soda ash per 1,000 effects a complete saponification in 8 hours. There is in this case an additional effect, viz., the saponification of the "natural" fatty constituents of the fibre, which under ordinary conditions would have required 32 hours' boiling. Further experiments with mixtures of tallow and of cotton-seed oil with oleic acid served to establish, as a general result, that the neutral fats (pure glycerol ethers) are much more rapidly attacked by alkaline solutions when mixed with oils which readily saponify. This result is probably attributable to an emulsification of the more resistant oil by the soap formed from the more easily saponificable constituents of the mixture.

A series of experiments upon the rapidity of action of sodium hydrate and carbonate, and mixtures of those compounds in varying proportions, shows a maximum result when a proportion of carbonate equivalent to 25 per cent. of the total alkali (Na_2O) was present: a result probably also due to the mechanical properties of the solution.

In studying the saponifying action of lime solutions it was necessary to treat the pieces, at the conclusion of the experiments, with an acid, and subsequently with alcohol, to remove the fatty acid liberated.

The following experiments with a solution of 10 grms. per 1,000 at 100° C. have reference to the saponification of the constituents of the raw fibre:—

(1.) The pieces were washed after the boiling, soured, and treated with boiling alcohol. The time required for complete saponification was *6 hours.*

(2.) The pieces were transferred without souring to a solution of soda ash (10/1,000) in which they were boiled for 1 hour. In this case it was found that the boiling in lime could be reduced to *4 hours.*

(3.) The pieces after lime-boiling were soured, but treated otherwise as in (2). The duration of the lime-boiling necessary to prepare for complete saponification in the soda solution did not exceed *1 hour.*

The results in (2) and (3) are to be explained as cases of the "induced" saponification elucidated above. The action of the lime "solution" at the higher temperature (120°) was elucidated by the following observations of the course of a boiling on the large scale:—A sample of liquid withdrawn after some hours' boiling was found to be free from suspended lime and showed an alkalinity = 1 grm. of CaO per litre. The quantity of lime originally added being 8—9 grms. per litre, the difference (7 grms.) is either fixed on the tissue or present as neutral salt in solution. Analysis of both solution and cloth showed the lime to be distributed as follows: 4 grms. as neutral salt, 2·88 grms. fixed in the cloth. The great activity of the lime solution is doubtless referable to this fixation of the base upon the fibre.

The practical conclusions which the author draws from the results of his experiments are that complete saponification of the fatty constituents of the cotton fibre is effected —(1.) By a single treatment with caustic soda (solution) and rosin. (2.) By a treatment with lime, followed by souring, and boiling in soda-ash solution. The former is rendered possible on the large scale by the now well-known Mather keir, and is gradually displacing the latter, which up to the time of introduction of this keir, was the standard process. The author freely admits the advantages of the former, which he refers exclusively to the mechanical perfections of the apparatus, at the same time recording a certain preference for the older method by reason of its greater "elasticity" and certainty.—C. F. C.

Cotton Bleaching.—Resistance of Mordants (Metallic Oxides) to the Bleaching Process. A. Scheurer. Bull. Soc. Ind. Mulhouse, 1888, 439—441.

The following oxides, fixed upon cotton cloth, were found to resist in part the process of lime boiling under pressure, FeO, Fe_2O_3, SnO_2, Al_2O_3. A certain proportion of the oxides yielded to the action of the solution, this proportion depending upon the condition of preparation of the cloth. The amount retained was least in the case of pure bleached calico; greater in the case of unbleached calico; considerably greater in the case of goods prepared in "oleïn."

The process of boiling under pressure with caustic soda and rosin was found to completely remove all the metallic mordants with the single exception of iron oxide.—C. F. C.

Alizarin Red Discharge on Dark Indigo Blue Ground. W. Wängler. Mittheil. des k. k. Tech. Gew.-Museums, 2, 1—11.

In Mercer's process of discharging indigo-dyed calico, the cloth is prepared with potassium ferricyanide and printed with alkaline colours, which effect the discharge. This method can only be applied to pale or medium shades of blue. The author has discovered a modification of the method which is applicable to dark shades. When indigo-dyed mercerised cloth is printed with a thickened solution of potassium ferricyanide, and passed through caustic soda at 15° Tw., in the cold, an immediate discharge of the indigo takes place. Attempts were made to add acetate of alumina or an oxalic or hydrochloric acid solution of phosphate of alumina to the printing colour, so as to obtain a deposit of alumina on the discharged cloth, but the results were not satisfactory. The desired result was obtained by printing a colour composed of—

1 gallon of sulphate-acetate of alumina of 22° Tw. made from 2 parts of acetate of lead and $2\frac{2}{3}$ parts of alum,
4 lbs. of light calcined farina,
5 lbs. of potassium ferricyanide,

and passing, for 20 to 25 seconds, through a mixture of 4 parts of caustic soda of 19° Tw., and 1 part of silicate of soda of 60° Tw., maintained at 60° C., washing well, afterwards dyeing with alizarin, and treating in the ordinary way to brighten the red.

An analysis of the fixed mordant gave—

	Per Cent.
SiO_2	42·372
Al_2O_3	34·745
H_2O	18·640
Na_2O	3·728
	99·487

To obtain good results, the following points must be attended to:—

1. The cloth used must be mercerised.

2. The printing colour must contain as much ferricyanide as possible, and the alumina mordant be in the form of sulphate-acetate. The consistence should be rather thin, and the colour well pressed into the cloth by the roller.

3. The mordant must be fixed by the alkaline silicate bath without delay, the indigo on the printed parts being discharged simultaneously with the fixing of the alumina mordant.—E. B.

The Dyeing of Paper Pulp with Coal-tar Colours. M. Coulon. Mittheil. des k. k. Tech. Gew.-Museums, 2, 28—34.

Contrary to the general opinion that, with the exception of chrysamine, the dyes of the Congo group are not suitable for paper dyeing, the author finds that, when the percentage of dye used is not too large, it is entirely absorbed, and the dye-bath left clear. This discovery has been made the subject of a patent. The dyes, *e.g.*, Congo, azo-blue, &c., are too expensive to use alone, and advantage is taken of the fact that they act as mordants for other dyes. A red colour is obtained by dyeing with Congo and then with safranine or rocelline. It is noteworthy that by employing first rocelline and then safranine, a good red is produced, either with or without the Congo-red. By adding eosin to the rosin size, and applying the same to the red-dyed paper, the characteristic fluorescent red is cheaply produced. Pulp dyed with chrysamine can be topped with auramine for a pleasant shade of yellow. A little safranine mixed with auramine produces an orange.

Methylene blue is an excellent dye for paper, but dark blue shades cannot be obtained with it. A satisfactory dark blue was obtained by preparing with alum, dyeing with Azo-blue, and tinting with a mixture of Soluble blue, nigrosine, logwood extract, and magenta—altogether amounting to 1·5 per cent. of the weight of the dry pulp.

Aniline black is produced on the pulp by adding a solution of 5 per cent. of aniline salts (reckoned on the weight of dry pulp), working five to six hours, then running the liquor out of the cylinder, adding 6 per cent. of potassium bichromate and the calculated quantity of hydrochloric acid thereto, and running or pumping back again. The pulp is then worked till it is coloured black, when a small quantity of chloride of copper is added, which prevents the "after-greening."

There is further mentioned a method of dyeing a chrome-iron logwood black, by mordanting for three hours with a solution of chrome and iron alums, and then, after removing the solution, dyeing with 6—10 per cent. of solid logwood extract and 1 to 2 per cent. of bichrome.—E. B.

PATENTS.

Improvements in the Treatment of Vegetable Fibres, and of Yarns and Fabrics Manufactured therefrom. A. Prinz and E. Quellmalz, Saxony. Eng. Pat. 5838, April 2, 1884. 6*d*. (Second Edition.)

This invention relates to the treatment of the nettle fibre, rhea, hemp, flax, Sunn, Gambo, Sida, and other fibres, especially jute, and their preparation for use in textile and paper-making industries. In the case of jute the inventors have succeeded in preparing fibre that can be spun into the finest yarn. The process consists in macerating the fibre for 24 hours in a clear solution of bleaching powder of a strength of about 6·5 per cent. The fibre is placed horizontally in tanks made of wood, metal, or masonry. By this process the gluten as well as the ligneous starch will be for the most part removed. In the case of jute, a substance called "jutine" by the inventors, is removed. The second part of the process consists in a treatment with caustic alkalis, together with benzene, petroleum, or carbon disulphide, at a pressure of from 3 to 6 atmospheres for from two to five hours. The material may be advantageously contained in perforated receptacles, which are then placed vertically in the boiler. After this treatment the fibre, which is now entirely free from encrusting matter, may be washed, bleached, and dried. If it be desired to impart a woolly appearance to the fibre it may, previous to the maceration in bleaching liquor, be treated with a cold solution of caustic soda of 45° Baumé for 50 hours. (This Journal, 1885, 205.)—E. J. B.

Improvements relating to the Bleaching, Dyeing, and similar Treatment of Cloth and other Fabrics, and to Apparatus therefor. G. A. Schleber, Greiz, Germany. Eng. Pat. 17,102, December 12, 1887. 8*d*.

The shrinkage in width, incurred in bleaching and dyeing in the ordinary machines, is not only obviated, but an increase, both in width and length, is claimed to be obtained by passing the cloth through a bleaching or dyeing machine, whilst stretched by two endless chains, which hold the edges of the cloth by means of needles or clutches. A drawing is given.—E. B.

Improvements in or relating to Bleaching by Electrolysis. E. M. H. Andreoli, Brixton Eng. Pat. 13,192, September 12, 1888. 6*d.*

A grid or grating is made by fixing through a grooved receptacle the ends of a number of charcoal rods, which have been coated first with copper and then tin. The emerging tinned ends are placed in a bath of molten lead, then a strip of copper, or a brass rod, is placed over the lead coating, and the whole dipped into a bath of some insulating material. The charcoal, of which the rods are made, must be at least twice baked, and immersed in a boiling bath of sugar, syrup, or glucose, previous to each baking. A concentrated solution of common salt is used as the electrolyte, and the current is alternated, to avoid the discolouration of the bath and the too rapid destruction of the charcoal electrodes.—E. B.

Improvements in Ungumming and Bleaching by Electrolysis China Grass, Rhea, Ramie, and other Nettles. E. M. H. Andreoli, Brixton. Eng. Pat. 13,194, September 12, 1888. 6*d.*

Bundles of decorticated ramie, &c. tied at their extremities are placed in trays, superposed over one another in crates, or are fastened together to form a continuous chain. The fibre is well scoured with alkali, with or without soap, and, after rinsing, bleached by being immersed in a cold bath, prepared by the electrolysis of sodium chloride, or other chloride, at 10° to 15° Tw., air being forced into the bath in order to cause the liquor to circulate. Charcoal electrodes are used. (*See* Eng. Pat. 8161 and 13,192; preceding abstract.)—E. B.

An Improved Apparatus for Cleansing Wool and other Textile Products. G. and A. Burnell, Hindmarsh, S. Australia. Eng. Pat. 14,039, September 29, 1888. 11*d.*

The wool or other material to be purified is passed by means of an endless apron into a tank, in which a large drum revolves. On the periphery of the drum a number of rollers are fixed and kept pressing on the drum by means of springs. The tank is partly filled with benzene or other suitable solvent. The wool, in a continuous stream, passes between the rollers and the drum into the solvent, where the grease is extracted, and the sand, dirt, &c. loosened. The latter fall through a layer of water to the bottom of the tank, from which they are continuously removed. On leaving the tank the wool is squeezed by rollers and passes into a smaller tank, containing water heated to any desired temperature, where the potash and other soluble salts are extracted. This tank is also similarly fitted with a drum and rollers.—E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Fiscal Saltpetre Deposits in Tarapacá. L. Darapsky. Chem. Zeit. **12**, 1358—1359.

The following description of these deposits is compiled from reliable sources and was given by L. Aldunate to the Chili Senate on July 27, 1888, with regard to the proposed sale of the fiscal saltpetre deposits. The deposits include 67 works which cover an area of 7,823 estacas (1 estaca = 33,000,000 sq. yds. (about)), and include about one-half of the saltpetre deposits formerly acquired by Peru, and about two-thirds of the total deposits of Tarapacá. According to a low estimate taken in 1876 each "estaca" contains 100,000 Spanish cwt. (1 Spanish cwt. = 45 kilos.), of saltpetre, and therefore the 7,823 estacas together 782,300,000 cwt. (Spanish). Deducting 20 per cent. for wear and depreciation, and allowing for the estacas which contain no saltpetre, there is a remainder of 625.840,000 cwt. The total amount of saltpetre exported from these fiscal deposits between 1830 and January 1888 comes to 155,271,661 cwt., of which 25,046,438 were exported during the year 1886–87. In addition to the above the State possesses 10,000 estacas which are no longer worked; according to the above estimate these are capable of yielding no less than 1,000,000,000 cwt., which, reckoned at 20 centavos per cwt., represent a sum of 200,000,000 pesos (1 peso = 3*s.* 9*d.*). The present price of saltpetre is 2 pesos 45 centavos per cwt., and this yields a profit of 50 per cent. when sold at 26*d.* per cwt. There are some 60 private saltpetre works in Tarapacá, including about 7,800 estacas, which are capable of yielding about 30,000,000 cwt. annually. The yearly output of these works from 1881 to 1886 varied from 7—12 million cwt., and for 1887 was 15,245,995 cwt.; that for 1888 is estimated at 18,000,000 cwt. There is every reason to believe that the saltpetre industry is capable of extension, and, in fact, 5,500,000 cwt. have been used in Europe during the three first months of the present year: of this quantity as much as 90 per cent. has probably been employed for agricultural purposes.—C. A. K.

Preparation of Magnesia in California. F. Gutzkow. Dingl. Polyt. J. **270**, 30—38.

This is a description of the manufacture of magnesia from sea water. Its use is chiefly as an absorbent for nitroglycerol. The mother-liquor from salt works is treated with milk of lime, the precipitated magnesium hydrate allowed to settle, the waste liquor decanted, and the precipitate stirred up with the necessary quantity of fresh water through which a stream of carbonic acid is passed till the precipitate is dissolved as the double carbonate. It is allowed to stand and the clear solution decanted, heated rapidly to 70° C., and then, as gradually as circumstances require, to 99° C. and boiled, filtered, and the precipitated magnesia alba so obtained dried on plates heated by steam. If it be desired to produce pure magnesia, the original mother-liquor is first cleared from organic matter by treating with alum, the quantity required being about 100 kilos. for every cubic metre of solution. This, however, varies according to the season of the year. The arrangement of the plant used is described in detail and a sectional elevation given. It consists essentially of a series of tanks at different elevations, communicating one with another, so that the operation commenced in the highest tank is carried on through the series, and finished in the lowest. The cost of manufacture, with a daily production of about 650 lbs., is 4½ cents per lb., and the selling price about 10 cents per lb.—A. W.

Action of Sulphuric Acid on Ferrous and Aluminium Sulphates. F. Jeremin. Russ. phys.-chem. Ges. **20**, 468.

With the view of discovering a simpler method for the removal of iron from aluminium sulphate, the author studied the behaviour of both these salphates with concentrated sulphuric acid of sp. gr. 1·83.

The largest amount of precipitate is obtained from a saturated solution of ferrous sulphate (21 grms. of $FeSO_4.7H_2O$ in 50 cc. of water) by adding the same quantity of sulphuric acid (sp. gr. 1·83).

If more or less sulphuric acid be added the precipitate is less. If, however, the strength of the iron solution varies, but the quantity of sulphuric acid remains the same, then the stronger the solution the more iron is precipitated.

In the case of a saturated solution of aluminium sulphate, the more sulphuric acid is added the less will be the precipitate. Five cc. of acid to 5 cc. of aluminium solution produce such a precipitate that the whole becomes a thick mass, whereas 20 cc. of acid produce with 5 cc. of aluminium solution a very faint turbidity.

Nevertheless complete separation cannot be effected, as the aluminium during precipitation always carries some iron with it.—T. L. B.

PATENTS.

A Process for Obtaining Nitrogen or Nitrogenous Mixtures from Nitrogenous Substances. M. von Maltzan, Berlin, and L. Tralls, Schellenken, Germany. Eng. Pat. 14,831, October 31, 1887. 6*d.*

This invention relates to a process for obtaining the nitrogen contained in all kinds of substances, which nitrogen by the oxidation of these mixtures is disengaged in the form of ammonia. The oxidation is effected in the

presence of certain auxiliary substances, such as sulphur, compounds of sulphur, calcium, manganese, or mixtures of these substances. The residue after the oxidation is collected and lixiviated, and yields a solution of ammonium salts. Or it may be used directly as a nitrogenous manure. The practical details of the process will vary with different materials of animal and vegetable origin. Sometimes it will be found useful to mix the nitrogenous material with the auxiliary substances, and cover the mixture with gypsum, which will retain all the ammonia as ammonium sulphate.
—S. H.

A Process for the Separation of Zinc Hydrate as a Crystalline Body from Solution in the Fixed Alkali Hydrates. H. Senier, London. Eng. Pat. 15,168, November 7, 1887. 4*d*.

A solution of sodium or potassium hydrate, which contains more than 6 per cent. of zinc hydrate, is evaporated until it attains a specific gravity of 1·6. The solution is then allowed to cool, when zinc hydrate will slowly crystallise out. After separating those crystals, the mother-liquor may be used as an exciting liquid for a primary battery, in which the elements consist of zinc and iron.—S. H.

Improvements in Apparatus for the Production of Oxygen and Nitrogen Gases from Atmospheric Air. E. B. Ellice-Clark and L. Chapman, London. Eng. Pat. 16,987, December 9, 1887. 8*d*.

This invention has for its object economy in the production of oxygen and nitrogen from atmospheric air, and has reference to the process described in Eng. Pat. 1885, 157 (this Journal, 1886, 40). According to the present improvements the retorts in which anhydrous barium oxide is contained are made of but small sectional area so as to contain only a small quantity of the material to be treated and to present a large heating surface to the furnace. All the retorts open into one common chamber covered by a door. The retorts are placed in an inclined position, so that the charge cannot leave clear air passages, and all the air passes through the charge of baryta. For effecting peroxidation and desoxidation of the baryta different degrees of temperature are required, and in order to effect this change of heat as rapidly as possible, the walls of the furnace in which the retorts are placed are made of a water casing, which is really a steam boiler, used for generating the steam for driving the air-pump. For the purpose of providing for continuous working, each side of the furnace contains a set of retorts, and there is also an arrangement of flues and dampers so that the fire-gases first impinge upon that set of retorts, the charge of which is to be desoxidised, and afterwards heat another set of retorts to the lower temperature necessary for the peroxidation of their contents. By reversing the damper the products of combustion pass in the reverse direction, and the set of retorts which was previously at a lower heat for peroxidation is now raised to a high heat suitable for desoxidation, and the other set to a low heat for peroxidation. Again, by another arrangement the products of combustion are passed directly into the chimney, whenever it is necessary to rapidly cool a set of retorts to the heat suitable for peroxidation.—S. H.

Improvements in the Packing of Acids. W. White and A. Rickmann, London. Eng. Pat. 17,095, December 12, 1887. 4*d*.

The acid is mixed with a dry salt to which it is indifferent, and preferably a salt which crystallises with much water. Thus, sulphuric acid is mixed with anhydrous sodium sulphate or magnesium sulphate; hydrochloric acid with chloride of calcium or magnesium, and so forth. The salt is dissolved in the acid by the action of heat, and as soon as solution is effected the mixture is cooled in order to solidify. The salt mixed with the acid does not in many cases interfere with the use of the acid, whereas its solid state facilitates its transport.—S. H.

Improvements in Condensers and Towers for the Condensation of Acid and Corrosive Gases. D. Herman, St. Helens. Eng. Pat. 17,255, December 15, 1887. 8*d*.

The invention consists essentially in constructing the condensing towers of a series of glass pipes, carried by bearers, each of the pipes having at one end an external flange, and at the other an internal flange, the internal flange being of less diameter than the external. Fig. 1 is a view, part in elevation and part in vertical section, and Fig. 2 a plan of the tower; *a* being the glass pipes with the external flanges *b* and the internal flanges *c*, at the lower end. This end fits within the upper end of the tube beneath; *d* are glass grids resting on the internal flanges, while the tubes are filled with coke or other suitable material; *e* are cross bearers, and *f* curved blocks resting on the cross-bearers. These blocks are furnished at their upper ends with strips of india-rubber *g*, which fit under the flanges *b*, and sustain them in position.—S. H.

Fig. 1.

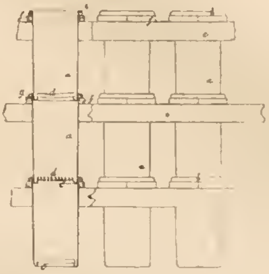
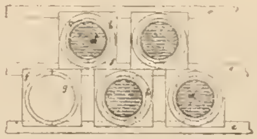


Fig. 2.



Improvements in the Manufacture of Chlorine. L. Mond and G. Eschellmann, Northwich. Eng. Pat. 17,273, December 15, 1887. 6*d*

This improvement is in the manufacture of chlorine from hydrochloric acid or ammonium chloride by means of magnesia. If magnesia be treated at a certain temperature with hydrochloric acid or ammonium chloride, steam and magnesium chloride or oxychloride are formed in the first case, ammonia in addition to the preceding in the second case. To obtain chlorine, the magnesium chloride or oxychloride is heated to a higher temperature and oxidised with dry air. The steam generated in the preceding reaction is quickly absorbed by the magnesium chloride or oxychloride, and this absorbed quantity of water being evolved in the treatment at a higher temperature by air, causes the retrograde formation of hydrochloric acid, which quantity varies from 20 to 40 per cent. of the total quantity of chlorine. In order to prevent this formation of hydrochloric acid the inventors mix with the magnesia, before it is treated with hydrochloric acid or ammonium chloride, a certain amount of a fixed alkali chloride, preferably chloride of sodium or potassium, 5 to 10 per cent. of the quantity of the magnesia being found sufficient. This admixture of a fixed alkali is said to prevent the absorption of steam by magnesia, and during the oxidation with air all the chlorine is obtained as such. After the oxidation the magnesia is ready for a renewed treatment with hydrochloric acid or ammonium chloride, as the fixed alkali remains unaltered and retains its activity continually. For the purpose of continuously producing chlorine from hydrochloric acid gas, a mixture of this vapour with air at a suitable temperature, preferably from 450° to 550° C., is passed over the magnesia mixed with alkali chloride.—S. H.

Improvements in the Purification of Sulphuric Acid. F. L. Teed, London. Eng. Pat. 17,612, December 22, 1887. 4*d*.

The object of this invention is the removal of lead from sulphuric acid. The cold acid is treated with hydrochloric acid in the form of the aqueous solution, or hydrochloric acid gas may be generated in the sulphuric acid by the addition of sodium chloride. The lead is thereby precipitated, and after removing the precipitate the hydrochloric acid remaining in the purified sulphuric acid is removed by any suitable means.—S. H.

Improvement in the Production of White Lead or Carbonate of Lead, and the Apparatus therefor. R. W. E. MacIvor, London. Eng. Pat. 10,426, July 18, 1888. 6*d*.

Acetate of ammonia or other alkaline acetate is caused to act upon the oxide, or any other compound of lead, in vessels described in the specification, carbonic acid being afterwards introduced. The process is a continuous one, the ammonium acetate being used over and over again.
—E. G. C.

Improvements in the Manufacture of White Lead, and in the Means and Apparatus employed therein. N. K. Morris, Denver, U.S.A. Eng. Pat. 13,444, September 18, 1888, 8*d*.

A chamber of wood or other suitable material, with a tiled floor, is fitted with horizontal shelves, on which metallic lead in the form of fine wire or sponge is placed. It also contains a number of shallow vessels filled with acetic acid, which are replenished when necessary from a tank on the top of the chamber communicating with them by suitably arranged pipes. The intake of a blower is connected with some source of carbonic acid gas, such as a reservoir or kiln, and also with one end of the chamber, while its delivery pipe is attached to the opposite end of the chamber. The chamber is heated in any suitable manner, preferably by steam pipes beneath it. At the temperature thus attained, the acetic acid vapourises, and is drawn into the blower, where it is mixed with carbonic acid gas, and returned to the chamber. The blower is run at such a speed as to cause only a gentle circulation of the mixed gases, and not a definite current. The supply of carbonic acid gas is regulated by means of a cock according to the rate at which it is absorbed by the lead. The novelty of the process is said to consist in the vapourisation of the acetic acid and its circulation in company with the carbonic acid gas. It is claimed that the conversion of a quantity of lead which would take 100—120 days by the older processes, is effected in 4 or 5 days by this method.—B. B.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Glass for Optical and Scientific Purposes. Schlott. Ber. d. Vereins z. Förderung d. Gewerbfl. **3**, 1888, 162.

The experiments made at Jena by Abbe, C. and R. Zeiss, and the author, have shown that boric and phosphoric acids are the only oxygen compounds that can replace silicic acid in glass, but that these can give rise to a very large number of varieties of glass. In addition to the five substances, silica, potash, soda, lead, and lime, generally used in the manufacture of glass, any of the following 28 substances may be added in the proportion of not less than 10 per cent. according to the result required: boron, phosphorus, lithium, magnesium, zinc, cadmium, barium, strontium, aluminium, beryllium, iron, manganese, cerium, didymium, erbium, silver, mercury, thallium, bismuth, antimony, arsenic, molybdenum, niobium, tungsten, tin, titanium, uranium, fluorine. Fletcher's gas furnace was employed for quantities up to 25 kilos.

The presence of boric acid in crown or flint glass causes reduced dispersion towards the blue end of the spectrum, and increased dispersion towards the red end, and hence it is possible to eliminate the secondary spectral colours. Potassium, sodium and fluorine produce the reverse effect. Boric acid is the essential basis of all flint glass in which the elimination of the secondary spectrum is required. Glass which contains boric or phosphoric acid must contain only a very small proportion of alkali, or the polished surfaces rapidly alter in contact with air. This defect can generally, however, be removed by adding to the glass an increased percentage of alumina or zinc oxide.

The discovery that glasses which contain phosphoric acid together with magnesia, alumina, or potash have a very low dispersive power, has made it possible to prepare crown glass with a very much lower dispersion than any previously made.

Barium oxide and phosphoric acid yield a glass in which a refractive index of 1·55 to 1·59 is accompanied by very low dispersive power. Aluminium sodium barium borate yields a borax crown glass with peculiar and very valuable properties. A borax glass which contains 50 per cent. of boric anhydride is very sensitive to moisture, but becomes non-hygroscopic, and fulfils all requirements if alumina, zinc oxide, or barium oxide be added.

In the prevention of internal strains the gradual solidification and cooling of the glass is a point of the greatest importance. It was found advisable to employ a chamber heated directly by a flame, the temperature being controlled and reduced automatically by means of a thermometer containing mercury vapour. The points of solidification of glasses lie between 370° and 465°, and the process of cooling through this interval of temperature has been extended from a few days to four weeks. The results obtained by this mode of treatment are much better than any that have been obtained before. The operation is regarded as satisfactory if one-fifth of the glass melted in each operation is obtained in plates which are suitable for optical purposes.

The Jena factory also makes a speciality of glass for thermometers. It is found to be essential that only one alkali should be present, but this may be either potash or soda. In practice soda is used because it is readily obtained free from potash, whereas the latter is not readily obtained free from soda. A glass which contains 7 per cent. of zinc oxide, 7 per cent. of lime, 14 per cent. of sodium oxide, $2\frac{1}{2}$ per cent. of alumina, and 2 per cent. of boric anhydride, is sufficiently fusible, but has considerable powers of resistance and answers excellently for this particular purpose.—C. H. B.

Determination of the Fire-Resisting Power of Earthenware and the Determination of High Temperatures. K. Zulkowski. Chem. Zeit. **12**, 1390—1391.

Seger has suggested that a scale for the measurement of high temperatures in ovens can be made by employing definite mixtures of Zettlitz kaolin, quartz, felspar, and marble, which would show various degrees of crackling at higher or lower temperatures, according to their composition. These mixtures are distinguished by different numbers and are shaped in the form of a tetrahedron. For very high temperatures mixtures of Zettlitz kaolin and quartz only are employed. Such scales can also be used for determining the fire-resisting power of earthenware.
—C. A. K.

PATENTS.

Improvements in the Manufacture of Compounds from Earthenware admixed with other Materials. S. Pitt, Sutton. From M. S. Higbie and G. Frelinghuysen, New Jersey, U.S.A. Eng. Pat. 15,875, November 18, 1887. 6*d*.

This invention relates to the manufacture of "compounds of earthenware," which shall be impervious to air and water. Calcined clay is broken, granulated, or pulverised, mixed while still hot with hot asphaltum, paraffin wax, &c., and pressed into any desired form.—E. G. C.

Improvements in Manufacturing and Treating Vitrifiable Colours or Pigments, and in Apparatus therefor. V. J. Kness, Paris, France. Eng. Pat. 7607, May 23, 1888. 8*d.*

According to this invention, ordinary vitrifiable colours or pigments in a state of powder are ground up with suitable proportions of two solutions, described in the specification as A and B solutions. A is a mixture of syrupy potassium silicate and lead acetate, while B consists of a solution of borax and glycerin. The mixtures so obtained may be put up in tubes and applied in the same way as ordinary colours, but it is preferable to mix or moisten them with a mixture of equal parts of water and the B solution. "The china, porcelain, glass, or other articles painted or decorated with these colours need not be burnt or exposed to the temperature of a furnace in order to vitrify the colours," this result being attained by the use of a vitrifying bath, consisting of a solution of borax to which is added hydrochloric, sulphuric, and hydrofluoric acids. A drawing of the apparatus used is given.—E. G. C.

An Improvement in the Method of Etching or Ornamenting Glass. E. J. Shaw, Walsall. Eng. Pat. 10,802, July 26, 1888. 4*d.*

Glass articles having one coloured surface are ornamented by etching a design or pattern on the non-coloured surface and removing as much of the coloured surface as may be desired to correspond with the said etching or design.

—E. E. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Hydraulic Cements. H. Le Chatelier. Ann. des Mines, **11**, 413—465.

In sections under the microscope all Portland cements exhibit two essential constitutents; the most prominent and abundant consists of colourless feebly double refractive crystals resembling in form sections of cubes, the other essential constituent is the deep coloured yellowish-red or greenish-brown substance which fills the interstices between the crystals. It is more highly double refractive than they are, but shows no definite crystalline form. The following accessory components are frequently met with in variable quantities in different samples of cement:—One, found in small quantities in all cements of good quality, resembles in size and form the above pseudo-cubic crystals, but the crystals are opaque, slightly yellow in colour, and are crossed at an angle of 60° by fine striæ. Another, only observed in some samples, generally incompletely burnt, occurs only in small quantities, in form of very small crystals giving polarisation colours. Whilst a third forms zones of inactive material with negative characters.

Weak acids, even acetic, attack the visible constituents of cements, leaving siliceous skeletons, hence it is inferred that all the essential cement constituents may be assumed to contain calcium and silica. The pseudo-cubic crystals are much more readily attacked by solutions of ammonium salts than the other constituents, and, therefore, they may be considered the most important or perhaps even the only constituent taking active part in the hardening process. Iron is present in cements in the ferric state; ferrous iron if present being accidental. The author next describes the chemical character of these constituents, and, in order to ascertain the character of the pseudo-cubic crystals, he selected a cement material containing only very little alumina, and with this object examined the nodules left on slacking hydraulic limes. In thin sections under the microscope fragments of calcium carbonate of quick and slacked lime and of wollastonite could be distinguished in the unburnt nodules, which had the following composition:—

Place of Origin.	Unburnt Nodules.						
	SiO_2.	CaO.	Al_2O_3.	Fe_2O_3.	H_2O and CO_2.	MgO. &c.	CaO : SiO_2.
Teil	43·0	46	5·5	1·0	0·0	1·0	1·15
Senonches	43·0	45	3·3	1·2	0·7	1·2	1·14
Paviers	45·5	48	4·4	1·4	0·3	0·7	1·14
„	47·0	49	2·0	1·5	0·3	1·0	1·13
	Cement Nodules.						
Paviers (grey)	26	66	3·0	7·2	1·1	1·0	2·75
Teil „	26	66	3·5	0·8	1·0	1·0	2·75
Senonches (green)	25·5	68	3·6	0·7	0·7	1·3	2·85
„ „	24	69	2·7	0·3	1·0	1·0	3·08

It seems singular that waste products resulting from irregular action of the siliceous furnace walls or the ash of the fuel should present such a uniform composition, silicates containing more lime might be expected; but it is assumed that dicalcium silicate is produced, and this owing to its spontaneous pulverisation (this Journal, 1888, 567) would pass into the mass of sifted hydraulic lime.

The cement nodules are hard, grey or green in colour, with saccharoidal fracture, and in section under the microscope are found to consist of pseudo-cubic crystals identical with those found in Portland cement, but they are closely packed together as there is a deficiency of matrix matter, consequently the composition of this kind of cements is similar whatever its origin, and therefore indicates approximately the composition of the crystals which will be seen from the above analytical numbers to approach that of a tricalcium silicate Ca_3SiO_5.

Turning to the composition of the less important constituents, the opaque yellowish striated crystals increase in number with the proportion of silica, and are observed especially on the surface of lumps of cement coming in contact with the ashes of the fuel; they appear to have properties intermediate between the silicates Ca_3SiO_5 and Ca_2SiO_3, and it is suggested that they may be isomorphic mixtures of these two silicates. The highly refractive crystals recall the properties of wollastonite, but are present in such small quantities as to be unimportant. The inert bodies are probably calcium aluminates.

The deeply coloured substance consists of double silicates of iron, aluminium, and calcium. No free lime was found in the cements, and, in fact, no good Portland cement should contain free lime, inasmuch as even as little as 1 per cent. is sufficient to reduce the strength of the cement by 10 per cent. The following conclusions are the result of these observations:—Burnt Portland cement consists essentially of a calcium silicate, approximating in composition to Ca_3SiO_5, which is the active constituent of the hardening, and is produced by direct chemical action in a mass of fused complex silicates; the latter, after having served as a vehicle to bring the silica and lime in contact, fills up the intervening spaces, but takes no part in the hardening.

A briquette of Portland cement was now subjected to the action of water for several months; it then presented a well-defined crystalline structure, and with a lens hexagonal plates could be seen in all the cavities. The surface, wherever protected from the action of carbonic anhydride, was also studded with crystals. In section these crystals appeared as bright spaces, showing polarisation colours, embedded in a scarcely translucent white mass, which shows no indication of crystallisation, and is inactive towards light. Here and there unaltered patches of the ferruginous matrix are visible. Closer investigation showed the plates to be calcium hydroxide; the white mass to be interlaced and matted spherulitic groups of attenuated crystals of a hydrated calcium silicate, with a few longer crystals of a more soluble compound, possibly an aluminate. The fundamental reaction in the hardening of Portland cement would therefore appear to be the decomposition of tri-calcium silicate, with the formation of hydrated mono-calcium silicate and calcium hydroxide, which change is represented in the following equation—

$$Ca_3SiO_5 + xH_2O = CaSiO_3, 2\cdot5\ H_2O + 2\ CaH_2O_2.$$

(Compare Barium Cements, this Journal, 1888, 676, and Calcium Silicates, *ibid.* 567), probably associated with secondary reaction, resulting in the formation of a hydrated calcium aluminate (this Journal, 1888, 567). It is certain, however, that iron takes no part in the hardening of Portland cements, although it is an important active constituent of quick-setting cements. The formation of the spherulitic groups can be seen by examining moistened Portland cement under a microscope (compare Plaster of Paris, this Journal, 1888, 675). The proportions of the materials for the preparation of Portland cement must be arranged so as to avoid the presence, in the burnt cement, of free lime and the calcium silicate which pulverises spontaneously (Calcium Salts, this Journal, 1888, 567); and from the foregoing results and the examination of good and inferior cements, it is shown that the proportion of lime employed should not exceed a maximum represented by the following formula—

$$\frac{CaO, MgO}{SiO_2 + Al_2O_3} = 3,$$

or be less than a minimum of—

$$\frac{CaO, MgO}{SiO_2 - (Al_2O_3, Fe_2O_3)} = 3,$$

In each case the quantities in the formulæ are equivalents of the substances, not weights.

Owing to imperfections in grinding and mixing the constituents, it is never possible to ensure complete action; therefore it is advisable to allow a slight excess of silica, as this simply results in the production of inert silico-aluminates. Some larger particles of lime will always slip into the mixture, and will produce a small quantity of free lime, which must be slaked before using the cement, either by exposing the ground cement to the air, or by mixing in gypsum or hydrated cement during the grinding.

The first effect of burning is the decomposition and dehydration of the clay at about 600°, in proof of which clay is found to yield more silica to potash and more alumina to sulphuric acid after such treatment than it did before it. Between 800°—900° the limestone decomposes, and the clay constituents commence to combine with the lime, the action increasing as the temperature rises, and being more prolonged; so that between the silica and alumina on one hand to the lime on the other, there are all sorts of intermediate products. First come glasses with little lime, then mixed silicates and mono- and di-calcium silicates, all fusible at the temperature of burning; finally, the more basic compounds, such as the infusible and all-important tri-calcium silicate, and the fusible tri-calcium aluminate. The proportion of these substances vary continually as the burning advances until a limit is reached, depending on the proportions of the various constituents present. It will be seen that a cement may assume characters due to any of the above products, either by modifying the heating process or by altering the proportions of the constituents. The temperature employed must be sufficient to fuse the complex silicates, therefore it is desirable to have these as fusible as possible; to obtain this result, the mixture should contain iron and alumina in the proportions of $1\cdot5\ Fe_2O_3 : 1\ Al_2O_3$.

In preparing Portland cement about 25 per cent. of inferior matters are produced, among these are:—1stly. The "blue powder," formed by the disintegration of clinkers of cement, this contains a large proportion of di-calcium silicate, the silica being derived from the walls of the furnace and from the ash of the fuel. This powder sets slowly but may become very hard, it contains no free lime and will not slake. 2ndly. Imperfectly burnt brown or grey porous lumps, these contain free lime, calcium ferrates and aluminates, and they slack gradually in moist air, falling to a brown powder. After partial quenching they yield a very rapidly setting cement, but with small and irregular resistance. 3rdly. Highly siliceous substances, such as glasses and wollastonite.

Cheap and inferior cements are prepared by burning natural products, the best results are obtained from limestones rich in clay only slightly burnt, and allowing the mass to slack in the air before it is used. It is only their cheapness which recommends them.

Hydraulic limes should be prepared from the siliceous limestones. The proportion of silica to calcium carbonate should be $16\cdot6\ SiO_2$ to $83\cdot4\ CaCO_3$. The limestone should contain about 3 per cent. of iron and aluminium oxide for the sake of forming fusible material. The grains of silica must not be too large. In many cases where limestones have not yielded good hydraulic cements, it is more likely due to the coarseness of the silica grains than to their chemical condition as has been supposed. The object is to obtain a clinker which will slake and crumble, and thus avoid the cost of mechanical pulverising.

The proportions above given are the best, and with these the hydraulic properties increase as the burning is more perfect, but at the same time the slaking properties diminish, till ultimately "limited" hydraulic limes are produced, which neither slaking nor crumble spontaneously, but when pulverised and slaked yield a very good quality of hydraulic product. The nodules from sifted hydraulic limes vary much in character, some being useful as cements, others useless. The great point in hydraulic limes is the slaking which should be done at the factory and not at the place where it is to be employed. The object is of course to slake the lime without hydrating the silicates, and the most efficient means is the use of heat and steam, this acts vigorously on the lime, &c., but not at all on the silicates; hence a large works may burn stronger and produce a better hydraulic product than a works where good slaking appliances are not at hand. An incompletely slaked lime sets at first but ultimately disintegrates, whilst hydraulic lime too strongly slaked contains much useless hydrated silicates.

With regard to the setting of cements the author recognises two stages; first, incipient hardening, then the setting proper; sometimes there is a third stage of deterioration, as for example, when a quick-setting cement becomes harder and harder during a period of three months and then loses strength. The first stage is the result of the hydration of the lime.calcium aluminates and ferrates, of finely divided calcium silicate, and the surface of larger particles of the same; whilst the setting proper is the result of the steady hydration of the tri-calcium silicate. By examining the progress of the first stage with a thermometer, a period of quiescence is first noticed, due, it is assumed, to the formation of the saturated solutions, then follows a period of heat development, attributed to the sudden crystallisation. It is evident that many causes influence the rate of the setting in the first stage; degree of fineness, porosity of the particles, such as those burnt rapidly at a low temperature, large proportions of aluminates and ferrates. The rate of the second stage is unimportant, as it is only the ultimate hardness that is of consequence, and this depends on the adhesion of the particles of the constituents to one another. Therefore factors influencing adhesion are of interest, such as the nature and state of the substances, the extent of surfaces in contact, the form of the crystals, the capacity and distribution of spaces.

Adhesion is favoured :—1. By the presence of substances which adhere together readily, such as calcium silicates and silica; 2. By increasing the surface of contact; therefore crystals exposing the greatest proportion of surface, such as the attenuated crystals observed in cements, are eminently suited to great adhesion and consequently hardness.

Spaces naturally tend to reduce adhesion, consequently when water gets imprisoned in a mass of cement it occupies spaces and reduces the extent of solid surfaces of contact; hence it is found that when a wet test briquette is placed on a dry plaster slab to set, it has greater resistance than a similar briquette not treated in that manner. Rapid hydration, solution, and crystallisation are favourable to the formation of attenuated crystals, whereas when hydration and solution take place so as to permit of steady crystallisation without supersaturation, comparatively bulky crystals form, and the resulting adhesion is bad. For the latter reason, over-burnt plaster sets badly or not at all, whilst under-burnt inferior cements owe their quick setting to their porosity; this allows water to penetrate quickly and produce rapid hydration, supersaturation, &c. The number of centres of crystallisation is of importance, for with many centres crystallisation is rapid, but supersaturation is prevented; the crystals then are numerous but shorter, and consequently the proportion of surfaces for contact is diminished; this would account for bad results with deadened cements.

The causes of the destruction of cements are next discussed. When cements contain efflorescent substances they lose water in the air and disintegrate; calcium aluminate is efflorescent, and when it is present in quick-setting cements they suffer in the manner described; Portland cement of good quality never contains such substances. Hydration in moist air or water, accompanied by expansion, is a frequent source of disintegration of cements; this is due to the presence of unslaked lime or calcium ferrates or aluminates, a point already fully noticed. It is well to remember :—that dense lime or dense substances containing lime take a long time to slake; that water as vapour is more potent than water in liquid state for the hydration of lime; and that even as little as 1 per cent. of unslaked lime in a cement is disastrous. Plaster or cements containing much lime are disintegrated by the solvent action of water, whilst the magnesium salts in sea-water injure cements even more than fresh water, by replacing lime by magnesia; both these sources of injury may be prevented by proper carbonation.

When carbonation takes place rapidly it simply produces pulverulent matter, but when it proceeds slowly it gives rise to crystals and then protects the mortar or cement, and even fills up cracks. Crystalline carbonation is therefore more perfect when carbonic anhydride acts on the less soluble calcium compounds; hence the absence or removal of calcium hydroxide, as, for instance, by the addition of pouzzolana to the cement, or the use of calcium silicates (slags, for example), which are inert towards water, but are attacked by carbonic anhydride, are favourable conditions. A good way to induce carbonation is to mix organic matter, *e.g.*, saw-dust, with the cement, as this is slowly decomposed by the lime with evolution of carbonic anhydride. The Romans used straw in preparing their fresco surfaces.

The part played by magnesium salts requires further investigation. No hydrated carbonate of calcium is formed above 5°.

With regard to testing cements, many of the above remarks are applicable. The cement should not contain more base than is sufficient to saturate all the acids. Ferric oxide must not be regarded as an acid, because calcium ferrates slake, and are therefore undesirable; as examples of a good cement, setting well, and a bad one which would not set, the author gives the following analytical data, expressed in equivalents, taking the quantity of silica present as unity.

—	Good.	Bad.
SiO_2	1·00 } 1·21	1·00 } 1·17
Al_2O_3	0·21	0·17
Fe_2O_3	0·04	0·06
CaO	3·29 } 3·37	3·71 } 3·76
MgO	0·08	0·05
$CaSO_4$	0·02	0·01
Loss, &c. per cent.	0·94	1·82
$\frac{\text{Bases}}{\text{Acids}}$	2·78	3·2

All the following methods have been found deficient for ascertaining the quality of cements :—Treatment with water or with ammonium salts; noting heat evolved on dissolving in acid; examining sections under the microscope; and the usual mechanical test, even after the cement has been exposed to hydration three months. Somewhat more satisfactory results have been obtained by placing the briquettes 24 hours after moistening into water at about 100°, but not in ebullition as the agitation would disintegrate the cements, more especially the slow-setting ones, 48 hours in the hot water being sufficient to develop most of the effects of expansion due to slaking, and after 7 days the resistance of the briquette is at its highest; it is then, to make the operation more complete, dessicated at 100° in dry air, inferior quick-drying cements have been found to lose half their resistance during this latter operation.

The following numbers are from tests made with cylindrical briquettes, 2 cm. high and 2 cm. diameter, some heated, some not :—

Seven days' Hydration.	Resistance after without Heating.	Heated to 100°.
Varsy quick-setting cement	Kilos. 630, 650, 750	Kilos. 490, 325, 340
Teil cement	480	460, 430
Portland cement....	625	640

Such tests, combined with determination of the rapidity of setting, appear to be more suitable for judging the value of cements than the usual mode of testing; the author does not consider this fully established, as he has not made enough experiments with the method, and therefore he concludes that there is no really good method of testing cements. He recommends comparing the characters of the material under examination with those of a product which has been in use for years for a similar purpose and has proved satisfactory; taking into account the chemical composition, heat of solution, density, resistance, &c.

—D. A. L.

Decomposition of Calcium Carbonate by Heat. H. Le Chatelier. Ann. des Mines, **11**, 374—379.

In connexion with the decomposition of calcium carbonate by heat (this Vol., 690), the author made the following experiments :—A porcelain tube was filled with precipitated carbonate in those portions which were heated, and beyond with fragments of marble. A thermo-electric couple was placed in the midst of the carbonate. The tubes were heated in a furnace at a sufficiently constant temperature so that it increased only 10° from the commencement to the end of an experiment lasting 12 hours. The couple was graduated immediately before the experiment at the boiling-point of sulphur and selenium and at the fusing point of gold, the latter point being again ascertained at the termination of the experiment in order to show that the couple had undergone no change. The couple was wrapped in gold-leaf before being placed in the carbonate, and as soon as the dissociation was complete the temperature was raised gradually to melt the gold within the experimental apparatus. Observations were made at various temperatures with the results already indicated.—D. A. L.

PATENTS.

Improvements in the Manufacture of Cement. F. Ransome, Norwood. Eng. Pat. 15,065, November 4th, 1887. 4*d*.

Cement material in a state of fine sub-division is introduced into a revolving retort, and heated therein, so as to cause the particles to more or less adhere to one another, and so that the material shall issue from the retort in the form of small lumps or pellets, which are subsequently pulverised. This invention is a modification of a previous one. (Eng. Pat. 5442, 1885. This Journal, 1885, 327.)—E. G. C.

Improvements in the Manufacture of Cement. G. M. R. Layton, Bedford. Eng. Pat. 15,666, November 15, 1887. 8*d*.

The inventor uses the hot cement or "clinker" for drying the "slurry" or cement material, the latter being placed on a floor forming the top of a chamber, or series of chambers, through which the "clinker" is conveyed on trolleys. —E. G. C.

An Improved Cement for caulking Metallic Joints. W. Watkins, Chicago, U.S.A. Eng. Pat. 11,616, August 11, 1888. 4*d*.

An iron cement or putty, formed of sweet oil and molasses, mixed with barytes, Venetian red, plumbago, Paris white, yellow ochre, litharge, and red lead.—E. G. C.

Improvements in the Manufacture of Portland Cement. J. W. T. Stephens, Cardiff, and R. Clark, London. Eng. Pat. 11,909, August 17, 1888. 4*d*.

Blue lias pebble limestones and clayey mud are the materials employed. The stones are burnt to reduce them to lime, and the latter is mixed with the mud, the mixture being finally burnt to reduce it to clinker.—E. G. C.

X.—METALLURGY, MINING, Etc.

The Separation of Gold by Wet Methods. Dingl. Polyt. J. 269, 577—582.

The chlorination method of Plattner is discussed, and the waste of chlorine, due to its attacking foreign matters if present, is pointed out. If lime or magnesia be present, some salt is added towards the end of the roasting operation. Some gold, however, is lost by volatilisation during this process, and it is to avoid this and overcome other difficulties that various modifications of the original process have been devised, the more important of which are connected with the use of chlorine under pressure. Besides the Newbury-Vautin modification, of which drawings are given (see this Journal, 1887, 824), there is a detailed description of another by Munktell. This latter consists of roasting the ore to oxide, washing away the ferrous salts, and passing through the roasted material a solution of chloride of lime and hydrochloric acid, these two materials being mixed only immediately before coming into contact with the ore. The method has been employed on the large scale, and the description is accompanied by drawings of the arrangement of the chlorination vats and other plant used.

The following is an analysis of an auriferous aqueous solution after chlorination:—

	Grains.
Aluminium sulphate	6·98
Magnesium sulphate	132·55
Lead sulphate	4·16
Sodium sulphate	426·62
Gold chloride	10·44
Iron chloride	0·32
Copper chloride	8·95
Sodium chloride	536·00
Silicic acid	0·24
Free chlorine	101·02
	1227·28

From such a solution as this gold can be completely precipitated by freshly burnt charcoal.—A. W.

The Separation of Gold and Silver. Dingl. Polyt. J. 269, 582—584.

In New York, sulphuric acid is used for this purpose. The alloy should contain four parts of silver to one of gold, and the copper should be not more than one-twelfth of the total weight. The granulated alloy is heated with three times its weight of acid of 66° B. in iron pots, the solution of silver sulphate decanted, the residue again treated with acid, washed with hot water, pressed, dried, and melted under bone-ash. The silver sulphate solution is diluted to 20° B., heated by steam, and the silver precipitated by copper. The precipitate is washed, pressed, dried, and melted with nitre, borax, and soda under a layer of bone-ash. The sulphurous acid formed during solution is conducted into the vitriol chamber, and the copper sulphate solution crystallised.

In the Philadelphia Mint nitric acid is used for the separation, the residue being finally treated with sulphuric acid, and gold obtained of the purity 998. The silver is precipitated by common salt, and the chloride reduced by zinc.

In San Francisco the sulphuric acid method is employed, the silver being precipitated by ferrous sulphate.

Statistics are given of the production of gold and silver in the Siebenbürgen District, East Siberia, the Russian Empire, Prussia, and the United States, the latter being by far the greatest producers in 1885, with 30,800,000 dollars of gold and 48,800,000 dollars of silver.—A. W.

On the Occurrence and Production of Iron in the World. Dingl. Polyt. J. 269, 584—597.

It is pointed out that in the year 1740 only 17,000 tons of pig iron were produced in England and that iron was imported from America. In 1788 the production reached 68,000 tons, and in 1796 125,000 tons. After the Revolution the American iron industry rapidly diminished, and was exceeded by the British, but to-day they are again on a par. The progress of the iron industry in various countries is reviewed, and the production of each for many years past is given in a long series of tables, showing the amount of iron ores worked and the pig iron obtained. From these it is seen that in 20 years the production of iron ore and pig iron increased to three times its former amount, and that in Germany the production of pig iron for each workman employed increased to four times its former quantity, and the amount of iron ore raised increased two fold.—A. W.

PATENTS.

Improvements in the Wet or Hydro-Metallurgical Method of extracting Gold from Crushed or other Finely Divided Auriferous Material. J. C. Newbery, Melbourne, C. T. J. Vautin, St. Kilda, Australia. Eng. Pat. 4609, March 28, 1887. 4*d*. (Third Edition.)

In the process of extracting gold by chlorine under pressure, the pressure has so far been produced by employing excess of chlorine. This patent relates to the production of that pressure by forcing air into the closed containing vessel in which the chlorination is taking place, thus preventing the use of an excess of chlorine over and above the amount necessary to combine with the gold. In filtering the gold solution a claim is made for the application of an aspirator to expedite the same, a vacuum pump being preferably used, as it gives a jigging motion to the materials under treatment, and so prevents the filtering medium from setting too tightly. The gold is precipitated by filtering through lump charcoal, which is then burnt. (*See* this Journal, 1888, pages 109, 125.)—A. W.

Improvements in Extracting Gold from Simple, Compound, and Refractory Ores, or Slags, or Wastes, or Cinders of Ores or Metals containing Gold or Gold Blends by Fusions with Antimoniac Compounds. F. Fenton Batley and R. J. Partridge, Grasmere. From J. Woolford, Brionde, France. Eng. Pat. 10,588, July 30, 1887. 8*d.*

The claim made is, "The process for operating upon ores or metals containing gold or gold blends by the plan of fusion or evaporation of them with or by antimoniac compounds in union with iron, or ores, or substances containing that metal along with carbonate of soda, and separating of the released gold in a metallic state along with antimony and the superfluous antimony in a compound state with oxygen and sulphur."—O. H.

Improvements in the Manufacture of Sodium and Potassium and in Apparatus therefor. C. Netto, Dresden. Eng. Pat. 14,602, October 26, 1887. 8*d.*

A column of coke or charcoal is heated in a receiver or retort to a high temperature. The caustic soda in a fused condition is then run in, and, falling as a fine spray on the red-hot charcoal, is decomposed very rapidly, and the vapours of sodium are able to escape freely between the lumps of charcoal into the condenser. To prevent the possibility of any air causing an explosion by entering the retort this is made without any opening in the lower part of it. A drawing of the apparatus accompanies the specification.

—E. E. B.

Improvements in Apparatus for the Extraction of Gold from Crushed or other Finely Divided Auriferous Material. C. T. J. Vautin, London. Eng. Pat. 15,574, Nov. 14, 1887. 8*d.* (Second Edition.)

See this Journal, 1888, page 125. —O. H.

Improvements in the Manufacture of Sodium and Potassium. A. B. Cunningham, London. Eng. Pat. 3601, March 8, 1888. 8*d.*

Caustic soda or potash is fused in an open vessel and pulverised carbon mixed with it, although not in sufficient quantity to destroy its liquidity. The charge is then introduced, whilst still liquid, into a red-hot retort. The fumes of sodium or potassium are condensed by any suitable method, and the residue is discharged through an outlet in the retort, preferably intermittently. Drawings accompany the specification.—E. E. B.

Improvements in the Manufacture of Aluminium. W. G. Forster. Eng. Pat. 7685, May 25, 1888. 6*d.*

This improvement consists in the utilisation of the slag formed in the manufacture of aluminium from cryolite. The slag is treated with water, and on adding hydrofluoride of aluminium, the double fluoride of sodium and aluminium is precipitated, from which the aluminium is extracted in the same manner as from the natural cryolite. It is not necessary to decant the solution from the insoluble residue before adding the aluminium hydrofluoride. Compounds for the production of aluminium may also be made by adding a solution of sodium fluoride to a solution of either hydrofluoride or hydrochloride of aluminium.—E. E. B.

Improvements in a Method or Process of Alloying or Aluminizing Metals with Aluminium. W. A. Baldwin, New York, U.S.A. Eng. Pat. 13,474, September 18, 1888. 4*d.*

A mixture is made of an earth containing alumina, such as clay, with common salt and some carbonaceous substance such as charcoal or coke. The mixture is placed in any suitable vessel, and into it is poured the melted metal which has to be alloyed. The aluminium is set free and combines with the metal forming the required alloy.—E. E. B.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Electro motive Force of Bichromate Batteries with Hydrochloric Acid. A. Reynier. Dingl. Polyt. J. 269, 611.

The following table is given showing the composition of the batteries and the electromotive force obtained:—

Temperature 17° C.

Composition of the Chromic Acid Mixture in Parts by Weight.	100 Parts by Weight contained.				E.M.F. in Volts.	
					Cell with one Solution.	Cell with two Solutions.
	Bichromate.	Acid at 21° B.	Hydrochloric Acid.	Density.	− Electrode Amalgamated Zinc. + Electrode Retort Carbon.	− Electrode Amalgamated Zinc in porous Pot containing acidulated Water 1:5 HCl. Sp. Gr. 1·10. + Electrode Retort Carbon.
Cells with Potassium Bichromate.						
I.						
Water........ 1,000 Potassium bichromate........ 65 Hydrochloric acid 21° B........ 240	5·0	18·30	6·13	1·07	1·92	2·05
II. (Theoretical.)						
Water........ 1,000 Potassium bichromate........ 100 Hydrochloric acid 21° B........ 519	6·18	32·05	10·68	1·10	1·95	2·09
III. (d'Arsonval.)						
Water........ 1,000 Potassium bichromate........ 65 Hydrochloric acid 21° B........ 1,200	4·41	52·98	17·66	1·12	2·05	2·11

Composition of the Chromic Acid Mixture in Parts by Weight.	100 Parts by Weight contained.			Density.	E.M.F. in Volts.	
	Bi-chromate.	Acid at 21° B.	Hydro-chloric Acid.		Cell with one Solution.	Cell with two Solutions.
					− Electrode Amalgamated Zinc. + Electrode Retort Carbon.	− Electrode Amalgamated Zinc in porous Pot containing acidulated Water 1:5 HCl. Sp. Gr. 1·10. + Electrode Retort Carbon.
CELLS WITH SODIUM BICHROMATE.						
IV.						
Water .... 1,000 Sodium bichromate .... 200 Hydrochloric acid 21° B. 1,200	8·33	50·00	16·66	1·14	1·99	2·09
V.						
Water .... 1,000 Sodium bichromate .... 500 Hydrochloric acid 21° B. 1,500	16·66	50·00	16·66	1·20	2·00	2·10
VI. (Theoretical.)						
Water .... 1,000 Sodium bichromate .... 1,800 Hydrochloric acid 21° B. 10,500	13·53	78·99	26·31	1·21	2·08	2·14

—A. W.

PATENTS.

Improvements in obtaining Aluminium Bronze. A. Zdziarski, London. From J. Boguski, Warsaw, Russia. Eng. Pat. 3090, February 11, 1884. (Second edition.) 6*d*.

The metal (copper, brass, etc.) to be alloyed with the aluminium is melted in a plumbago or wrought-iron crucible, and on its surface is fused a quantity of cryolite or other compound of aluminium with a suitable flux. The metal is connected with the cathode of a dynamo, whilst a carbon rod connected with the anode is placed in the melted cryolite without contact with the metal underneath. By this means alloys of aluminium are produced, and if the metal be not melted then a layer of aluminium is formed on its surface. The flux used must be capable of ready combination with fluorine, which is liberated at the positive pole, and alkaline carbonates are recommended for this purpose. When cryolite is used it is necessary first to separate the silica, or else it is reduced and silicon enters into the alloy, and in the case of aluminium bronze renders it brittle. Oxide of aluminium may also be used with sufficient carbonate of potash to give an easily fusible mixture, in which case the carbon anode is not so rapidly destroyed. (Compare this Journal, 1885, 224.)—A. W.

An Improved Method of, and Apparatus for, Amalgamating Gold and other Metals. S. T. Dahl, Bömmel, Norway. Eng. Pat. 7159, May 14, 1888. 8*d*.

This is an improved form of pan amalgamator in which the outer portion of the pan only is made use of, thus preventing the difficulties attached to the present forms due to the difference in speed between the centre and the periphery. The base of the apparatus is made of masonry covered with cement, and consists essentially of a circular trough. On the centre of the base is a vertical shaft, on which are fixed arms which carry vertical conducting rods attached to a cylindrical ring of wood. Mercury is placed in the circular trough, the ring of wood is lowered into the trough until it just touches the surface of the mercury; it is then fixed and made to revolve by proper gearing connected with the vertical shaft, and the ore is then washed in. The apparatus can be used open or under pressure. Electricity is applied, if necessary, by connecting with the two poles of a dynamo two copper or iron rings, one placed on the inner and upper side of the wooden ring and the other placed at the bottom and on the outer side of the circular trough. The great advantage of this amalgamator is that it can be made of any size. It is also more easy of management, and the cost of erection is small as the base of the apparatus can be made entirely of masonry. The pulp can be introduced in any convenient way, and drawings are given showing the whole machine, and the means employed for equally distributing the pulp, both when the process is carried on with and without pressure.—A. W.

Improvements in or relating to Bleaching by Electrolysis. E. M. H. Andreoli, Brixton. Eng. Pat. 13,192, September 12, 1888. 6*d*.

See under VI., page 844.

Improvements in Ungumming and Bleaching by Electrolysis China Grass, Rhea, Ramie, and other Nettles. E. M. H. Andreoli, Brixton. Eng. Pat. 13,194, September 12, 1888. 6*d*.

See page 844. —O. H.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Lubricants for Wool. T. Morawski. Mittheil. des k. k. Tech. Gew.-Museum, 2, 14–16.

The use of mineral oil, either alone or mixed with saponifiable oils, is condemned, since grease stains are usually produced from such oils during the milling. The grease or "extracted oil," recovered by means of acids from the milling baths, is now of better quality, containing less unsaponifiable matter than formerly, and therefore more suitable for lubricating. Since mineral oil produces bad results, manufacturers are offering, at prices much above the real value, such mixtures as the following, which forms a very stable emulsion:—

	Per Cent.
Water	76·67
Saponifiable oil	20·86
Irish moss extract	0·72
Dry soda soap	0·91
Insoluble and loss	0·84
	100·00

—E. B.

Composition of Grease recovered in the Milling Processes. T. Morawski. Mittheil. des k. k. Tech. Gew.-Museum, 2, 16–17.

By the addition of a slight excess of sulphuric acid to the milling liquors the grease is precipitated. After pressing out the fatty matters as completely as possible from the magma, the residue still contains some 15—20 per cent. This amount is reduced by extracting with benzine. The extracted cake then consists largely of wool fibres. In order to find an application for this residue, experiments were made with the charcoal obtained on carbonising it, but it was found worthless as a decolourant. As it contains nitrogen to the extent of from 2—5 per cent., it may have value as a manure, if the metallic compounds, which are derived from the mordanting of the wool. be not objectionable.

The following analysis shows the composition of the extracted cake :—

	Per Cent.
Water	7·51
Ash	13·19
Fat	5·18
Nitrogenous matter (wool) equiv. to 9·7 per cent. of nitrogen	54·80
Organic matter	19·32
	100·00

The ash contained :—

	Per Cent.
Sand and clay	69·40
Fe_2O_3	12·40
Cr_2O_3	3·04
Al_2O_3	8·30
CuO	1·81
SnO_2	0·54
CaO	1·37
MgO	0·01
SO_3	1·42
P_2O_5	trace
Alkalis and loss	1·71
	100·00

—E. B.

PATENT.

Improvements in the Manufacture and Application of the Compounds of Chloride of Sulphur with Fatty Bodies. A. Sommer, Berkeley, California, U.S.A. Eng. Pat. 12,795, September 4, 1888. 1s. 2*d*.

This patent contains an apparently exhaustive statement of the conditions under which animal and vegetable oils, fats, waxes, and fatty acids combine with chloride of sulphur,—a classification of fatty bodies according to the properties of their sulphochlorinated compounds,—working processes for manufacturing and neutralising these compounds, and lastly the application of these compounds (1) for making adhesive tissues; (2) for "extinguishing" (*i.e.*, holding in permanent suspension) mercury; (3) for fulling, preserving, and waterproofing leather and hide; (4) for making lubricants and paint oils. From the standpoint of the manufacturer, oils may be divided into three groups, according to the rapidity of their combination with chloride of sulphur. Castor oil, lard oil, cocoanut oil may be taken as types. When combination is instantaneous, as with castor oil, the patentee dilutes the sulphur chloride, not as usual with a volatile solvent, but with some neutral and non-volatile diluent as paraffin or wax, and performs the operation at 0° C. To neutralise the acids formed, finely sifted air-slaked lime is incorporated with the mass, or alkali in some form of combination, either in solution or in fine powder. Very detailed instructions are given as to how to proceed with many different kinds of fats, so as to obtain the desired products; and also how to use these products in the manufacture of various articles. Each section contains nine or ten closely printed pages, and the whole concludes with twenty separate claims.—W. L. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

PATENTS.

An Improved Paint or Varnish for Iron, Steel, Metal, and Tarpaulins. K. McLea and R. Punshon, London. Eng. Pat. 15,381, November 10, 1887. 4*d*.

A composition containing sulphur, resin, "ozorcerite" (*ozokerite*), and linseed oil.—E. G. C.

A New or Improved Process and Apparatus for Rendering Textile Fabrics Waterproof or Water-repellent. T. F. Wiley, Bradford. Eng. Pat. 15,900, November 19, 1887. 8*d*.

This invention relates to a process for coating fabrics with paraffin wax and similar substances, by pressing it against a heated cylinder, the periphery of which is kept supplied with material from a bath into which it dips.

Another method consists in causing a spray of the melted material to impinge on the fabric. The spray is produced by the action of steam, or a blast of hot air passing over the narrow opening of pipes dipping into the melted material.—E. J. B.

A New Process or Method of and Apparatus for Rendering Textile Fabrics Waterproof or Water-repellent. T. F. Wiley, Bradford. Eng. Pat. 15,896, November 19, 1887. 8*d*.

The process consists in coating the fabrics with such substances as paraffin wax, bees wax, etc., either alone or in suitable combination, without the aid of solvents. The fabric passes between a hollow india-rubber roller and a slab of the waterproofing material, which is kept pressing thereon by means of weights. In this way a coating is formed which, when the fabric passes over heated cylinders, melts and thoroughly distributes itself on the fibres. The apparatus is fully described and a drawing given.—E. J. B.

Improvements in the Manufacture of Non-Inflammable Celluloid Matters. A. C. Henderson, London. From C. Stocker, Paris, France. Eng. Pat. 16,330, November 28, 1887. 6*d*.

The improvement consists in incorporating with the celluloid or similar substance made from nitro-cellulose, a quantity of a metallic salt such as protochloride of tin dissolved in alcohol, ether, or other suitable solvent.

—E. J. B.

The Manufacture of a Novel Elastic Substance. H. M. Steinthal, Scarborough. Eng. Pat. 17,732. December 24, 1887. 4*d*.

A mixture of flowers of sulphur, powdered amber, and "caoutchine," is incorporated with boiled linseed oil.

—W. L. C.

An Improved Liquid Enamelling Composition. J. H. Jackson, London. Eng. Pat. 10,379, July 17, 1888. 6*d.*

One gallon of methylated spirit is boiled for three hours with $\frac{1}{4}$ lb. of resin and $1\frac{1}{2}$ lb. of shellac; 6 lbs. of bronze powder of any desired colour are then added, and the composition when cold is ready for use. $\frac{1}{2}$ lb. of benzoin may be substituted for the resin, in which case only $4\frac{1}{2}$ lbs. of bronze powder are added.

The resulting liquid may be applied to metal and other surfaces, with a brush, in successive coats, the first being allowed to dry before the second is put on.—B. B.

Non-Corrosive and Anti-Fouling Compositions. A. J. Davison, Leytonstone. Eng. Pat. 11,209, August 2, 1888. 4*d.*

The chief ingredients used by this inventor are resin, coal tar, black lead, quicklime, creosote, shellac, red lead, and methylated spirits.—E. G. C.

XV.—AGRICULTURE, MANURES, Etc.

Vegetation in the neighbourhood of Works. Chem. Zeit. **12**, 1279—1280.

At the recent meeting of scientists in Cologne this subject was discussed. The most serious damage was said to be caused by the sulphurous acid produced from the fuel used. Members of the pine family are more especially affected.
—T. L. B.

Nitrogenous Constituents of young Soja Hispida Plants. E. Schulze. Zeits. f. Physiolog. Chem. **12**, 405–415.

Etiolated *Soja hispida* shoots contain as much as from 7 to 8 per cent. of asparagine, as well as leucine, phenylamidopropionic acid, choline, and bases of the hypoxanthine and xanthine groups, whilst the presence of arginine is uncertain. In this latter point the soja shoots differs from those of the lupine which contain plenty of arginine. Choline appears to be very widely distributed throughout the vegetable kingdom.—D. A. L.

The Sulphur Compounds of the Cruciferae. W. J. Smith. Zeits. f. Physiologie, **12**, 419—433.

The author has examined the seeds of a great many cruciferae, and finds that with one exception, in all these seeds most of the sulphur is in the form of an acid similar to the myronic acid found in black mustard seed, the rest of the sulphur being traced to the albumen. The exception to this rule is *Isatis tinctoria,* which contains a noteworthy amount of sulphuric acid, but only in the husks. The decomposition of this sulphur organic acid by the ferment in the seeds takes place at different rates in different plants; thus in *Brassica napus* it proceeds slowly, but quicker in *Sinapis alba* and *Lepidium sativum.* This difference is due to the character of the acids and not to the ferment which appears to be identical in all these plants. These acids are completely destroyed by the germination of the seeds, but are soon reproduced, so that there is a considerable quantity in a plant a week old. The difference between the total quantity of sulphuric acid in the seeds before and after germination is insignificant, so that its consumption during germination for the formation of albumen is not definitely ascertained.—D. A. L.

Manuring with Artificial Manures in the Summer of 1887. Determann. Land. Wochenblatt f. Schleswig-Holstein, 1888, 330–332.

Rye on a sandy soil (class 6 and 7) following manured rye and potatoes, was manured with 8 centners of kainite, 5 centners of pulverised Thomas phosphate, and some rows with $\frac{1}{2}$ centner of ammonium sulphate per hectare in addition. The crop stood and yielded better on the manured land than on the parts where no extra manure was placed, but no result was observed from the sulphate. The phosphate and kainite had a good influence on the young clover plants (sown with the rye) and in spite of the dry summer they yielded a good crop in the autumn.

Some oats and rye were top-dressed with kainite and phosphate without results, the oats, as well as some peas, suffered by the drought. Roots prospered well, so did grass and potatoes on extra dressings of the phosphate and kainite. In fact, both the yield and edible quality of the potatoes improve, but with Chili saltpetre in addition the quantity increases but the edible quality suffers, so that the potatoes are then only fit for fodder; Chili saltpetre alone is uncertain, the phosphate and kainite should be sown in January or February.—D. A. L.

Occurrence of Micro-Organisms at different Depths in the Soil. C. Fränkel. Bied. Centr. **17**, 677—679.

In this investigation samples were taken by a specially-constructed borer, which only removed soil from the desired depth. Equal bulks of the samples were put in tubes of gelatin, and spread well out on the walls of the tube. The organisms in the soil samples, like those in potable waters, at first increase rapidly, but subsequently fall off in numbers. It is therefore important to test them as soon as possible after removal. In the tests for anaërobic bacteria the access of oxygen was prevented by a layer of gelatin. The following tables show the results of these tests. The Potsdam samples were from uninhabited places, whilst the Berlin samples were taken from populous districts.

Soils from Neighbourhood of Potsdam, 1886—1887.

Depth of Soil in Metres.	Number of Bacteria Germs in about 1 cc.								
	24th April.	27th May.	12th June.	9th July.	14th August.	4th Sept.	2nd Oct.	3rd Nov.	16th Mar.
Surface	..	150,000	110,000	..	300,000	95,000	130,000	55,000	80,000
0·5	70,000	200,000	90,000	..	240,000	65,000	100,000	75,000	85,000
0·75	25,000	..	..	..	..	3,000	..	8,000	..
1·00	1.000	2,000	2,000	4,300	42,000	600	40,000	7,000	3,000
1·5	200	15.000	2,000	400	80,000	700	600	200	300
2·0	..	2,000	600	300	500	..	700	100	200
2·5	250	500	700	..	400	..	150	..	150
3·0	..	3,000	100	..	100	150	..	1,500	100
3·5	..	..	800	..	..	100	1,400	50	700
4·0	..	..	150	300	..	..	600	..	..

Soil from Various Places in Berlin, 1885—1886.

Depth of Soil in Metres.	Number of Bacteria Germs in 1 cc.							
	20th July.	26th July.	7th August.	8th August.	1st November.	6th April.	11th Nov.	Garden Soil.
Surface	8,000	350,000	160,000	..	300,000	..	..	150,000
0·5	6,500	50,000	40,000	..	..	..	..	300,000
1·0	45,000	800	10,000	35,000	1,000	100,000	80,000	150,000
1·5	3,500	..	..	50,000	2,000	180,000	20,000	80,000
2·0	..	750	6,000	15,000	3,500	65,000	40,000	200,000
2·5	..	..	..	20,000	300	470,000	650	700
3·0	..	..	300	500	1,000	34,000	600	100
3·5	..	..	..	150	750	..	3,000	..
4·0	..	..	..	..	..	..	900	..

—D. A. L.

Swedish Peat Moss Litter. C. V. Feilitzen. Bied. Centr. 17, 751–755.

The author has examined many samples of peat-moss from different districts and from different depths in the same district, and some of his results are given in the following table. He considers that water-absorbing capacity should be referred to the dry peat-moss and the absorptive capacity for the moist (air-dry) material calculated from such data. In his experiments the moss was exposed to water for three days, a period fixed by experiment, then allowed to drain and the increase determined; whilst for ammonia-absorbing capacity, the moss was exposed under a glass bell jar with a dish of ammonia for some days, then left in the air for 24 hours before determining the increase of nitrogen, by Kjeldahl's method. From the table it will be seen that the absorptive power is not dependent entirely on the organic matter present, but the state of decay, the character of the moss, the physical condition, all influence the absorbing power; for instance, the disintegrated moss (dust) absorbs more than the ordinary litter, but of course this would not be the case if the dust be mixed with earthy matter. With regard to the retention of water by the peat-moss, the author found that an air-dried moss absorbing 23 times its weight of water in three days had after eight days retained 13·8 times its weight. The Swedish mosses and moss districts bear comparison with those of north Germany.—D. A. L.

——	Loss on Ignition.	Ash.	Lime.	Nitrogen.	Water absorbed by One part of dry Substance.	Percentage of Ammonia absorbed by Air-dry Substance.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Highmoor at Flahult, superficial layers consisting chiefly of undecomposed roots of *Eriophorum vaginatum*, litter	98·52	1·45	..	0·76	6·60	1·89
Same locality, dust, containing more decayed roots	94·84	5·16	..	0·99	9·70	2·49
„ „ litter from underlying stratum of slightly decayed *Sphagnum* moss	99·02	0·98	..	0·44	19·53	..
Dust from same, darker and more decayed	98·01	1·99	..	0·77	17·6	2· 1
Litter from depth of 100 cm., completely decayed s. moss	99·16	0·84	..	0·55	24·2	..
Litter from 186 cm. deep, dark and decomposed Eriophorum	98·88	1·12	..	0·89	4·1	3·04
High moor at Lykas, litter of undecomposed s. moss and some Eriophorum peat	99·02	0·98	..	0·64	24·5	..
Undecomposed S. moss from Svarta	98·51	1·49	0·12	0·78	13·0	..
„ „ „ Kanarps Moor	98·30	1·70	..	0·75	13·4	..
Decayed peat earth from Skagerholm	97·20	2·80	0·34	1·11	5·7	2·94
„ „ „ Herlingstorf	85·43	14·57	3·19	2·77	4·2	2·06
„ „ „ Martebomoor	87·57	12·43	8·37	2·49	4·2	2·19

A Process for obtaining Nitrogen or Nitrogenous Mixtures from Nitrogenous Substances. M. von Maltzan, Berlin, and L. Tralls, Sebellenken, Germany. Eng. Pat. 14,831, October 31, 1887. 6*d*.

See under VII., *page* 844.—O. H.

XVI.—SUGAR, STARCH, GUM, Etc.

Extraction of Sugar from Sugar Cane by the Diffusion Method. P. Leme and M. Dränert. Bied. Centr. **17**, 790.

The cane grown on the dry soil of the Province of Rio de Janeiro contains from 13 to 19·3 per cent. of saccharose, 90 per cent. of juice is obtained on an average from the cane. The diffusion method is better than the pressing method, inasmuch as the sugar retained by the begasse is diminished from 3 to less than 1 per cent., whilst 4·9 per cent. is lost in molasses, and at least 11 per cent. of sugar obtained from the cane.—D. A. L.

The Formation of Meta-pectic Acid by the Action of Lime on Beet Juice. J. Weisberg. Chem. Zeit. **12**, 1455.

Pellet has stated that beet juice when treated with lime suffers a reduction in its rotary power. This reduction he ascribes to the formation of meta-pectic acid, which is levorotary, and which is not removed from the solution by the basic acetate of lead used in clarifying. The author points out that Pellet's experimental results do not agree with this assertion. If meta-pectic acid be really formed, it follows that when beet pulp is directly treated with lime, meta-pectic acid will be produced in considerable quantities, and will lead to a diminution of the polarimetric reading. Now Battut has obtained the following results on analysing normal beets :—

By alcohol extraction..........	13·22	per cent. cane sugar
By the lime method	13·19	„ „ „

which are practically identical.

In the case of spoiled beets the numbers obtained were as follows :—

Alcoholic extraction	10·92	per cent. cane sugar
Water extraction	11·00	„ „ „
Lime method..................	10·00	„ „ „

According to Pellet this difference of 1 per cent., between the first two and the third result, must be owing to meta-pectic acid.

Pellet obtained the following numbers on analysing abnormal beets :—

Water extraction (or alcohol extraction)	9·30	per cent. cane
Lime method.............................	9·38	„ „

If these numbers be correct it is impossible to understand how Pellet arrives at the opinion that the meta-pectic acid produced by the action of lime on beet juice (and this still remains to be proved) diminishes the optical activity.
—H. T. P.

The Artificial Improvement of the Beet by Means of Cane Sugar. E. O. von Lippmann. Chem. Zeit. **12**, 1455—1456.

At a meeting of the Halle branch of the Verein für Zuckerindustrie, Knauer, for the first time, published his experience of his own patented method for the artificial improvement of the beet. Beets which have been tested as to their fitness for seed production, by piercing them with Colette's probe are taken, and the hole filled up with solid sugar or a solution of sugar, and the opening then stopped up with clay. They are then planted out. The sugar soon becomes changed to a slimy fluid, which is absorbed by the plant, and tends towards the production of descendants richer in sugar. Parallel experiments were made with beets, some being filled with sugar, and others with sand. The seed obtained from both varieties of beets was sown in alternate rows, and gave on analysis, regularly, differences of 1—1·5 per cent. sugar, in favour of the sugar-treated beets. The author is of opinion that the conclusions drawn by Knauer from these results are rather far-reaching, seeing that the determinations of cane sugar were made by the direct polarimetric method, and that no proof was given that the increased optical activity was really due to cane sugar. Indeed, such a result is quite unlikely, as it would go to show that the accidental property of the parent could be transmitted to the offspring, which is quite unprecedented in the annals of physiology.—H. T. P.

New Methods and Apparatus for Sugar Manufactories. Dingl. Polyt. J. **270**, 268–273.

J. Suchomel (Oesterreich. Ungar. Zeits. f. Zuckerind. und Landwirthsch. **17**, 61 and 159) reports fully on the influence of saturation with lime on beet-juice and raw sugars. The experiments made by the author prove conclusively that even in the case of low-grade sugars the treatment with lime and carbonic acid does not materially increase the purity of the sugar. In many cases, however, a decided decolourisation was noticed, and also increased brightness, so that only for inferior and dirty samples and sugar containing invert sugar can the treatment with lime be recommended.

From his experiments with beet-juices, the author concludes that the success of the purification depends chiefly upon the first treatment with lime and carbonic acid. The purity of the juice increases with the amount of lime used for saturation up to 3·5 per cent., and the author believes that it is possible to obtain juice in the highest state of purity from any kind of beet by a single treatment with lime and carbonic acid, if sufficient lime be used for the saturation, and efficient filtration be applied afterwards.

The quantity of lime compounds which separates from the purified juice on concentration is inversely proportional to the amount of lime used for saturation. The lime remaining in the juice after purification may be almost completely removed by a second saturation with lime, followed by thorough boiling, the juice being previously concentrated.

A. Kollrepp has detected cholestrin in the precipitate obtained by the action of lime on beet-juice (Zeits. d. ver. f. Rübenzucker Industrie d. Deutsch. Reich. **38**, 772). This substance is probably extracted with the sugar during the treatment of beets with alcohol for the purpose of analysis, and as it is not precipitated by basic acetate of lead, its presence may influence the result of a polarimetric determination of cane sugar. Cholesterin forms a jelly with water, and this fact may explain why the precipitates from beet-juices filter so badly.

Fahlberg's saccharin has been examined by the Comité consultatif d'hygiène de France from a hygienic point of view. The conclusions reported by the commission (Brouardel, Pouchet, Ogier) are as follows :—

1. Saccharin is not a food, and cannot replace sugar.
2. The use of saccharin or saccharin preparations as food prevents or retards the conversion of starch and of albuminoid substances in the digestive organs.
3. These preparations, therefore, interrupt the digestive functions, and so cause dyspepsia.
4. The use of saccharin is too recent to allow of the exact effects of its daily use to be stated, but so much is certain that it has an unfavourable influence on digestion, and therefore it ought to be excluded from the list of edibles.—H. T. P.

PATENTS.

A New Process and Apparatus for Treating Soluble and partially Soluble Gums so as to render them fit for Industrial purposes. A. N. Pearson, Northcote, Victoria. Eng. Pat. 12,645, September 1, 1888. 6*d*.

This process consists, first, in dissolving the soluble portions of the gum in water by suspending it in small portions on a series of foraminous trays arranged one above the other; second, in filtering the solution so obtained by means of a filter having a receiving chamber leading to a long pipe discharging into a closed chamber containing a foraminous tray covered with a layer of sand; third, in concentrating this solution by evaporation; and, fourth, in pouring it into trays or allowing it to percolate through holes in a plate or vessel, and then drying it. When a more refined article is required the solution before concentration is dissolved by means of coagulable or precipitable material such as albumen.—J. H.

Improvements in and relating to the filtration of Beet Root Juice in the Process of making Beet Root Sugar, and in the utilisation of the filtering material after filtration has been effected. O. Bluhme, Coeslin, Germany. Eng. Pat. 13,129, September 11, 1888. 4*d.*

The exhausted pulp of the expressed beet root is substituted for the charcoal, fine gravel, &c. commonly used for filtering the saccharine juices. It is claimed that if the purity of the juice filtered in the ordinary way be expressed by 91·5, that of the juice filtered by the new method will be represented by 96·5. The pulp, charged with all the vegetable and mineral impurities of the beet juice, can be used as a food for animals.—B. B.

XVII.—BREWING, WINES, SPIRITS, Etc.

Somersetshire Cider. J. Higgins. Bath Meeting of Brit. Assoc., Sect. F. Sept. 6th, 1888.

Cider is a true natural wine, and one of the easiest of all wines to make, differing from grape wines only in the necessity for grinding the fruit before expressing the juice. It ferments at a very low temperature, 35° to 43° Fah., and rapidly changes its sugar to alcohol, without the addition of any ferment, giving off large volumes of gas with seething force and throwing up a strong frothy head, which, however, does not appear to be a true "Yeast," but rather composed of the lighter impurities, pushed to the surface by the escaping bubbles of gas. As soon as a fair amount of alcohol is developed, the fermentation subsides, in a measure checked by the presence of the spirit. For if the apple-juice be weak in sugar so that it can produce but little spirit, all the sugar is used up in the first act of fermentation, and the acetous fermentation sets in at once. Then, in a very short time, the barrel contains that mixture of malic and acetic acids, which the owner fondly calls cider, but those who drink it, vinegar. If, however, there were a full proportion of sugar in the juice, the alcohol checks this acetous fermentation, and the sugars mask the malic acid which all cider holds in such large proportion, then we have a sweet cider, and this is the only sort that is used and appreciated out of Somerset. The newly-formed alcohol acts in another beneficial way on the new cider. It takes up, and in a very marked way, digests, the essential oils of the pips and rinds of the fruit, which the grinding and pressing have released from their cells. When this action of the alcohol goes on at a low temperature, a delicious fruity aroma is diffused throughout the cider. This constitutes one of the most pleasing characteristics of the beverage. There is nearly always a trace of this aroma in any "unsophisticated" cider. But it is constantly masked and lost by coarse and rank flavours; such as a "taste of the cask," "ropiness," or oiliness as it is called. For if the fermentation proceed at a high temperature, the essential oils behave like other less subtle fats, the heat makes them rancid and destroys their fragrance; then the impartial spirit picks up the coarse rancidity, dissolves it out, and makes it patent to our offended and disgusted palates. Low temperature is of the greatest importance in cider making, for the aroma and purity of flavour depend in a great measure on the degree of heat at which these qualities are called forth. The proportion of alcohol in cider varies from 5 to 10 per cent. Strong beer has about 10 per cent. of spirit. Cider made from "Cocagee" apples, and the sort called "Siberian Harveys," contains a much higher proportion of spirit. Cider spirit is particularly light and clean. Carefully distilled it makes good brandy. If the fresh must were thoroughly fermented a very large run of "high wines" could be obtained from it. Another constituent of our apple juice drinks is malic acid. What tartaric acid is to wine, malic acid is to the apples, currants, gooseberries, rhubarb, &c. grown in our climate. This malic acid we cannot get rid of without destroying the character of the cider in a very great degree. Carbonate of lime will precipitate most of it; but to produce its full effect, the apple juice should be boiled. Now, boiling cider to get rid of this acid is like boiling a rose to get rid of the blight. The cider after this treatment is reduced to a flat kind of juice; so we must still continue to ask chemists for a bland, innoxious chemical that will precipitate malic acid in cold cider. There is a peculiar advantage which grape juice has over apple juice. When grape juice begins to ferment, directly any alcohol is formed the acid begins to be thrown down in an insoluble form. This is an impure crystalline salt, called argol. This deposit goes on, eliminating the acid from the wine, as long as fresh alcoholic spirit is developed. If we can only obtain something that will do artificially for our cider what nature does for grape wine, agriculture in Somerset will enter on a new career, in which her landlords, tenants, and workpeople may find wealth and prosperity.

—W. S.

Progress in Brewing. Dingl. Polyt. J. **270**, 135–141.

The Constancy of Yeast-species.—P. Lindner (Wochenschr. f. Brauerei. **5**, 57). The author has tested the constancy of yeast species by cultivating them under extremely varying conditions for a number of generations. The nutritive media employed were a cane sugar asparagin solution and an acid rye-malt wort. The cultures in the first solution were carried on at a temperature of 4°—6° R., and in the latter at 20° R. Under these conditions the yeasts retained their distinguishing characteristics unchanged. *Reinke* (Wochenschr. f. Brauerei. **5**, 83) has noticed in a number of cases that the presence of sarcinae in beer was attended by decolourisation of the beer. It is, therefore, advisable to examine microscopically all beers which exhibit a suspicious loss of colour after a week's storage.

Munich and Berlin Weissbier. E. Wein (Allgem. Brauer und Hopfenzeit. **28**, 2).—Three samples of beer and two of Bockbier from three Munich breweries, and one sample of Berlin Weissbier were analysed. The following results were obtained:—

—	Specific Gravity.	Water per Cent.	Alcohol per Cent. by weight.	Maltose per Cent.	Dextrin per Cent.	Nitrogen per Cent.	Ash per Cent.	Cc. normal Alkali used per 100 cc.	Total Solids per Cent.	Total Solids of Original Wort.	Degree of Attenuation (per Cent.)
1. Berlin:— Weissbier........	1·0118	92·97	2·82	0·92	2·10	0·051	0·124	2·6	4·21	9·65	56·3
2. Munich Weissbier:— From M. Schramm..	1·0162	90·52	3·75	2·04	2·13	0·056	0·113	1·65	5·73	12·95	55·7
„ G. Schneider and Son.....	1·0159	90·81	3·57	1·53	2·64	0·061	0·112	1·90	5·62	12·49	55·0
„ Röckl.........	1·0140	91·11	3·72	1·35	2·23	0·048	0·108	1·75	5·17	12·34	58·1
3. Munich Weissbierbock:— From M. Schramm..	1·0277	86·55	4·49	3·65	3·48	0·094	0·228	2·00	8·96	17·62	49·1
„ G. Schneider and Son.....	1·0208	89·15	3·89	2·33	2·97	0·073	0·113	2·05	6·96	14·45	51·9

—H. T. P.

Progress in Brewing. Dingl. Polyt. J. **270**, 278—285.

In Mayer's double-malt kiln (Wochenschr. f. Brauerei. **5**, 309) the floors are placed side by side and heated by a common grate and flues. Malt, however, can be half dried on the one floor, and dried to any required extent on the other. The air which passes through the green-corn is much purer than is the case with ordinary malt-kilns, and its temperature can be regulated to a nicety. The malt is completely finished on one floor, this being accomplished by a simple method of regulating the flow of the flue gases.

Lately the apparatus has been enlarged and improved, and the results obtained with it are said to be very favourable. The quantity of coal used, per 50 kilos. of dry malt produced, is given at 17 kilos.

A. Jörgensen (Zeits. f. d. gesammte Brauwesen, **11**, 197) draws attention to the use of air-pressure indicators in malt kilns. The apparatus, introduced by Kühl at Alt-Karlsberg, consists essentially of a U tube provided on each limb with a bulb. The one limb communicates with the outer air by means of a very narrow bent tube, while the other can be connected by a tap either with the air or with the rooms in which the pressure is to be measured (up to 3). The limbs are filled with two liquids of different colours, but nearly the same specific gravity, their line of demarcation being utilised as the index. The apparatus is fitted with a movable scale so that it can be adjusted to zero at any moment.

In a malt-kiln, the hot air rises from the heating chamber and passes through the moist malt. The space above the malt floor, as well the heating chamber can be placed in communication with the pressure-meter; and thus the difference of pressure between the air above and below the malt can be determined. Since the volume of air passing through the malt-floors in a given time is directly proportional to this difference of pressure, it follows that any desired volume of air per minute may be made to flow through the kiln by simply regulating the difference of pressure between the air above and below the floor, by means of ventilators.

A method for sulphuring and drying hops has been patented in Germany by G. Langhans. The sulphurous acid, diluted with air, is warmed, when required, and continually circulated through a number of vessels, which are completely filled with hops. After a time the sulphurous acid is displayed by a current of air. This process is carried on alternately in two rows of vessels, the one row being recharged while the other is in use. By this means the loss of sulphurous acid is reduced to a minimum. The plant consists of an apparatus, in which sulphur is burnt to sulphurous acid, six cylinders for the hops, mounted in two rows, an absorption apparatus, ventilators, and an arrangement for heating the mixture of air and sulphurous acid, the various vessels being connected together by means of pipes.—H. T. P.

The Brewing Process in Warmer Climates and the Export of Beer. O. Reinke. Wochenschr. f. Brauerei. **5**, 725.

The production and importation of beer are becoming antagonistic in distant countries. Whilst hops and barley are too expensive in Africa for the production of beer, it is the cheapness of these materials in Japan and Chili which promises a future success for brewing in those countries. Good yeast is wanting in Japan, but this difficulty is easily met by the existence of a method of transporting sound yeast in good condition. South America has hitherto been supplied with beer from North America, but it would appear that the importation will soon become unnecessary. —G. H. B.

The Preservation of Yeast. O. Reinke. Wochenschr. f. Brauerei. **5**, 745.

After alluding to previously known methods of preserving yeast, the author describes his own process. About 50 grms. of well-pressed yeast are placed between two sheets of sterilised filter paper in an atmosphere free from dust, rolled out to a thin layer, wrapped in a sheet of filter paper, and then dried by pressure between layers of sterilised asbestos. The dried packets are then placed in a metallic vessel between layers of burnt gypsum (previously heated for three hours to 150° C.). The canisters, containing about 7 kilos. of yeast in 100 packets, are then hermetically sealed. For use, about 1 kilo. of the preserved yeast is removed from the filter paper and added to 10 litres of beer wort at 10° C. When fermentation sets in, more wort of lower temperature is gradually added, until the bottom fermentation can be set up in the large vat at 4° C.—G. H. B.

Results of Examinations of the Air of Breweries with Remarks on Hansen's Method of Air-Analysis. P. Lindner. Wochenschr. f. Brauerei. **5**, 877.

The author's method consisted in a one hour's exposure of sterilised glass cylinders in different parts of the brewery with occasional addition of sterilised wort or nutritive gelatin. The cylinders were charged in the laboratory with meat-juice gelatin and examined after four or five days' incubation. The chief result of the examination was the presence of various sarcinae, especially the dangerous *Pediococcus cerevisiae*, of moulds and Torula. The author finds an objection to Hansen's method in the quantity of apparatus required, and is in favour of examining air by means of nutritive gelatin, and emphasises the necessity of studying the life history of the dargerous organisms in nutritive gelatin.—G. H. B.

On the Zymo-technical Analysis of the Micro-organisms of the Air. E. C. Hansen. Prager Brauer und Hopfenzeitung, 1888, **1**, 223.

The method of examining brewing liquors for micro-organisms already published by the author (*see* this Journal, 1887, 114) is here extended, and an improved method of taking the sample of air is to aspirate measured volumes into small flasks of sterilised water, from which small flasks of sterilised beer wort are subsequently inoculated. The incubation is conducted for 14 days at 25° C. The air contained the most germs at the harvest season, in August and September, and was rendered dangerously impure by the drying of malted grains in the brewery. The author insists that analyses, to have a real practical value, must be conducted as far as possible under the conditions existing in breweries, gelatin cultivations often giving rise to false conclusions. The questions underlying these investigations refer to the relations of the air to the wort and beer; in what degree is it rich in micro-organisms which can affect the liquors, and amongst these are there such as can give rise to dangerous disturbance of the normal fermentation?—G. H. B.

Denaturation of Alcohol. G. Zetter. Chem. Zeit. **12**, 1391.

The following suggestions are made by the author in connexion with the laws affecting the denaturation of alcohol in Germany. (1.) The chief addition to the alcohol should be methyl-alcohol of a certain fixed quality and in the proportion of 5 litres per 100 litres of spirit; no pyridine bases should be added. Special substances should be employed for denaturating spirit for use in certain manufactures according to the German law of 24 June 1887. (2.) Trade in the substances used for denaturation should be free, but they should be strictly and exactly examined as to their quality. (3.) No limit should be assigned to the quantity of alcohol which may be denaturated at one time, beyond a minimum limit of 100 litres. (4.) Heavy punishments should be inflicted on all attempts to render denaturated spirit fit for consumption.—C. A. K.

On the Influence of the Malting Temperature in the Composition of Malt, Wort, and Beer. P. Matz and J. Baleke. Wochenschr. f. Brauerei. 5, 858.

The Hanna barley employed in these experiments had a germinating capacity of 99 per cent., and contained 13·1 per cent. moisture, 1·29 per cent. nitrogen, 0·83 per cent. phosphoric acid, and 2·65 per cent. ash. The drying was conducted in an ordinary malt-kiln, and an iron pipe was used to convey the heat to the corners of the kiln for the purpose of equalising the temperature. The following table shows the differences which resulted from changes in the temperature and admission of air. The series includes the worts and beers produced from the dried malt.

—	65° R. with Dampers $\frac{3}{4}$ closed. (Heating pipe.)	65° R. with Dampers $\frac{3}{4}$ closed. (Direct Heating.)	65° R. with closed Dampers. (One Hour.)	65° R. with open Dampers.	65° R. with Dampers $\frac{3}{4}$ closed and increased Initial Temperature (39°).	70° R. with closed Dampers.	70° R. with open Dampers.
Malt:							
Moisture..............Per cent.	4·00	3·80	3·06	3·42	3·20	3·37	3·58
Extract in the dry malt substance	78·90	77·30	78·10	78·30	76·31	77·47	77·30
Maltose : Non-maltose	1 : 0·397	1 : 0·466	1 : 0·395	1 : 0·43	1 : 0·40	1 : 0·51	1 : 0·486
Time of saccharification in minutes	30	30	30	30	30	40	53
Colour of the wort	Light yellow.	Light yellow.	Light yellow.	Light yellow.	Light yellow.	Amber yellow.	Amberyellow.
Wort:							
Extract by Ball's method	13·05	13·00	13·05	13·20	13·20	13·05	13·10
Maltose: Non-maltose..........	1 : 0·36	1 : 0·396	1 : 0·36	1 : 0·38	1 : 0·408	1 : 0·404	1 : 0·412
In 100 grms. of Beer:							
Extract..........................	5·0	4·95	4·95	5·00	5·25	5·28	5·40
Alcohol	4·00	4·04	3·86	4·00	4·06	3·92	4·00
Maltose..........................	1·43	1·47	1·40	1·43	1·66	1·43	1·46
Phosphoric acid (in the ash)....	42·11	42·57	42·39	42·15	42·44	41·22	40·65
Original wort....................	12·72	12·76	12·42	12·72	13·08	12·84	13·10
Limit of fermentation...........	60·7	61·2	60·1	60·7	59·9	58·9	58·8

—G. H. B.

PATENTS.

Improvements in or applicable to the Manufacture of Unfermented Wine. J. F. Henderson, Aberdeen. Eng. Pat. 14,548, October 25, 1887. 6*d*.

This invention consists in the preparation of a liqueur from champagne brandy, pure saccharine and spirituous essence of muscatel raisins, the said liqueur being afterwards employed for the manufacture of still or sparkling wines by the addition of suitable proportions of water or of aërated water.—J. H.

An Improved Extract for use as a Ferment or as a Food Preparation. M. T. Hatschek, London. Eng. Pat. 3363, March 5, 1888. 6*d*.

This invention relates to the production of a dietetic nutritious food, mainly peptone, and termed "malto-peptine." It is prepared from malt combs, either alone or mixed with the bran of grain, such as wheat, rye, barley, &c. The raw material is steeped in about 10 times its weight of water, at a temperature of 125° Fah., and containing $\frac{1}{4}$ to $\frac{1}{2}$ per cent. of some mineral acid, preferably hydrochloric, together with $\frac{1}{10}$ to $\frac{1}{20}$ per cent. of sulphurous acid. After digesting for 10 to 16 hours, the resulting extract consisting mainly of peptone with asparagin, amides, sugar and salt, is neutralised with chalk or other alkali, drawn off and filtered through any suitable material. The extract may be used direct as yeast food in fermentation processes, or may be concentrated to a syrup or made into dry tablets, in which form it may be used by invalids as an addition to their ordinary food.—J. H.

Improvements in and relating to the Treatment of Magmas for Distillation. M. L. Godefroy, Paris, France. Eng. Pat. 4143, March 17, 1888. 6*d*.

This process "has for its object the chemical modification of the impurities contained in the magmas of industry both before and after rectification" and is carried out as follows:—Zinc powder is mixed with a little water, and to this a solution of sulphate of copper is added, until the zinc in suspension, which had assumed a black colour, begins to turn brown. It is then allowed to stand, decanted, and washed with water, and introduced into the magmas at rate of 40 to 50 grms. of pure zinc per hectolitre, the mass well stirred, and about 70 to 85 grms. of chloride of lime diluted in a sufficient quantity of water then added. The mass after standing some time is distilled.

The principal results claimed for this process are—

"1. The almost complete destruction of poisonous products of the lead."
"2. An increased yield with good taste."
"3. A notable improvement of the alcohol."
"4. Simplification in the rectification by the fact that there is obtained at first a larger quantity with a perfectly pure good taste, whilst the lower products to be repassed diminish very much."—J. H.

Improvements in the Manufacture or Treatment of Beer or other Fermented Liquors or Beverages. W. P. Thompson, Liverpool. From C. Pfandler, Rochester, U.S.A. Eng. Pat. 10,020, July 10, 1888. 8*d*.

All fermented beverages (not distilled liquors), after the main fermentation, are crude and turbid, and for immediate consumption have been simply clarified, but for superior beverages an extended treatment is required to age or ripen them, requiring large storage capacity.

This invention seeks to produce this superior beverage with its ripened qualities in a much shorter time. To this end, after the main fermentation, the beverage is enclosed in a close vessel in a cool atmosphere; the atmospheric air is abstracted and a partial vacuum maintained by an exhaust pump, while the secondary fermentation progresses, and until the beverage has the required character. The process refers chiefly to the manufacture of United States lager beer. A drawing explanatory of the text accompanies the specification.—J. H.

Improvements in the Manufacture of Saccharine Liquors for Brewing and other similar purposes, and in the Mode of their Manufacture. H. Gugenheim, London. Eng. Pat. 10,216, July 13, 1888. 4*d.*

This process consists in the manufacture of a dilute (25 per cent.) solution of glucose by the usual well-known methods from rice, sago, tapioca, &c., or of 25 per cent. solution of raw Jaggery sugar. These solutions after filtration through animal charcoal are then ready for use. The liquor prepared in the manner described cannot be transported without deteriorating; it must accordingly be manufactured in each case on the spot.—J. H.

An Improved Apparatus for Testing the Purity or Genuineness of Wine. T. F. Bergmann, Lilienstein, Germany. Eng. Pat. 11,740, August 14, 1888.

The apparatus consists of a glass tube fitted with a fluid tight metallic cap having a screw-threaded neck through an opening in which a rod slides freely; the upper end of this rod is fitted with a knob and its lower end carries a disc fitted with a rubber ring so as to form a fluid-tight joint with the sides of the tube. The cap on the top of the tube is furnished with air holes and is surmounted by a screw collar and stuffing box, through which passes the sliding rod. In using the apparatus, the collar is unscrewed, the disc is pressed downwards, and the tube dipped into the wine. When a sufficient quantity has entered through the opening in the bottom of the tube, the latter is closed by drawing up the disc and the top air holes are closed by screwing down the collar. The tube is then removed from the wine and placed in a glass of clear water, the lower end of the tube being again opened by pressing the knob, the upper end at the same time being kept closed.

If the wine be pure and unadulterated it remains in the tube, and does not mix with the water, the latter remaining perfectly clear, but if the wine be adulterated some portions will mix with and discolour the water.—J. H.

A Process for Treating and Rectifying Alcohol and Apparatus therefor. E. and A. de Meritens, Paris, France. Eng. Pat. 13,293, September 14, 1888. 6*d.*

A Process for Treating and Purifying Water, Beer, Wine, and other Liquids, and Apparatus therefor. A. de Meritens, Paris, France. 13,294, September 14, 1888. 6*d.*

These processes consist in the application of an alternate electric current to the various liquids above mentioned, whereby in the case of crude alcohol the essential oils, aldehydes, and the like are eliminated and the spirit is freed from all impurities or objectionable matters. In the case of water, beer, and wine, by means of an alternate current passing through the liquids, the microbes or other living organisms that may be present are killed, whilst at the same time the flavour peculiar to new wine or beer is removed, and a ripened or matured flavour imparted to them. It is claimed that such liquids thus freed from ferments are capable of travelling to any distance and withstanding climatic influences without the addition of any preservative agent such as salicylic acid and the like.

Drawings of the apparatus employed accompany the specifications.—J. H.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A*)—CHEMISTRY OF FOOD.

Researches on the Composition and Digestibility of Japanese Fodders. O. Kellner. Bulletin of the Imperial College of Agric. and Dendrology, Tokyo, Japan, 1888.

In this bulletin are recorded the results of experiments, conducted from 1882 to 1887, on the digestibility of certain Japanese fodders by Dr. Kellner and his Japanese pupils. Sheep were the animals experimented with, and in all cases there were two animals under experiment, who were fed for six or eight days with the food under trial before the actual experiment began. The results were calculated from eight day trials in every case, the animals being fed three times a day, and the food residues, fœces, and urine carefully collected and analysed. In the experiments during the last two or three years, Henneberg's "feeding boxes" were used.

In experiments with the millet hay, 7 and 8, one sheep in each case suffered from diarrhœa, so the final digestion coefficients are calculated from one animal only.

The results of some of the researches have been already published in Land. Versuchs Station, 1885, 72.

The names and origins of the fodders, with their percentage compositions and their digestive coefficients as deduced from these experiments, are as follows:—

(1.) Japanese hay, from the mixed grasses growing on the banks and ditches of paddy fields, and contaminated with earth from being made on the roadside. Ration 1 kilo. per head per day, with 6 grms. of common salt.

(2.) Japanese hay similar to No. 1. Ration 1 kilo. per head per day, with 7 grms. of common salt.

(3.) Japanese hay inferior in quality to 1 and 2. Ration 750 grms. per head per day.

(4.) Hay, very poor quality, principally of *Eulalia japonica* with a little *Lespedeza cyrtobotrya*, compositæ, &c. Ration 800 grms. per head per day; not completely eaten.

(5.) Hay, very poor quality, principally of *Eulalia japonica* with much *Equisetum arvense.* Ration 800 grms. per head per day; not completely eaten.

(6.) Hay of *Imperata arundinacea*, a tall harsh grass growing on uncultivated hills. Ration 1 kilo. per head per day; not all eaten.

(7.) Hay of *Panicum frumentaceum*, cut when the seed was milk-ripe. Ration 1 kilo. per head per day, and 6 grms. of common salt.

(8.) Hay as 7, but much rained on during its making. Ration 1 kilo. per head per day, and 6 grms. of common salt.

(9.) Hay of *Soja hispida*, cut when the pods were fully developed, but the leaves still green. Ration 1 kilo. per head per day, and 6 grms. of common salt.

(10.) Hay of *Soja hispida*, cut when in full blossom. Ration 800 grms. per head per day, and 10 grms. of common salt.

(11.) Straw of paddy rice in rather over-ripe condition. Ration 600 grms. per head per day, and 10 grms. common salt.

(12.) Straw of upland rice. Ration 750 grms. per head per day, and 7 grms. common salt.

(13.) Rice bran, or rice cleanings, obtained in "polishing" the rice previously freed from its shudes. Ration 750 grms. of hay No. 2, 250 grms. of rice bran, and 6 grms. of salt.

(14.) Soy beans, *Soja hispida.* Ration 750 grms of hay No. 2, 250 grms. of soy beans, and 6 grms. of salt.

Percentage Composition of Coarse Fodders.

—	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)	(8.)	(9.)	(10.)	(11.)	(12.)	(13.)	(14.)
	Japanese Hay.	Japanese Hay.	Japanese Hay.	Hay from Uncultivated Land.	Hay from Uncultivated Land.	Hay of *Imperata Arundinacea.*	Millet Hay.	Millet Hay.	Hay of Soy Bean.	Hay of Soy Bean.	Paddy Straw.	Upland Rice Straw.	Rice Bran.	Soy Bean.
Water	17·55	16·86	13·03	15·86	14·87	16·22	17·14	14·46	16·85	13·5	20·79	10·33	12·44	11·88
In dry matter:—														
Crude proteids ...	9·89	12·24	9·29	8·85	6·98	10·82	11·23	11·77	16·91	18·42	6·80	6·75	16·82	39·33
Fat	2·64	3·10	3·34	3·41	3·26	2·80	1·89	2·34	2·56	3·64	2·17	2·16	19·07	19·36
Fibre	35·27	33·20	32·59	40·41	40·46	42·38	32·34	41·85	42·29	37·58	18·68	40·35	10·26	5·40
Non-nitrogenous extractives.....	42·20	42·31	45·63	40·03	42·47	35·69	45·72	31·76	31·28	33·63	24·80	32·14	43·43	31·60
Ash.............	10·03	9·15	9·15	7·30	6·83	8·34	8·82	9·34	6·93	6·73	17·55	18·60	10·31	4·31
Total nitrogen ...	1·583	1·866	—	—	—	1·734	1·807	1·886	2·705	2·947	1·088	—	2·692	5·544
Albuminoid nitrogen	1·582	1·515	—	—	—	1·633	1·520	1·687	2·146	2·630	·88	—	2·254	5·514

Digestive Coefficients for Sheep.

Dry matter	51·4	58·0	47·5	48·7	47·5	47·0	61·1	47·8	55·8	59·9	43·8	39·2	84·9	83·2
Organic matter	55·2	60·5	52·0	52·7	49·5	49·4	63·3	51·6	58·7	62·1	49·8	44·0	89·2	85·0
Crude proteids	43·5	60·3	34·6	41·0	23·5	51·8	31·7	52·6	63·8	74·3	46·5	43·8	77·3	87·2
Fat	46·4	47·7	50·0	43·3	40·9	38·2	60·1	69·6	13·8	46·6	41·4	51·9	67·3	94·3
Fibre	64·2	65·3	57·0	64·6	63·3	56·0	62·7	69·0	57·8	48·3	58·1	55·2	89·3	168·3
Non-nitrogenous extractives.......	52·0	57·5	52·0	43·7	41·2	42·1	65·9	41·6	61·2	70·4	35·4	28·8	100·0	62·2

The general results show that the Japanese hay, 1, 2, and 3, is not up to the medium quality of European hay, but must be classed as "poor." The "wild hay," 4 and 5, is very poor, and is rather to be classed as straw than hay, and animals will eat but little of it. The hay of *Imperata*, 6, is "rather poor." The millet hay, 7, is "medium good." That which was damaged by rain, 8, had lost much of its digestible proteids and non-nitrogenous extractive matter; this loss is estimated at nearly 28 per cent. of the total digestible proteids, and nearly 64 per cent. of the total digestible carbohydrates. Soy bean hay, 9, is considered the best coarse fodder of the country; although it contains much fibre it is highly digestible, and about equal to lucerne hay. The sample 10 was cut much before the usual time, a better and more digestible fodder was the result, but the total crop is very much reduced thereby.

Both paddy straw, 11, and upland rice straw, 12, are good fodders for straw; they are fairly rich in proteids, and fully as digestible as other cereal straws. Experience, as well as these experiments, shows that paddy straw is superior in feeding value to that of upland rice.

Only two concentrated foods were experimented with, and this in conjunction with hay, No. 2, above. Rice bran, 13, is obtained in whitening or polishing the rice grain after the husks are removed; it consists of the bran with some broken grains, and often a good deal of sand or earth. Sometimes sand is purposely added to help in the polishing process, then the ash may amount to 20 per cent., of which one-half is sand. Sometimes this material is adulterated with earth, &c. up to 50 or 60 per cent. When pure and in good condition, however, it is an excellent food and more digestible than other brans of cereals.

Soy beans are usually too expensive for extensive use in cattle feeding, being utilised as human food in various ways. These experiments, however, show their great value and digestibility. The digestion coefficient of the crude fibre in soy bean indicates that the addition of the highly nitrogenous bean to the diet of hay caused an increased digestion of the fibre of the hay; this has been noticed in other cases, as with lupins, fish, meal, linseed, &c.

The coarse fodders of Japan are very poor in quality, and before any marked improvement in the native breeds of stock can be expected, and still more before imported good breeds can be expected to thrive, efforts must be made to improve the quality of such fodders. Of concentrated foods, Japan has a good variety now often only used as manure.

—A. G. B.

Citric Acid in Cows' Milk. F. Soxhlet. Bied. Centr. **17**, 787—788.

Experiments made by G. T. Häckel have confirmed the presence of citric acid as a normal constituent of cows' milk. The examination of a great number of samples show that they contain from 1·8 to 2·2 grms. of calcium citrate, and from 0·9 to 1·1 grms. of citric acid per litre, or about 0·1 per cent. of citric acid; so that the quantity of citric acid yielded by a good milking cow in a day amounts to as much as that contained in two or three lemons. The lime found in milk serum generally exceeds that combined with the mineral acids, the presence of citric acid will now explain this apparent anomaly. This acid is supposed to be derived either from citric acid in the hay or green fodder, or to be formed from the decomposition of cellulose. The concretions frequently found in condensed milk consist of pure calcium citrate, and as human milk contains no citric acid, it is perhaps characteristic of milk from herbivora.

—D. A. L.

PATENTS.

Converting Sea Water into a Thirst-assuaging Drink, and Substances employed therefor. G. S. Haslehurst, Rhyl. Eng. Pat. 11,974, September 3, 1887. 6*d.*

The patentee finds that about 2,000 grains of sea water, 175 grains of effervescent saline salt, *e.g.*, lemon kali, and 10 grains of carbonate of bismuth form a beverage "refreshing and beneficial."—C. C. H.

An Improved Extract for use as a Ferment and as a Food Preparation. M. P. Hatschek, London. Eng. Pat. 3,363, March 5, 1888. 6*d.*

See under XVII., page 859.

—O. H.

(*B*)—SANITARY CHEMISTRY.

The Purification of Effluent Waters. I. Action of Caustic Lime on Effluent Water containing Organic Matter. H. Scrieb. Chem. Zeit. **12**, 1489—1490. (Cf., this Journal, 1887, 603.)

Caustic lime is employed in almost all processes for the purification of effluent waters by chemico-mechanical means, and if rapid subsidence and a clear effluent be desired, it is necessary that the lime should be in excess. The objectors to lime as a purifying agent maintain that this excess dissolves suspended organic matter, so that the effluent water purified by lime contains more organic matter in solution than the original effluent; and, moreover, that as the lime gets neutralised by the carbonic acid in the river this organic matter is precipitated and induces the growth of fungus which causes further nuisance. On these grounds lime has been condemned as a purifying agent by a recent semi-official commission.

The author has treated different portions of the same effluent water with varying quantities of lime, and determined the amount of dissolved organic matter contained after the treatment; if excess of lime dissolve suspended organic matter the portions treated with a larger quantity of lime should contain a larger quantity of dissolved organic matter; but the analyses show that this quantity is as often less as it is more, when a larger quantity of lime is employed.

Nor is any organic matter precipitated along with the calcium carbonate when the clear purified effluent is neutralised with carbonic acid, for this precipitate does not blacken when heated, and is perfectly soluble in an excess of carbonic acid; so the organic matter is not held in solution by the lime.

That lime really tends to decrease the dissolved organic matter is shown by the following table :—

No. of Sample.	Effluent Water.			
	Unpurified and Unfiltered Organic Matter.	Unpurified and Filtered Organic Matter.	Purified with CaO.	
			Organic Matter.	CaO.
	Mgrm. per Litre.	Mgrm. per Litre.	Mgrm. per Litre.	Mgrm. per Litre.
1	655	520	430	450
2	930	690	815	560
3	1,110	810	695	560
4	675	505	490	—
5	1,035	730	565	1,090
6	625	305	220	336
7	2,456	1,765	1,385	582
8	870	780	620	649

In all these experiments except No. 2 the amount of organic matter in the purified water is less than in the filtered unpurified water. The waters tested include samples from starch, paper, and sugar factories, as well as town drainage.

If the effluent water be kept before being analysed the organic matter ferments and is partially lost as gas, and as this does not occur in water containing lime it would make the organic matter in the unpurified water less than in the purified, if the analysis of the two samples be delayed.

—A. G. B.

PATENTS.

Improved Means and Apparatus for Disinfecting and Deodorising and for producing Spray of Various Antiseptic Agents. A. Boake and F. G. A. Roberts, Stratford. Eng. Pat. 10,747, August 4, 1887. 8*d.*

Liquid sulphurous anhydride is mixed with certain phenols, *e.g.*, carbolic acid with camphors and terbenes, and stored in the liquid state under pressure. A fine spray of the mixture is allowed to escape into the air for the purposes of disinfection, and in order to ensure complete vaporisation of the whole, the spray is passed through a heated copper coil prior to its dispersion in the air.—C. C. H.

A New or Improved Process and Apparatus for the Treatment of Sewage and other Matters for extracting Ammonia and Oxydising Sulphur Compounds. T. M. J. Truchelut and J. U. Truchelut, Paris, France. Eng. Pat. 11,534, August 24, 1887. 8*d.*

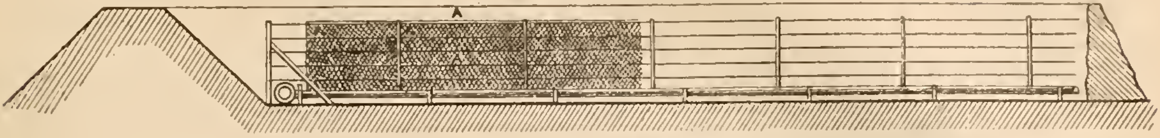
A large chamber constructed in brickwork contains a number of shallow trays, with narrow spaces between, alternately touching and falling short of the two ends of the chamber so as to form a to-and-fro path for any current of air traversing the chamber. Above are two tanks, one containing the liquid to be treated, the other milk of lime. The liquid treated is, by reduction of pressure in the chamber, drawn in with the requisite proportion of milk of lime, and overflows from one shelf to the other. The gases evolved are drawn off by a fan from the bottom of the apparatus and circulated through a chamber one-tenth the size of the first, otherwise similar to the first, but having sulphuric acid on the shelves for the absorption of ammonia. The air is passed back to the last chamber again and so continues to circulate. The ammonia evolved is obtained as ammonium sulphate and the sulphur compounds formed are oxydised by the air passing over the liquid.—C. C. H.

Improvements in Filtration in relation to the Process known as "Clark's Process," and to other purposes. J. H. Porter, G. Porter, and J. Porter, London. Eng. Pat. 13,943, October 14, 1887. 8*d.*

The present invention is intended for use in the purification of water on the large scale by means of the "Clark Process." Across the tanks usually employed for settlement rods or wires are laid or strained, and suitably supported as shown at A. (Fig. 1). Coarse fibrous material, such as cocoanut matting, is stretched against this, the lower end of which (Fig. 3), C, enters a pipe crossing the tank transversely as shown in Figs. 1 and 2. This matting is again covered by a finer cloth suitably weighted down on the pipe as shown at D E. The water filters through the fibrous material, leaving the chalk on the surface of the fine cloth, and thence by the pipes from the tank. The finer filtering cloths may be removed and cleansed as often as is found desirable.—C. C. H.

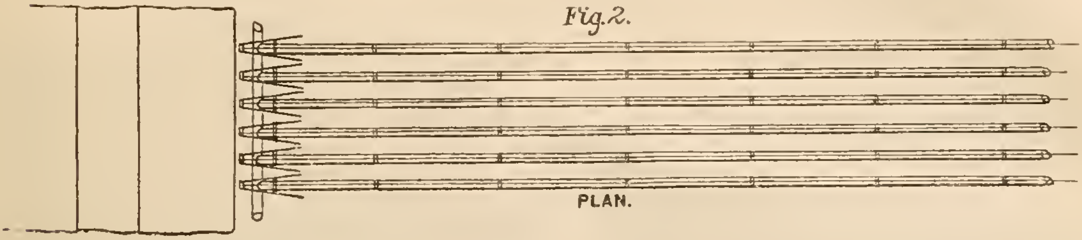
(For Figs. 1, 2, and 3, see next page.)

Fig. 1.



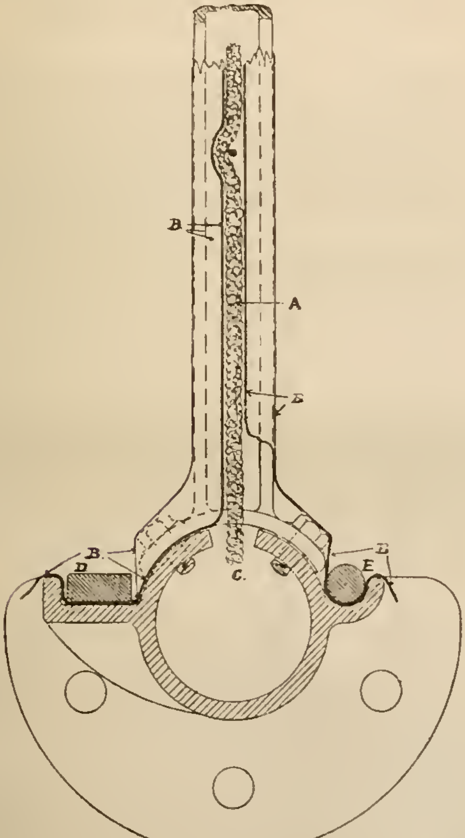
ELEVATION.

Fig. 2.



PLAN.

Fig. 3



(C)—DISINFECTANTS, &c.

PATENTS.

Manufacture of a Dry Antiseptic Non-hygroscopic Powder from a Liquid Extract of Saponin, &c. N. Bradley, Manchester. Eng. Pat. 660, February 11, 1882. Amended April 28, 1888. 6*d.*

The original specification described and claimed the preparation of a dry extract of saponin and its mixture with calcium and magnesium carbonates and other salts, also its use in the scouring of silk and for giving a head or froth to flat liquids such as beer. The patentee now disclaims the addition of dextrin to the preparation; and also the applications to the purposes formerly set forth.
—C. C. H.

Improvements in the Preparation of Materials to be used as Disinfectants, Deodorisers, and Antiseptics, as well as for the Destruction of Parasites infesting Man and the Lower Animals and similar uses. R. V. Tuson, New Charlton. Eng. Pat. 12,222, September 9, 1887. 4*d.*

The improved disinfectant is made by saturating a solution of corrosive sublimate or other salt of mercury with sulphurous acid; salts chloride of zinc is sometimes added, *e.g.*, 3 lbs. of chloride of zinc and 2 ozs. of corrosive sublimate are dissolved in half a gallon of water, which is subsequently made up to one gallon with an aqueous solution of sulphurous anhydride.—C. C. H.

A new Disinfectant. J. Bennett, Goole. Eng. Pat. 12,483, September 14, 1887. 4*d.*

Peat dust 68 parts, water 24 parts, sulphuric acid 4 parts, are thoroughly mixed in a mechanical mixer, and subsequently used as a disinfectant.—C. C. H.

XIX.—PAPER, PASTEBOARD, Etc.

Estimation of Wood Shavings in Paper. R. Godeffroy and Max Coulon. Mittheil. des k. k. Tech. Gew.-Museums, 2, 18—28.

A series of experiments were made with pure linen, cotton, wood, and straw cellulose to ascertain whether anything was contained in them capable of forming a basis for a quantitative estimation of the cellulose in a mixture. Samples of each kind of cellulose were dried at 100°, weighed, boiled with water, dried, then extracted 48 hours with absolute alcohol, afterwards for the same time with pure ether. After evaporating off the solvents, the residues were weighed and examined. Only traces of extractive matter were obtained from the cotton and linen. The others gave the results appended:—

—	Wood. Cellulose.	Straw Cellulose.	Finely Divided Pine-wood Shavings.
Aqueous extract.	Trace.	Trace.	Trace.
	Per Cent.	Per Cent.	Per Cent.
Alcoholic „ .	1·194	0·546	1·499
Ethereal „ .	0·091	0·022	0·0705

The alcoholic and ethereal extracts had an odour of vanillin.

It was found that air-dried wood cellulose, whether extracted or not, was capable of reducing gold from a solution of gold chloride in the proportion of 14·825 of 100 grms. of air-dried wood cellulose. Eight qualities of paper were prepared as follows:—

—	No. 1.	No. 2.	No. 3.	No. 4	No. 5.	No. 6.	No. 7.	No. 8.
	Parts.	Parts	Parts.	Parts.	Parts.	Parts.	Parts.	Parts.
Linen rags....	20	30	40	50	60	70	80	90
Wood shavings	80	70	60	50	40	30	20	10

and the analytical results below obtained.

Paper No.	Moisture Dried at 100°.	Ash of Air-dried Paper.	Wood Cellulose found in Air-dried Paper.	Wood Cellulose really contained.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	8·93	1·56	80·15	80
2	8·76	1·574	69·10	70
3	8·39	1·723	63·4	60
4	8·15	1·826	50·65	50
5	8·04	1·834	41·52	40
6	7·82	1·971	32·62	30
7	7·09	2·19	22·58	20
8	6·66	2·12	12·59	10

The authors reserve the further study of this subject for another paper, and intimate their intention of investigating the reducing actions of wood shavings of different kinds, and the detection of the same in both sized and unsized papers, the present series of analyses having been made on unsized paper.—E. B.

The Dyeing of Paper Pulp with Coal Tar Colours. M. Coulon. Mittheil. des k. k. Tech. Gew.-Museums. 2, 28–34.

See under VI. page 843. —O. H.

PATENTS.

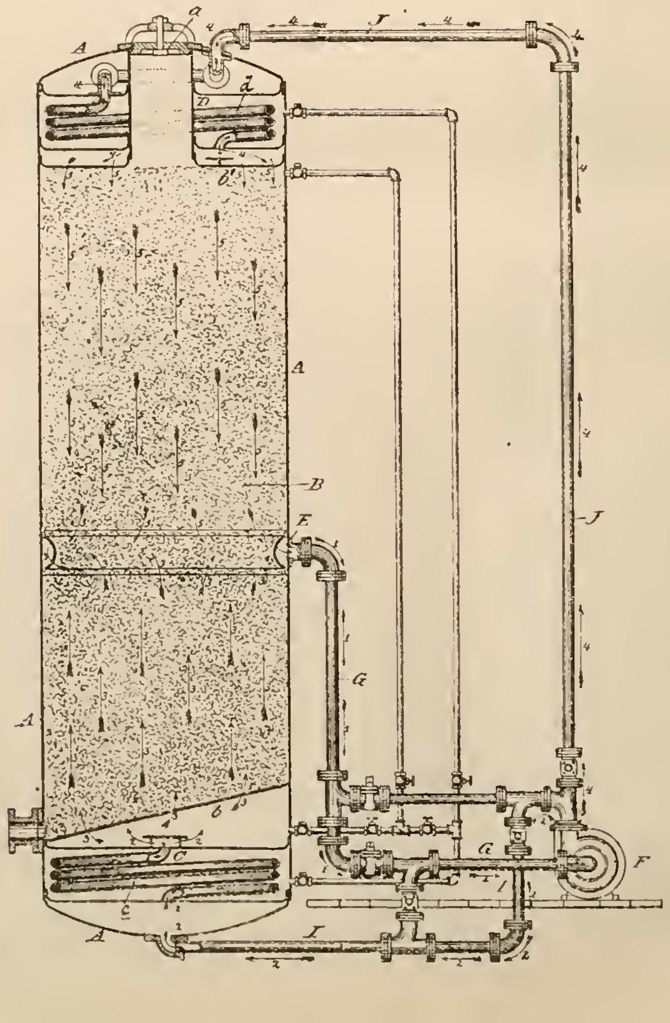
Improvements in the Preparation of Safety Paper affording Protection against Erasure or other Alteration. J. Jameson, Newcastle-on-Tyne. Eng. Pat. 14,733, October 29, 1887. 8*d.*

The inventor covers the paper to be protected with minute drops of a strong solution of aniline colour, either alone or mixed with some sizing material, such as gelatin or shellac dissolved in borax solution. The coating is produced by means of a fine spray, special arrangements being made for allowing only fine particles of solution to fall upon the paper. A drawing of the apparatus for distributing the "colour" accompanies the specification.

—E. J. B.

Improvements in the Treatment of Vegetable Substances for the Manufacture of Paper Stock, Pulp, or Fibre. H. H. Lake, London. From A. Selkirk, New York, U.S.A. Eng. Pat. 11,848, August 16, 1888. 8*d.*

The process is adapted to the treatment of fir, poplar, and other woods, straw, grasses, flax, jute, manilla, and also cotton hulls, and it consists in heating them with a solution



of caustic soda of varying strengths, according to the material employed, at a pressure of from 60 to 100 lbs. per square inch, in a boiler of peculiar construction, which is shown in the Figure.

The material to be treated is placed in the boiler between the perforated plates *b* and b^1.

The liquor circulates through the mass in two different directions. Thus one portion is forced by means of the pump along the pipe I in the direction of the arrows 2. On entering the boiler it is heated in the coil *c* in the heater C, and passes up through the fibre in the direction of the arrows 3. On reaching the middle of the boiler the liquor passes into the perforated annular space E, and returns to the pump (arrows 1). Another portion of liquor is forced up the pipe J, as shown by the arrows 4, and enters the upper part of the boiler, where it is heated in the coil *d* in heater D, and flows through the material (arrows 5). On reaching the middle of the boiler it also passes into the annular space E and returns to the pump.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

A Medicinal Use for Hydroxylamine. C. Schwarz. Pharm. Zeit. **33**, 659.

Hydroxylamine has been recently introduced into medical practice by Binz, who proposes it as a substitute for pyrogallic acid and chrysarobin in applications to the skin as it does not discolour the skin and bandages. and has a strong reducing action. The chloride serves for pharmaceutical purposes and may contain as impurities, free acid, iron, barium, and ammonia. As the salt itself reddens litmus this cannot be used to test for free acid, but Congo paper will serve, and should not be turned blue. An alcoholic solution of the salt should give no precipitate with alcoholic platinic chloride. The acid of the salt may be estimated by titration with caustic alkali in presence of phenolphthalein. The author estimates the hydroxylamine by adding potassium bicarbonate and a known excess of decinormal iodine solution to a solution of the salt, then decinormal hyposulphite solution to remove the excess of iodine, titrating finally with iodine in presence of starch until the blue colour appears. The reaction is based on the fact that hydroxylamine in presence of potassium bicarbonate is oxidised to nitrous oxide by iodine according to the equation—

$$2\ NH_2OH.HCl + 4\ I = N_2O + H_2O + 2\ HCl + 4\ HI.$$

—G. H. B.

On Mercury Phenate. H. Andres. Pharm. Zeits. Russl. **27**, 625.

Commercial preparations contain varying amounts of mercury. A preparation corresponding exactly to the formula $(C_6H_5O)_2Hg$ is obtained in the following way. Potassium phenate is first prepared by dissolving 94 parts of phenol and 56 parts of potassium hydrate in 90 per cent. alcohol, evaporating the solution to a syrup on the water-bath and drying over sulphuric acid. 100 parts of the potassium phenate are dissolved in alcohol and the filtered solution precipitated with an alcoholic solution of 112 parts of mercury bichloride. The orange precipitate is collected on a filter, washed with 60 per cent. alcohol until nearly free from chlorine, and then with absolute alcohol until the filtrate gives no reaction with sulphuretted hydrogen. The mercury phenate after drying in an exsiccator over sulphuric acid is an amorphous brick-red powder, insoluble in water, alcohol, ether, chloroform, and carbon bisulphide.—G. H. B.

On Mercury Salicylate. G. Kranzfeld. Pharm. Zeits. Russl. **27**, 641.

In order to obtain the pure compound the author dissolves one equivalent of mercury bichloride in hot water and precipitates the clear solution with sodium hydrate. The mercuric oxide is well washed, placed in a flask with a little water, heated over a water-bath, and one equivalent of salicylic acid is then added gradually. After heating and shaking for some hours the yellow colour of the oxide gives place to the white colour of the salicylate. The end of the reaction may be further tested by the complete solubility of a sample in sodium hydrate solution. If the salt does not dissolve a little more salicylic acid is added to complete the reaction. The product corresponds to the formula $(C_6H_4.COO)_2Hg$.—G. H. B.

Cinchona Bark. J. E. de Vry, Hague. Chem. Zeit. **12**, 1360—1368.

Cinchona succirubra, the original source of the red cinchona bark, begins to show a diminution in the percentage of contained alkaloids after it reaches an age of 12—16 years, whilst it is at this age that it contains a large quantity of cinchona red.

When an excess of 95—98 per cent. alcohol is added to an aqueous extract of cultivated cinchona bark a sticky substance is precipitated, as was long ago (1820) observed by Pelletier. This body is a calcium salt which yields, when warmed with water and magnesia, calcium quinate, magnesium quinate, and cinchona red; this decomposition points to the presence of both quinic acid and cinchona tannin in the salt, which latter is transformed into cinchona red by treatment with magnesia in contact with the oxygen of the air. The calcium salt is hygroscopic; it turns the plane of polarisation to the left, but to a less extent than calcium quinate does. Cinchona tannin, which is precipitated from an aqueous extract of the bark by strong acids, occurs in considerably greater quantity in the cultivated than in the wild bark.

From the author's investigations it appears that the young cinchona plants only contain the alkaloids in an amorphous state (so-called quinoidine), and that the appearance of the crystalline alkaloids takes place as the plants develop; hence it is probable that the latter are produced from the former, and that the reverse process, often regarded as the more probable, does not occur. Two forms of the amorphous alkaloid, one of which turns the plane of polarisation to the right, the other to the left, exist in the bark.

The neutral combinations of the amorphous alkaloid (quinoidine) with acids which give an alkaline reaction on litmus paper are very hygroscopic, and extremely soluble in water, and this solubility is communicated to the similar salts of the crystalline cinchona alkaloids when present. Advantage is taken of this property in the preparation of quinetum or cinchona febrifuga, which consists of the neutral salts of the total alkaloids of the bark which have an alkaline reaction, and are very readily soluble in water. Quinetum is of especial value for subcutaneous injection.

—C. A. K.

Report on New Fine Chemicals of Therapeutic Value. Merck's Bull. **1**, 28—40.

Camphoric Acid, $C_8H_{14}(CO.OH)_2$.—In a recent meeting of the Berlin Medical Society, Dr. M. Reschert pointed out that this acid, which hitherto had no application as a therapeutic agent, exerts an eminently beneficial effect in both acute and chronic inflammatory affections of the mucous membranes of the entire respiratory tract. It is likewise valuable in various acute diseases of the dermis. A topical application of a 3—6 per cent. solution of camphoric acid effects a contraction of the surface tissue within as little as two minutes, causing a sensation of relief from pain, combined with a reduction of the inflammatory symptoms. *Acute coryza* has repeatedly yielded to treatment with the nasal douche charged with a solution of 1 in 500, or to a cotton-wool tampon with a 3 per cent. solution.

Camphoric acid however produces no caustic accessory effects; on the contrary in *laryngeal ulcerations*, &c. it promotes granulation, and solutions of but 0·9 to 1 per cent. act *aseptically*. It may be exhibited subcutaneously or topically in 0·5 to 1 or 2 per cent. solutions, or as an inhalant in 1 to 2 per cent. solution.

Dr. Fürbringer reports its prompt efficacy—in at least 50 per cent. of the cases treated—in stopping the night-sweats of consumptives. He terms it "an agreeable very slightly toxic, and but very slightly irritant antiseptic."

Camphoric Acid occurs in thin, colourless, scale-like crystals, or in large clear monoclinic prisms of acid taste. It has a melting point of 178° C., is very little soluble in water, but easily so in alcohol and ether. Fats and oils dissolve upwards of 2 per cent. of it.

Iodine Trichloride has been experimentally examined by Dr. O. Riedel as to its antiseptic power, for the German Imperial Sanitary Bureau at Berlin. It was found that 1 part in 1,000 destroys bacillus spores in a comparatively short time; but only the aqueous solution does this, not alcoholic or oily solutions. The trichloride by far surpasses carbolic acid, and is only second to corrosive sublimate in antiseptic power.

Mercury Albuminate.—A. Schneider's method (Pharm. Centralh. 1888, 141 and 163). One part of egg albumen is dissolved by shaking in 8 (by weight) of water, and filtered. To the filtrate is added corrosive sublimate with stirring after the addition of each portion, so long as the additions cause a precipitate, this requiring about 333 parts of the sublimate to every 1,000 of the albumen. The precipitate is allowed 48 hours to settle. The supernatant liquor is decanted from the precipitate, and the latter is mixed without first washing it with sufficient powdered sugar of milk to produce an almost dry powder. This is dried over sulphuric acid, powdered finely, and then mixed with sufficient milk-sugar to make the sublimate employed represent 0·4 per cent. of the whole. Thus, 1,000 parts of Schneider's mercury albuminate will contain 4 of the bichloride to about 12 of albumen and 984 of lactose. Thus prepared, the albumen gives up no mercury bichloride to water with which it is agitated, whilst it does so readily to solutions of sodium chloride, ammonium chloride, potassium iodide, blood-serum, meat broth, &c. upon agitation.

Mercuric Cyanide.—Stellden reports on 1,400 cases of diphtheria treated by him with this cyanide. There were among that number only 69 deaths, these not amounting to quite 5 per cent., whilst ordinarily in the same district the death-rate was 92 per cent.

The mixture used by Stellden was honey 450 grains, tincture of aconite 30 grains, and mercury cyanide 0·3 grain. A gargle of 1 part of mercury cyanide to 10,000 of peppermint water was also employed. The frequent doses and applications are said to create a medium in which the diphtherial bacillus cannot live.

Methyl-trihydroxyquinoline Sodium Carbonate or "Thermifugine" ($C_{11}H_{12}O_3N$ combined with sodium), was recently discovered by Nencki, and the sodium salt was experimented upon by Demme, of Berne. He finds it to be a good antipyretic, combining the three faculties of reducing temperature, retarding the pulse, and increasing the blood-pressure. The acid forms beautiful crystals, but slightly soluble in water or alcohol, and melting at 265° C. The *sodium salt* ("thermifugine") is a faint yellowish-white salt, forming a dark brown aqueous solution. The doses of thermifugine are stated as 0·10 to 0·15 grm. for ages of four to six years, 0·2 grm. 7 to 10, and 0·25 grm. for 11 to 15 years.

Pure Narceine, melting at 170° C. This is used according to the clinical tests of Erlenmeyer and Reissner, as a valuable sedative and hypnotic in *psychiatric diseases*. The results obtained by it in this direction are superior to those obtained with morphia. In neuralgia and ischia it is preferable to morphine.

Vasicine.—An alkaloid discovered by Dr. Hooper in the leaves of *Adhatoda vasica*, Nees. This plant, which belongs to the order *Acanthaceæ*, is a native of the Punjaub, where it abounds. It is also found in Ceylon and the Malays. It grows as a dense, almost tree-like shrub, and its leaves are used by the natives as an expectorant and palliative in *asthma, bronchitis*, and other affections of the respiratory tract.

Besides this, the leaves and extracts are used as an insecticide. Numerous experiments have shown that a solution of the alcoholic extract of *Vasatha-leaves* is an intensely lethal poison to all the lower orders of animal life, whilst producing no appreciable effect on healthy animals of the higher order.—W. S.

Report on New Discoveries and Applications of Chemical Substances as Therapeutics. Merck's Bull. **1** [5], 1888.

Acetal.—$CH_3.CH(O.C_2H_5)_2$. This substance is obtained as a by-product in the alcohol and aldehyde manufactures. It is a limpid liquid of sp. gr. 0·821 at 22° C., a boiling point of 104° C., and is soluble in 18 parts of water at 25° C. According to von Meering it is given internally as a narcotic in doses of 5 to 10 grms.

Cresylic Acid (Cresol).—It has been recently brought into prominent notice as an antiseptic by Dujardin-Beaumetz. This authority finds its anti-zymotic action superior to that of phenol. One part of a two per cent. solution added to ten parts of a fermenting liquid was found by that authority to stop all further fermentation.

Trichloracetic Acid. — $CCl_3.CO.OH$. Deliquescent rhombohedral crystals melting at 52·3° C., boiling at 195° C., and with a sp. gr. of 1·617 at 46° C. It is the best and quickest *escharotic* yet known for warts, corns, and bunions.

Alstonine (Chlorageninе). — This is the alkaloid of *Alstonia constricta*, an Australasian apocynea. It forms white, lustrous, silky needles, easily soluble in ether, chloroform, or alcohol. It is nearly insoluble in cold water, but somewhat soluble in hot water, to which it imparts an intensely bitter taste.

Alstonine is an antiperiodic, antiseptic, and stimulant, and thus unites the qualities of quinine and strychnine. It is employed in *typhoid* and in *lacteal fevers*.

The bark of *Alstonia constricta* is sometimes used by ale brewers as a substitute for hops, since it is free from the effect of inducing headache or other ailments consequent on the imbibation of the hop bitter.

Andromedotoxin, $C_{34}H_{51}O_{10}$, an extremely powerful emetic, is the active principle of the species of Rosebay known as *Rhododendron ponticum, Ericaceæ*. According to Plugge the principle is contained also in other members of the family of the *Ericaceæ*. It forms needle-shaped crystals, easily soluble in cold or hot water. Its melting point is 228°—229° C., and it turns the plane of polarised light to the left. On evaporating it with concentrated sulphuric acid or with phosphoric or hydrochloric acids a red colouration is developed; this is a reaction capable of showing the presence of as little as half of a millionth of a grm. (seven to eight millionths of a grain) of andromedotoxin. It is an enormously strong poison and paralyses the peripheral motor nerves.

Betol.—$C_6H_4(OH)CO.OC_{10}H_7$ (*β-naphthyl salicylic ether*). This may be and is termed naphtho-salol. It forms a white, lustrous, crystalline powder, is colourless, and insipid as to taste. Its melting point is 95° C., it is nearly insoluble in water, either hot or cold, in glycerol, and but little in cold alcohol, though in boiling alcohol it dissolves in the proportion of 1 in 3. It is soluble in warm linseed-oil.

The physiological and therapeutical peculiarity of *betol*, which it shares with its analogue *salol*, is that it is inert and innocuous in the normal gastric digestive process; but so soon as it reaches the alkaline fluids of the intestinal digestion, it becomes decomposed into its constituents, salicylic acid and β-naphthol. Like *salol* it is used for *articular rheumatism.*

Boldoin.—$C_{30}H_{52}O_8$, is a glucoside obtained from the boldo leaves (*Peumus boldus, Tul.*) About 3 per cent. of the glucoside is obtained from the leaves.

As a *hypnotic*, *boldoin* is pronounced by Juranville to be more efficacious than either morphine or chloral hydrate. It produces no untoward accessory effects, and has no disagreeable taste; it is an invigorant and stimulates the appetite.

The sleep caused by it has the qualities of the natural sleep, and the respiration is regular.

Jaborandi (*Pilocarpus*) as a fluid extract is recommended and has been found very successful by Professor Waugh in *erysipelas*.

Mercury imido-succinate is a white silky powder, easily soluble in water and without reaction on albuminous liquids. Vollert (*Therapeut. Monatsh.* 1888, 401) states that it is an extremely valuable addition to the list of mercurial hypodermics. It decidedly excels the older mercurial preparations in subcutaneous cases, in (1) Long enduring stability of its solutions; (2) Comparative painlessness of application; and (3) Slightness of infiltration at the point of injection.

Mercury Cyanide and Hydroxycyanide.—The hydroxycyanide is described as destined entirely to supplant corrosive sublimate. In not attacking the metal of surgical instruments when used for disinfecting them, it is superior to that salt. In disinfecting bacterialised peptone fluids, it shows six times the bactericidal power of corrosive sublimate. The report of Stellden as to the successful use of the simple cyanide in diphtheretic cases has already been given.

Alpha-Naphthol is reported by Maximowitsch as an antiseptic of extraordinary efficiency in preventing the development of pathogenic micro-organisms. Solutions containing only from 1 to 2½ parts of this naphthol in 10,000 of liquid, intercepts the propagation of the *typhoïd-* and *tuberculose-bacilli*, whilst α-naphthol is 700 times less active in specific physiological effect on the human organism than biniodide of mercury. As regards anti-zymotic effect, 1 part of α-naphthol added to 10,000 of a glucose solution prevents the latter from entering alcoholic fermentation.

Hydroxypropylene-di-iso-Amylamine.—A newly synthesised alkaloid. It is a colourless liquid, soluble in alcohol, ether, and in the fatty oils. Its physiological action is similar to that of atropine. In large doses it induces epilepsy, in moderate ones is an energetic stimulant of the heart, elevating both blood-pressure and temperature.

Parthenicine.—An alkaloid discovered by C. Ulrici, of Cuba, in a plant native there, *Parthenium hysterophorus.* It forms large rectangular prisms with pyramids on the four lateral sides. It is odourless, very bitter, readily soluble in water, and still more so in hot water, alcohol, ether, and chloroform. It gives colour-reactions with sulphuric acid and potassium bichromate, which distinguish it. It has the power, administered in doses of 0·05 grm. (¾ grain), of assuaging neuralgia; it has also proved useful in intermittent fever.—W. S.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Potassium Meta-bisulphite. J. M. Eder. Phot. Corresp. **25**, 416.

Potassium meta-bisulphite, $K_2SO_3 . SO_2$, is used in place of sodium hydrogen sulphite to preserve pyrogallol solutions. It is prepared by saturating a solution of potassium carbonate with sulphurous anhydride and adding alcohol. The salt separates as a white crystalline powder, and is washed with alcohol. It loses sulphurous anhydride when exposed to the air. The systematic name of the salt would be *potassium anhydro-sulphite*.—C. H. B.

Organic Developers. Mercier. Phot. Corresp. **25**, 444.

A solution of *eserin* or *calaburin* from the Calabar bean, mixed with sodium sulphite and carbonate, is capable of developing the latent image on gelatino-bromide plates. A strong infusion of green tea made alkaline with ammonia also acts as a developer, but an ammoniacal infusion of oak bark has the same effect, and hence it would seem that tannin is really the active agent. If gum guaiacum which has not been exposed to light be moistened with alcohol and extracted with a hot solution of sodium carbonate, the liquid has feeble developing powers.

The reducing power of these solutions is very much inferior to that of an alkaline solution of pyrogallol.

—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements in Detonators. A. V. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 16,919, December 8, 1887. 8*d*.

The object of this invention is to provide detonating mixtures which are cheaper and less dangerous than the fulminate of mercury generally used for charging detonators. The inventor finds by experiment that explosive mixtures of picrate of lead and picrate of potash and a chlorate when used in the ordinary pulverulent state and compressed into detonator tubes, only explode partially when ignited and do not give good results, whereas after granulating the above substances and similar explosives so that they form minute grains of 3,000 to 10,000 per grm., thoroughly satisfactory results are obtained.

The main feature of this invention is the granulating of the substances to be used for charging the detonators, and as the mixtures which can thus be used are inexpensive it is proposed to increase the charges for detonator tubes beyond the present limits, and for this purpose a bottle-shaped detonator tube is described. Where detonators of exceptional energy are required a small tube containing say 0·5 grm. of fulminate of mercury is inserted in the bottle-shaped detonator tube charged with the granulated explosive mixture.—C. N. H.

An Improved Explosive Compound. A. V. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 16,920, December 8, 1887. 6*d*.

The inventor finds that ammonio-nitrate of copper ($4 NH_3Cu(NO_3)_2$) possesses explosive properties, and although it cannot be fired by a spark or Bickford fuse, it develops great energy when detonated.

The ammonio-nitrate of copper is not sensitive to concussion. It is claimed that a very short flame of comparatively low temperature is emitted on detonation, not capable of igniting fire-damp under conditions where gunpowder or dynamite would cause it to explode.

It can be used for propelling projectiles after it has been granulated in the same manner as gunpowder is granulated, but has to be fired by a special primer of gunpowder. In filling cartridges for firearms with granulated ammonio-nitrate of copper, the gunpowder primer is so arranged as to be fired directly by the cap, and then the charging is completed as with ordinary gunpowder.

For use in mines it is simply filled into ordinary paper cartridges and fired by a detonator.—C. N. H.

Improvements in the Manufacture of Explosives. J. Y. Johnson, London. From F. C. Glaser, Berlin, Germany. Eng. Pat. 17,167, December 13, 1887. 6*d*.

"The manufacture of explosives suitable for use in small arms and ordnance for blasting and other like purposes by nitrating vegetable fibrous material, woody matter, cellulose, or the like in the manufactured condition, and either partially charred or roasted or not, and subjecting it to the action of acetic ether, acetone, or like solvent of equal strength, and then drying or allowing to dry or distilling off the solvent, and when required reducing to the required forms or granulating, whether there be used or not oxygen-yielding substances or such substances and hydrocarbon, and whether washing and treatment with an alkali be resorted to or not."—C. N. H.

The Preparation of certain new Compounds from Picric Acid and the Manufacture therefrom of Explosives, partly applicable also to Coloured Fires. S. H. Emmens, New York, U.S.A. Eng. Pat. 370, January 10, 1888. 6*d.*

The inventor has discovered that when picric acid is treated with red furming nitric acid of sp. gr. 1·52 it dissolves with evolution of red fumes, and the solution when cooled yields a crop of crystals. These crystals, which are an ingredient of his explosives he calls "Emmens" acid, and they differ in properties and composition from picric acid.

"The liquor remaining after these crystals have been deposited and removed will yield a second crop of similar crystals, and will deposit simultaneously a quantity of lustrous flakes. These flakes heated in water separate into two new bodies—one of which enters into solution and forms crystals unlike the above, while the other body fuses and remains below the water undissolved."

These acid crystals and residuum are also used as ingredients of the explosives and a mixture of "Emmens" acid, and these two new bodies is called "Emmens" mixture. Explosives are formed by fusing "Emmens" acid to a nitrate together, or "Emmens" mixture and a nitrate, and such explosives are called "Emmensite." The mixtures have to be exploded by detonation.—C. N. H.

Improvements relating to the Manufacture of Explosives. T. Chandelon, Liège, Belgium. Eng. Pat. 13,360, September 15, 1888. 6*d.*

The chief feature in this invention is the use of organic picrates together with nitrates, or chlorates or both, to form an explosive compound.

Mixtures are described of picrate of benzene, picrate of nitrobenzene, picrate of dinitrobenzene, and picrate of nitronapthalene with nitrate of ammonia or other nitrates, also of mixtures of the above picrates in which the nitrate has been replaced wholly or partly by a chlorate.—C. N. H.

Improvements in the Manufacture of Explosive Compounds. C. E. Bichel, Berlin, Germany. Eng. Pat. 14,623, November 11, 1886. Amended October 5, 1888. 6*d.*

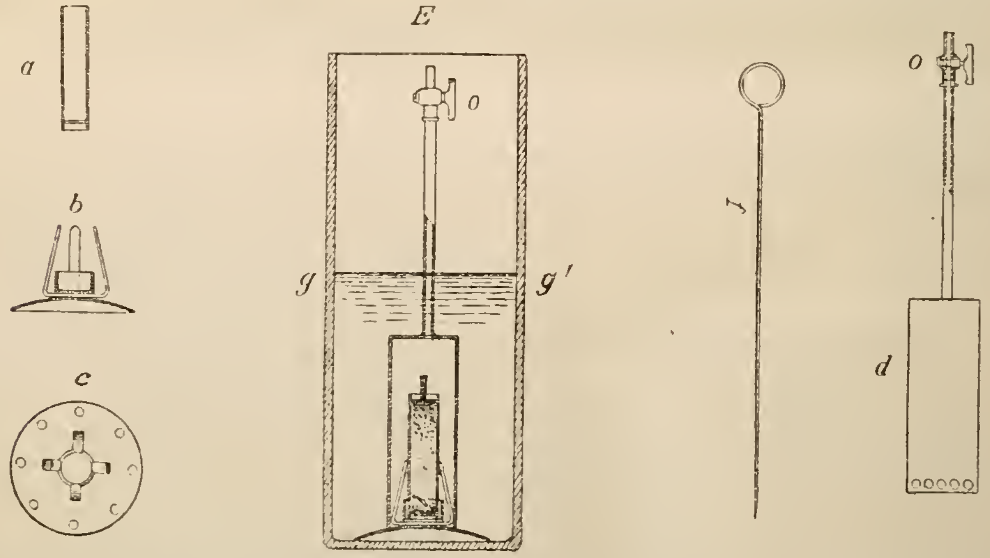
The inventor prepares a "cheap and harmless explosive" by firstly sulphurising resin oil or other hydrocarbons, such as wood or coal tar or their distillates boiling between 120° C. and 200° C.; secondly, mixing the above with nitrates or chlorates. He also employs the above sulphurised hydrocarbons mixed with nitro-benzene, nitro-phenol, nitrotoluene, &c., and with explosive nitro-compounds such as nitro-glycerol and nitraniline in order to render these latter more stable.

The sulphurising is carried out by distilling the hydrocarbons in combination with sulphur, and it is claimed that the compounds resulting from the above treatment "exhibit the peculiarity that they mix readily with nitro-compounds, whilst in the case of the products of distillation not sulphuretted, even when they appear to mix, a subsequent separation takes place which renders the production of a stable product impossible."—C. N. H.

XXIII.—ANALYTICAL CHEMISTRY.

The Practical Value of the Lewis Thompson Calorimeter. Scheurer-Kestner. Bull. Soc. Ind. Mulhouse, 1888, 506—513.

This apparatus is shown in the annexed cut; *a* is a copper cartridge case for receiving the substance under investigation mixed with nitrate and chlorate of potash; *b*—*c* is a stand with four vertical springs, as shown, which grasp the cartridge when in position, and over which slips the tightly-fitting copper bell *d*. This last is surmounted by a tube provided with a stop-cock, and serves to protect the cartridge when the latter is placed upon its stand; *g* is a glass vessel containing water to the level *g g'*; *f* is a wire for cleaning out the tube of the copper bell when required; *E* shows the whole apparatus ready for action. The calorimetrical operation is performed as follows:—The cartridge *a* is placed upon the stand *b*—*c* and lighted by a fuse. It is then immediately covered by the copper bell *d*, and the whole plunged into the glass vessel of water. The gaseous products of combustion escape through the holes round the base of the bell, and pass through the water from bottom to top. When the combustion is finished, the stop-cock is opened and the water allowed to enter the bell The glass vessel contains 2 kilos. of water, and from 1·5 to 2·0 grms. of substance is a convenient quantity for each determination.



The author has undertaken a series of experiments for the purpose of comparing the results yielded by this calorimeter with those obtained from the Favre-Silbermann instrument. For scientific purposes it is obviously inadequate, but if due precaution be observed in its use, and an addition of 15 per cent. be made to the figures obtained, the result agrees very closely with the heat of combustion as found with the Favre-Silbermann calorimeter — the maximum deviation being below 4 per cent. The correc-

tion of 15 per cent. above mentioned was obtained by testing wood-charcoal in the two calorimeters, and its practical accuracy has been established by comparative estimations with 30 different kinds of coal. In no case did the discrepancy exceed 4 per cent., and in two-thirds of the instances it was below 2 per cent. It is usually recommended to employ from 8 to 10 parts of oxidising mixture (3 of potassium chlorate to 1 of potassium nitrate) for one of combustible, but in no case has the author found this to be sufficient. He has always repeated the experiment (when necessary) till perfect combustion was obtained and no black specks appeared in the water, and he found the satisfactory proportions to vary from 11½ to 14 parts of oxidising mixture to one of combustible. The most advantageous figures have to be found by experiment. They vary with the percentage of ash, and more oxidising mixture is required for a bituminous than for a non-bituminous coal.
—A. R. D.

Device for removing Fused Masses from Platinum Crucibles. L. L. de Koninck. Zeits. f. angew. Chem. 1888, 569.

Various plans have been proposed for detaching the contents of platinum crucibles containing bisulphate or alkaline carbonate melts, but none has proved satisfactory, especially if the crucible be not perfectly smooth. The following method, however, is available, even in the case of an old crucible with roughened surface :—

As soon as the fusion is completed a piece of platinum wire 8—10 cm. in length, having one end bent to form a loop, and the other coiled into a spiral form, is inserted into the melted mass, so that the spiral is completely immersed, and held there until the contents of the crucible solidifies. It is then hung by means of a second wire, having a hook at each end, from a glass rod carried in a clamp sliding on the retort stand that supports the crucible, at the height of a few millimetres above its triangle. On heating sharply, the outer layer of the mass fuses and the crucible falls on to the triangle, leaving the bulk of the melt suspended by the wire ; both it and the particles remaining in the crucible can be readily dissolved in the appropriate liquid.

The plan is specially serviceable in the case of fusions with bisulphate in the determination of titanium, when of course the solvent must be used cold ; on suspending the mass near the surface of the solvent the saturated liquid falls to the bottom of the vessel and is continually replaced by fresh, so that solution takes place rapidly.—B. B.

Methylated Spirits for Heating Purposes in Laboratories. C. Reinhardt. Zeits. f. angew. Chem. 1888, 634.

The author has found that the methylated spirits of commerce, introduced since the alcohol tax was levied in Germany, has a most destructive action on copper, zinc, and brass, &c., so that the brass lamps which he has used have required frequent repairs. This is, however, not the only drawback with this heating material, for it acts on platinum vessels placed over it to such an extent that they become rapidly spoiled.—J. W. L.

Determination of Nitrogen by Kjeldahl's Method. Apparatus for Measuring off Small Quantities of Mercury. Wrampelmeyer. Chem. Zeit. 12, 1317.

The best means for hastening the decomposition of the nitrogenous body examined, by means of sulphuric acid and phosphoric anhydride, is the addition of 0·05 cc. of mercury as previously recommended by the author. In order to be able to add exactly this quantity of mercury an iron cock, capable of holding 0·1 cc., is attached to a tube 760 mm. in length and ending in a vessel which serves as the mercury reservoir, the cock being so arranged that on bringing it into connexion with the tube the air in the cock is compressed to about one-half of its volume by the overlying column of mercury ; the mercury fills the other half of the cock, and the latter, when turned through 180°, delivers its charge of mercury. Occasionally double the above volume of mercury will flow out, owing to the escape of the contained air from the cock ; should this happen a double quantity of sodium sulphide is added to the caustic soda solution.—C. A. K.

Determination of Phosphoric Acid in Manures with the Help of Citric Acid. F. Seyfert. Chem. Zeit. 12, 1390.

The author remarks that the only objection to K. Miller's method as improved by Vogel for the determination of phosphoric acid in basic slag and superphosphate by the addition of a 50 per cent. solution of citric acid (Chem. Zeit. 12, 85) lies in the difficulty with which the magnesium ammonium phosphate separates. In Vogel's method the solution containing the phosphate is first treated with the citric acid solution, then a 10 per cent. solution of ammonia is added, next the magnesium mixture, and finally one-third of the total volume of the liquid of 10 per cent. ammonia. The precipitate is separated by stirring with a glass rod as usual. If instead of a glass rod, a body having a rough surface be used for stirring, the precipitate separates rapidly and can be filtered off with safety after standing for half an hour. A closely cut feather or a thin strip of wood serves the purpose best. It is further stated that the separation of other precipitates can be similarly effected, and the heating during precipitation thereby rendered unnecessary ; barium sulphate and calcium oxalate are given as examples.—C. A. K.

On the Accuracy of the Dry Assay for Silver. H. Rössler. Zeits. f. angew. Chem. 1888, 567—568.

Loss is inevitable in determining silver by the dry way, consequently the wet method is to be preferred, whenever applicable, as in the case of fairly rich silver alloys.

It is, however, important to know the amount of this loss, because only the dry way can be used for ores and metals containing small quantities of silver.

This the author has determined by mixing weighed quantities of pure silver with various proportions of such diluting material, and then assaying the mixture by the ordinary methods.

Loss occurs by absorption in the slag when either a crucible or a scorifier is used, but the quantity volatilised and absorbed during cupellation is the most serious item (from 100 grms. of fine dust from a gas muffle, ·58 grm. of silver was obtained).

A table is given showing the percentage of silver lost in assaying various materials, selections from which are appended.

Substance.	Proportion of Ag in Substance.	Weight of Ag taken.	Proportion of Pb to Ag.	Percentage of Ag lost.
	G. in 100 k.	Mg.		
Argentiferous lead ..	150	150	600 : 1	2·5
Rich „ „ ..	1,500	150	60 : 1	1·6
„ copper	150	15	12,000 : 1	8·3
Silver ore	10,000	250	160 : 1	1·6
Lead ore	50	12·5	2,000 : 1	5·3

—B. B.

Table of Degrees of Hardness of Waters. L. L. de Koninck. Zeits. f. angew. Chem. 1888, 569—570.

Faisst and Knauss's table gives the number of cc. of standard soap solution corresponding to each degree of hardness. As one degree of hardness corresponds to more than 3 cc. of soap solution the value for any intermediate number of cc. of soap solution has to be interpolated.

The author reverses the plan, and gives the value of each whole number of cc. of soap solution in degrees of hardness, thus facilitating calculation.

Suppose in an estimation 34·5 cc. of solution have been required, the degree of hardness is calculated as follows :—

For 34 cc. soap solution, degree of hardness is 8·70
„ 0·5 cc. „ 0·5 × 0·29 = 0·145 = 0·15
Total....... 8·85

cc.	Degrees of Hardness.	Difference.	cc.	Degrees of Hardness.	Difference.
1·4	0°	..	24	5·87	0·28
2	0·15	0·25	25	6·15	0·28
3	0·40	0·25	26	6·43	0·28
4	0·65	0·25	27	6·71	0·28
5	0·90	0·25	28	6·99	0·28
6	1·15	0·25	29	7·27	0·28
7	1·40	0·25	30	7·55	0·28
8	1·65	0·25	31	7·85	0·29
9	1·90	0·26	32	8 12	0·29
10	2·16	0·26	33	8·41	0·29
11	2·42	0·26	34	8·70	0·29
12	2·68	0·26	35	8·99	0·29
13	2·94	0·26	36	9·28	0·29
14	3·20	0·26	37	9·57	0·30
15	3·46	0·26	38	9·87	0·30
16	3·72	0·26	39	10·17	0·30
17	3·98	0·27	40	10·47	0·30
18	4·25	0·27	41	10·77	0·30
19	4·52	0·27	42	11·07	0·31
20	4·79	0·27	43	11·38	0·31
21	5·06	0·27	44	11·69	0·31
22	5·33	0·27	45	12·00	..
23	5·60	0·27			

—W. S.

Estimation of Nitrous Acid in presence of Nitric Acid. W. Kalmann. Mittheil. des k. k. Tech. Gew.-Museums 2, 12—13.

Reliable results are said to be obtained by the following method :—A solution of HI is prepared by running a solution of Na_2SO_3 into one of iodine in potassium iodide till the solution becomes colourless,—

$$Na_2SO_3 + I_2 + H_2O = Na_2SO_4 + 2\ HI.$$

An excess of Na_2SO_3 must be avoided. The estimation of the nitrous acid is based on the following reaction :—

$$NaNO_2 + 2\ HI = NaI + NO + I + H_2O,$$

and the nitric oxide evolved is measured. An alkaline solution of sodium thiosulphate, which has been previously boiled, is placed in the measuring tube. The method is applicable to the detection of nitrites in water, where the quantity present is too small to be detected by the diphenylamine test. On allowing the water, to which the HI solution has been added, to stand, iodine separates out. The following results show the accuracy of the process :—

Test.	Commercial Sodium Nitrite.	Vol. of NO in cc. at 0° C. and 760 mm.	N_2O_3.	N_2O_3 found by Permanganate Method.
	Grm.		Per Cent.	
1*a*	0·1000	29·483	50·15	50·84; 50·42 mean = 50·63
1*b*	0·0956	28·451	50·63	
2*a*	0·0870	24·046	47·01	46·80; 46·64 mean = 46·72
2*b*	0·0926	25·525	46·89	

—E. B.

Decomposition of Realgar by Caustic Potash. W. Kalmann and M. Gläser. Mittheil. des k. k. Tech. Gew.-Museums 2, 34—36.

This research was undertaken with a view to explaining the reducing action of an alkaline solution of realgar on indigo. Native realgar from Santa Dorna was used. The brown residue, left after boiling with caustic potash, amounted in two instances to (I.) 27·03 per cent. and (II.) 26·38 per cent. Analyses of these residues gave :—

—	I.	II.
As	23·03	22·97
S	0·84	0·81
K	0·25	0·21
Gangue	2 72	2·05

Percentages calculated on the realgar.

The average amount of arsenic in the realgar was found to be 68·17 per cent. Berzelius states that one-third of the arsenic in realgar remains in the residue insoluble in KOH. This quantity would be 22·72, which is confirmed by the above analyses. Berzelius assigns the formula $As_{12}S$ to the insoluble residue. But Kühn and Nilson, and, with them, the authors, consider that the arsenic is present in the metallic state, since the residue, when dried at 100° C., steadily gains weight, and the presence of potassium as above shows that it is difficult to wash.

The expression of the decomposition, therefore, is—

$$3\ As_2S_2 = As_2 + 2\ As_2S_3.$$

The alkaline solution contains potassium sulpharsenite and arsenite. Exposed to the air, oxidation takes place and the solution becomes dirty green in colour. When the unoxidised solution is precipitated with HCl, all the arsenic comes down as As_5S_3, but after oxidation only half the arsenic is precipitated and then as As_2S_5.

—	Precipitated with HCl.	Remained in Solution.
	Per Cent.	Per Cent.
Immediately precipitated from alkaline solution	45·35 As	..
Precipitated after several days exposure to air	22·27 „	22·40
	21·73 „	22·37

The arsenic, in each estimation, was converted into ammonium magnesium arsenate and weighed as magnesium pyroarsenate.

Were all the sulphur in the solution precipitated as As_2S_5, the proportion of arsenic precipitated to that left in solution would be 3:2, since 5 As_2S_3 give 3 As_2S_5; or of 10 parts, 6 precipitated and 4 left in solution. But even after long exposure to the air, only half the arsenic is precipitated. The authors promise a continuation of this work.—E. B.

Reactions of Santonin. Vilcin. Chem. Zeit. 12, 1301.

Red colouration occurs on heating an alcoholic solution of santonin with alcoholic potash; addition of sodium renders the reaction more intense. If a santonin solution be reduced with zinc and acetic acid and poured into water a precipitate is formed, which does not show the red colouration, even on addition of sodium.—T. L. B.

Colour Reactions of Lignified Cell Membranes.
H. Warnecke. Pharm. Zeit. 33, 573.

Iodine solutions.—Ligneous cell-walls are coloured yellow by a solution of iodine in potassium iodide or zinc chloride; cork membranes give, however, the same reaction.

Indol.—In aqueous solution, colours ligneous membranes reddish violet on addition of sulphuric acid, and this cannot be removed by continuous washing with distilled water.

Phenol does not produce distinctive colourations.

Orcinol and *resorcinol* give good reactions as follows :—The section is treated with a 1 per cent. alcoholic solution of the reagent (protected from the light) and the alcohol allowed partly to evaporate, so that no air remains in the cells. When treated subsequently with concentrated hydrochloric acid, a beautiful deep blue is obtained in the case of resorcinol, and in the case of orcinol a bluish violet.

Pyrogallol, similarly applied, yields a blue green. If water be subsequently added the blue green turns to blue.

Phlorglucinol, under similar circumstances produces a violet red colouration, even when the hydrochloric acid has been diluted with an equal volume of water.—T. L. B.

Detection of Rosin. T. Morawski. Mittheil. des k. k. Tech. Gew.-Museums **2**, 12—14.

The method of L. Storch (this Journal, 1888, pp. 136, 526), for detecting rosin-oil can be applied to the detection of rosin. Rosin in paper, in the mixture of fatty matters separated by acid from a soap solution, and in beeswax was easily detected by this test.—E. B.

The Examination of Brandy. Zeits. f. angew. Chem. 1888, 583—587.

Means for detecting and estimating fusel oil in brandy have been sought by many chemists; a good method is that of Röse, with Herzfeld's improved apparatus. It is executed as follows :—Into the apparatus shown in the figure is placed redistilled anhydrous chloroform up to the 20 cc. mark, care being taken not to soil the walls of the upper part of the tube (the temperature must be kept at 15° C. throughout the operation). Meanwhile 200 cc. of the brandy to be tested have been distilled, with the addition of a small quantity of caustic potash, until $\frac{4}{5}$ths have passed over. The distillate is made up to 200 cc., and its specific gravity adjusted to that of 30 per cent. alcohol (by volume), viz., ·96564, by the addition of water or absolute alcohol, as the case may be, the correctness of the adjustment being confirmed by the sp. gr. bottle. 100 cc. of this liquid are put into the apparatus, the line of demarcation between it and the chloroform becoming thereby flat and sharp, 1 cc. of sulphuric acid, sp. gr. 1·2857 added, the apparatus closed with a cork, and the whole vigorously and repeatedly shaken. When the liquids have separated, the volume of the chloroform layer will be found to have increased. Its volume is read off, and the amount by which its exceeds that given by a blank experiment with pure alcohol of the sp. gr. ·96564, is due to the presence of fusel oil; each increase in the bulk of the chloroform of ·01 cc. corresponds to the presence of ·006631 per cent. by vol. of amyl alcohol.

The temperature and strength of the alcohol prescribed must be rigidly adhered to.

Furfurol, aldehyde, ethereal oils, &c., if present, modify the results, but their effect is largely diminished by the addition of potash when distilling, as mentioned above.

Such impurities have a greater influence on the readings both of Traube's capillarimeter and his stalagmometer, and the chloroform method is to be preferred to either.—B. B.

The Analysis of Meat Guano. I. König. Zeits. f. angew. Chem. 1888, 629—630.

The author points out the difficulty one experiences in obtaining portions of uniform quality for analysis from samples of the meat guano, owing to the presence of lumps of bone and clotted blood, which are not readily reduced to such a fine state of subdivision as would admit of their being thoroughly mixed. In several samples the nitrogen was determined in the larger lumps and in the finer portions, with the following result :—

—	Sample.			
	I.	II.	III.	IV.
Coarse portion ..	8·08	8·30	8·05	8·96
Fine portion	3·88	3·96	4·32	4·54

In consideration of this difficulty of obtaining in 1—2 grm. a really uniform portion for analysis, the author has employed a much larger quantity. The nitrogen was determined according to the following modification of Kjeldahl's method. 15 grms. of the guano are treated with 150 grms. of the sulphuric acid and Nordhausen acid mixture (3 : 2 by vol.) in a porcelain dish on the water-bath until everything has dissolved. The solution is then poured into a 200 cc. measure, the dish washed out with sulphuric acid, and the volume made up to the mark with sulphuric acid. 20 cc. of this is taken and the organic matter destroyed as in Kjeldahl's method, and the amount of ammonia determined in this (1·5 grm. guano).

By following out this method the author obtained the following results, estimating in each case the N in two 20 cc. specimens of each sample, *a* and *b*.

Sample.							
I.		II.		III.		IV.	
Per Cent. N.		Per Cent. N.		Per Cent. N.		Per Cent. N.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
5·24	5·22	5·32	5·36	5·93	5·96	6·08	6·05

For the determination of the phosphoric acid about 5 to 10 grms. are ignited, and the determination made in the ash.—J. W. L.

Preservative for Solutions of Tartaric and Citric Acids. C. Reinhardt. Zeits. f. angew. Chem. 1888, 634—635.

The author has found that the addition of $\frac{1}{10}$ per cent. of salicylic acid (on the weight of dry substance) to a solution of tartaric acid, or $\frac{1}{5}$ per cent. to a solution of citric acid, prevents these from going mouldy, and they may be kept for years in quite good condition. Solution of sodium succinate is not preserved by this means.—J. W. L.

Analysis of Wax. G. Buchner. Chem. Zeit. **12**, 1276.

In making analyses of bees-wax by Hübl's method the author took as check a sample of absolutely pure chemically bleached bees-wax. This gave, however, too high an acid value, and too low a ratio. Subsequent experiments showed that chemically bleached wax gives invariably a higher acid value, and a lower ratio than yellow wax and wax bleached in sunlight. The saponification equivalent of chemically bleached wax is likewise higher than the saponification equivalent of the other sorts.—T. L. B.

Analysis of Turkey-Red Oils. F. Breinl. Mittheil. des k. k. Tech. Gew.-Museums **2**, 37—47.

Two different results returned, concerning the composition of a sample of Turkey-red oil, led the author to make a comparative test with the various methods in use.

Two samples of Turkey-red oil of the following composition were selected :—

—	I.	II.
	Percentage.	
Na_2O combined with fatty acids and fatty-sulphuric acids	2·12	1·52
NH_3 combined as above	..	1·60
SO_3 combined with fatty acids	2·41	3·24
Na_2SO_4	0·25	1·10
Total solids	40·27	48·90
Ash	4·88	4·59

An analysis of the ash gave—

—	I.		II.	
	Calculated on the Weight of		Calculated on the Weight of	
	Ash.	Oil.	Ash.	Oil.
Na_2CO_3	9·43	0·46	..	..
Na_2SO_4	90·17	4·40	99·80	4·50

The following were the analytical results :—

Method.	I.	II.
	Average Percentage.	
G. Stein's, precipitation of the fatty matters with saturated salt solution, drying and weighing with wax	42·64	67·26
L. Brühl's, precipitation with acid, solution of the fatty matter in ether. Ether evaporated off	39·87	47·70
L. Brühl's, as above, but an aliquot portion of ethereal solution evaporated	41·04	48·00
R. Benedikt's, separation with acid and common salt, mixture of fats with stearine, washing and drying	35·78	..
R. Benedikt's, as above, but without using common salt	35·68	42·18

Commenting on the above figures, the author makes the following observations, which he has supported by experiments:—

1. The mixture of fatty acids is not separated as such by Stein's process, but in the form of the sodium or ammonium salts of the same, along with water. A portion of the cake of wax and fatty acids from sample I. was mixed with a weighed quantity of sand, and dried at 105°; it lost 5·93 per cent. (= 2·52 per cent. calculated as Turkey-red oil) of its weight of water; another weighed portion was burnt, and 11·13 per cent. (4·82 per cent. as Turkey-red oil) of ash obtained.

The ash consisted of :—

	Parts.
Na_2CO_3	1·05
Na_2SO_4	9·00
NaCl	1·08

2. A closer examination of Brühl's separated fatty acids revealed the fact that, by drying the same in the air-bath for 24 hours, it could be separated into a layer of fatty acids and one of dilute sulphuric acid. The fatty acid of No. 1., so treated, became reduced to 35·03 per cent., 1·93 per cent. of H_2SO_4 and 2·83 per cent. of H_2O being removed. Brühl himself acknowledges that the fatty acid cake separated by his method contains H_2SO_4, but does not think the quantity sufficiently large to influence results.

3. A decomposition of the fatty sulphuric acids takes place in Benedikt's method. The results are consequently rather too low, I. being 1·8 per cent. and II. 2·6 per cent. too low.

The author recommends that samples of Turkey-red oil should be titrated with normal acid, using methyl-orange as an indicator, to estimate the amount of soda or ammonia combined with the fatty or fatty-sulphuric acids, and with normal soda and phenol phthalein to estimate the free acid.—E. B.

New Books.

Chemische Technologie der Gespinnstfasern, ihre Geschichte, Gewinnung, Bearbeitung und Veredlung. Von Dr. Otto N. Witt. Docent an der Königlichen Technischen Hochschule zu Berlin. Mit zahlreichen in den Text eingedruckten Holzstichen. Erste Lieferung. Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn. London: H. Grevel & Co., 33, King Street, Covent Garden. 1888.

Octavo volume, in paper cover, price 6*s*. 6*d*., contains Introduction and 192 pages of subject-matter, illustrated with 57 wood engravings, and one large plate exhibiting the wool-washing machine with drying cylinder according to Mehl's system. The work opens with a Historical Sketch of the Development of the Textile Industry. Chap. 1. The Textile Fibres. The Silks. The true Silks. Cultivation of the Silkworm. Diseases of the Silkworm. Obtaining the Silk. Chemistry of the Silk Fibre. The Wild Silks. Tusser Silks. Conditioning Silk. Sea-silk or Byssus. Hairs. Sheep's Wool. Formation of Wool. Chemical Properties of Wool. The Washing of Wool and Utilisation of the Wool Perspiration. Working up the Washwaters. Working the Washed Wool. Carbonisation of Wool and the Preparation of Shoddy. Statistics of Wool. Allied Fibres not from the Sheep. Mohair, Cashmere, Alpaca, Camels' hair, Cows' hair. Vegetable Fibres. Hairs of Seeds. Bast Fibres. Physical Properties of Vegetable Fibres. Cotton. Origin of Cotton and Preparation for the Market. Commercial Varieties of Cotton. Statistics of Cotton. Bombay Wool. The Bast Fibres. Flax. Properties of Flax. Commercial Varieties of Flax. Hemp. Properties and Commercial Varieties of Hemp. Jute. Nettle Fibres. China Grass. Rhea Ramie. Pseudo-Bast Fibres. New Zealand Flax. Manilla Hemp. Aloes Fibre. Agave Fibre. Ananas Fibre. Palm Fibre. Cocoa-nut Fibre. Mineral Fibres. Asbestos. Metal Fibres. Bibliography of the Textile Fibres. Chemical Agents used in the Treatment and Preparation of the Textile Fibres. The other parts of this important work will be described as they appear from the press.

Chemie der Organischen Farbstoffe. Von Dr. R. Nietzki, Professor an der Universität zu Basel. Berlin: Verlag von Julius Springer. 1889. London: H. Grevel & Co., 33, King Street, Covent Garden.

Small 8vo. volume, bound in cloth, price 7*s*. It contains Preface, Table of Contents, Introduction, 236 pages of subject-matter, a carefully arranged and tabulated list of the literature of the subject, an appendix, and an alphabetical index. The subject is treated under the subdivisions bearing the following headings:—Introduction. I. Nitro compounds. II. Azo colours. (1.) Amido-azo compounds. (2.) Hydroxyazo compounds. (3.) Azo compounds from the diazo-carbonic acids. (4.) Azo compounds from carbonic acids and diazo compounds. (5.) Tetrazo- or dis-azo colours. III. Hydroxyquinones and quinone-oxims. IV. Imidoketones and hydrazides. V. Triphenylmethane colours. VI. Imidoquinone colours. VII. Azine colours. VIII. Aniline black. IX. Indulines and nigrosines. X. Quinolinè and acridine colours. XI. Indigo colours. XII. Euxanthinic acid and galloflavin. XIII. Canarin. XIV. Murexide. XV. Colours of unknown constitution.

Chemisch-Technische Analyse. Handbuch der Analytischen Untersuchungen zur Beaufsichtigung des Chemischen Grossbetriebes und zum Unterrichte. Herausgegeben von Dr. Julius Post, Professor an der Technischen Hochschule zu Hannover. Zweite Vermehrte und Verbesserte Auflage. Erster Band. (Mit zahlreichen Holzstichen). Braunschweig: Friedrich Vieweg und Sohn (Verleger). London: H. Grevel & Co., 33, King Street, Covent Garden. 1888.

The three parts forming the first volume of this well-known work are now issued, 8vo. size, bound in paper covers. Prices are as follows: Part I., 3*s*. 6*d*.; Part II., 7*s*. 6*d*.; and Part III., 6*s*. 6*d*. The details of contents, &c., of the remaining parts of the succeeding volumes will be given so soon as issue from the press takes place.

Professor Post is assisted in the labour of compiling this work by a staff of Technical Professors and Directors of manufacturing establishments in Germany, amongst whom such names as Engler, Drehschmidt, Bergmann, Ledebur, Lintner, Noelting, Wagner and Weingärtner occur.

PART I.—This volume comprises 132 pages of subject-matter, 22 of which are devoted to the Investigation of Water, 25 to that of Fuels and their Constituents, 8 to the Determination of the Calorific value of Fuels, 40 to Pyrometric determinations, and 35 to the subject of Generator- and Smoke-gases. Part I. contains 35 engravings, illustrating apparatus described in the text. The methods proposed by Hempel for the determination of fuel gases, &c., are fully described and illustrated.

PART II.—This volume is headed, "Industrie der Kohlenwasserstoffe und Fette," and its text covers 261 pages, 105 of which are devoted to the subject of Illuminating Gas, 109 to the subject of the Liquid and Solid Hydrocarbons of the Mineral Kingdom, and 45 to the Fats, Stearin, Glycerol, Soaps, Fatty Lubricants, and Ethereal Oils. The pages of Part II. are embellished with 100 illustrative cuts and engravings. Photometry and the Estimation of the Impurities in Coal Gas are fully treated of; the forms of apparatus also in use for the determination of flashing point, especially those of Abel, Engler, Victor Meyer, and Heumann; the principal methods of and apparatus for determining the viscosity of oils (those of Fischer and Engler); apparatus for direct testing of lubrication-values, and finally the principal methods for determining in oil and grease mixtures, the kinds of oils and fats present.

PART III. is devoted to the Metals and their Salts. It is a volume containing 249 pages, and illustrated by 21 wood engravings. The following subjects are treated of:—Iron, the General Subject of Metallurgical investigations, Copper, Lead, Silver, Gold, Zinc, Bismuth, Antimony, Arsenic, Mercury, Platinum, Uranium. Metallic Salts:—The Salts of Iron, Alluminium, Chromium, Copper, Lead, Silver, Gold, Zinc, Manganese, and Tin.

CHEMISCH-TECHNISCHES REPERTORIUM.—Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der Technischen und Industriellen Chemie mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. EMIL JACOBSEN, 1887. Zweites Halbjahr. Zweite Halfte. Berlin, S.W., Schönebergerstrasse, 26: (1888), R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder. London: H. Grevel & Co., 33, King Street, Covent Garden.

OCTAVO volume in paper cover, containing 205 pages, and illustrated with numerous wood engravings. It contains also the Alphabetical Index for the total issue of the year 1887, consisting of quarterly parts. The present issue is devoted to the following branches:—Foods, Paper, Photography, Refuse products, Manures, Disinfectants and Sanitary Chemistry, Soaps, Matches and Explosives, the Preparation and Purification of Chemicals, Chemical Analysis, Apparatus, Machines, the Technology of Electricity and Heat, Adulteration of Trade products, New Books.

CHEMISCH-TECHNISCHES REPERTORIUM. Dr. EMIL JACOBSEN, 1888. Erstes Halbjahr. Erste Hälfte.

THE first issue for the first half of the present year has also just appeared, and the subjects it treats of are the following:—Building materials, Cements, Artificial stone, Colours, Dyes, and Calico printing, Fats, Oils, Illuminating and Heating materials, Fermented liquors, Tanning, Leather and the manufacture of Sizes, Textiles, Glass and Earthenware, Wood and Horn, India-rubber, Cements, Glues and Adhesives, &c., Lakes, Varnishes, and Paints, Metals.

Trade Report.

(*From the Board of Trade Journal and other sources.*)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

FRANCE.

Prohibition of Importation of Saccharin.

The Earl of Lytton, Her Majesty's Ambassador at Paris, in a despatch, dated the 2nd December, forwards a copy of a decree of the French Government, prohibiting the importation into France and Algeria of saccharin and substances containing saccharin.

ITALY.

The Tariff Classification of "Sulfonal."

Mr. J. G. Kennedy, Her Majesty's Chargé d'Affaires at Rome, in a despatch, dated the 9th November last, notifies that a decree of the Minister of Finance, published in the *Official Gazette* of the 8th November, directs that the chemical compound known in trade as "sulfonal," which is used in medicine as an anæsthetic, shall, for Customs purposes, be assimilated to chloral hydrate, and shall be classified among compound medicines not specified (with base of alcohol) under Article 62 of the tariff.

UNITED STATES.

Classification of Articles in Customs Tariff.

Certain paper coated with a preparation of gelatin and lamp black, intended for use on special work by photographers, is dutiable as a manufacture of paper, under T. I., 388.

So-called Vandyke brown and Venetian red, which are not earthy paints, the former being a vegetable colour and the latter an oxide of iron, are dutiable, under the provisions in T. I., 87, for "colours and paints," at the rate of 25 per cent. *ad valorem.*

So-called "Salol" is dutiable as a coal-tar product at the rate of 20 per cent. *ad valorem*, under T. I., 83.

So-called "gallo-flavine" is dutiable as a coal-tar colour, under T. I., 82.

BRAZIL.

Prohibition of Importation of Articles containing Salicylic Acid.

Mr. H. Wyndham, Her Majesty's Minister at Rio de Janeiro in a despatch, dated the 31st October, with respect to the prohibition of the importation of articles containing salicylic acid into Brazil, says:—

"Owing to wines, beer, &c. imported into Brazil having been found to be adulterated with salicylic acid, the inspector of health addressed the Minister of the Empire (Interior) on the 11th of January last, requesting that steps might be taken to prevent the sale of wines, beer, &c. containing the said acid. The Minister referred the matter to the Academy of Medicine, and the opinion of that body being in accordance with that of the Board of Health, his Excellency issued an 'aviso' on January 14th last, which is to be strictly enforced from the 1st of January next, prohibiting the sale of any liquors adulterated with salicylic acid."

CANADA.

Classification of Articles in Customs Tariff.

Carboys and Demijohns.—Whereas importers of sulphuric and other acids for the manufacture of fertilisers, and exporters of sulphuric acid manufactured in Canada, frequently require to return the carboys and demijohns in which such acids have been imported, to the countries whence the same were imported, or to Canada, for the purpose of being refilled and returned, or reimported, it is ordered that on the first importation of such carboys or demijohns, and on payment of the duty, provided by the tariff then in force upon the same, such carboys or demijohns shall be stamped or branded in such manner as will secure their identification on any future importation of the same, and, under authority of sub-section *b* and *o* of the 245th section of "the Customs Act," then, on any such subsequent importation, and on identification by the collector or proper officer of Customs, the said carboys or demijohns shall be, and they are hereby exempted from any further payment of duty, until otherwise provided by Order in Council.

Polariscopic Test.—In computing the duties payable on sugars for refining purposes subject to polariscopic test, all fractions of degrees as shown by the instrument are not considered, and all entries passed inconsistent herewith are to be re-adjusted.

Vinegar.—The standard for vinegar shall be taken to be that strength which requires thirty-five (35) grains of bicarbonate of potash to neutralise one ounce troy of vinegar, and so-called vinegar of greater strength shall be taken and held to be acetic acid and rated for duty accordingly.

EXTRACTS FROM BRITISH AND FOREIGN CONSULAR REPORTS.

THE NATURE AND CURE OF FISH POISONING.

Mr. H. N. Dering, Her Majesty's Chargé d'Affaires at St. Petersburg, in a despatch, dated the 2nd October, forwards a *précis* by Mr. Michell, from an announcement in the *Official Gazette*, respecting a prize of 5,000 roubles offered by the Committee of Caspian Fisheries for the best essay on the nature and cure of fish poisoning.

The *précis* in question is given in full on p. 647 of the *Board of Trade Journal* for December.

MISCELLANEOUS TRADE NOTICES.

DISCOVERY OF A NEW TEXTILE IN RUSSIA.

The French *Revue des Colonies* reports the discovery of a new textile on the shores of the Caspian. This plant, called *kanaff* by the natives, grows in the summer, and attains a height of 10 feet, with a diameter varying from two to three centimetres.

By careful cultivation and technical manipulation, M. O. Blakenbourg, a chemist and engineer, who has made a special study of kanaff, has obtained an admirable textile matter; it is soft, elastic, and silky, gives a thread which is very tough, and can be chemically bleached without losing its value. The stuffs manufactured out of kanaff, and then bleached, can be successfully dyed in every shade of colour, and would compete with any of the ordinary furnishing materials now in use. But it is particularly for making sacks, tarpaulin, ropes, &c. that this new textile, from its cheapness and its extraordinary resisting power, might defy all competition. Its specific weight is much less, but its resistance much greater than those of hemp. Thus, a cord of 8·25 mm. diameter, woven with the hand out of three threads of kanaff, requires a weight of 180 kilos. to break it. A cord, half an inch thick, manufactured at Moscow, did not break till the weight of 625 kilos. was reached.

When it is considered that Russia annually consumes more than 150 millions of sacks, a third of which are imported, it may easily be seen that the appearance of this new textile, on the Russian market is an event of no slight importance.

Consumption of Lead in Russia.

The employment of lead in Russia is twice as great at the present time, according to the Russian *Journal de St. Pétersbourg* for November 17th, as it was five years ago. In consequence of this, the Government has been obliged, since the commencement of 1888, to enforce the energetic working of the silver-lead mines of the Altai, of Nertchinskst, of the Kirghiz Steppe, and of the province of Tevek. As the product of several of these mines was found to be greatly reduced, in consequence of their exhaustion, new explorations have been made in the hope of discovering fresh beds of lead ore, and these experiments have met with the most complete success. Quite recently, in the upper basin of the Kouban, and of the affluents of that river, beds of considerable wealth have been discovered. The richest is that of Catherininskoé, and this is to be the first of the new lead mines to be worked.

The Manufacture of Seed-Oils at Stuttgart.

The following information, respecting the increasing importance of the manufacture of seed-oils at Stuttgart, is extracted from the *Journal de la Chambre de Commerce de Constantinople* for the 10th November last:—

"The manufacture of seed-oils at Stuttgart, since the increase of the octroi on table oils, has considerably developed, but, unfortunately, prices have fallen by reason of keen competition, so that a manufacturer who wishes to satisfy his customers by a good article is obliged to work without profit. In order to remedy this condition of affairs, several manufacturers of North and South Germany have decided to establish a joint stock company, under the title *Verein Deutscher Olfabriken*, among whom are the manufacturers of Esslingen and Oberturkheim. In five months 158,000 quintals of seeds have been worked in the seven factories belonging to the society, and exports have been valued at 4,800,000 marks. In comparison with the results of last year, considerable progress is to be observed. The export has more than doubled, notwithstanding the bad crops of oil-seeds in the Indies and in Asia Minor, whence these factories obtain their raw material."

The Preparation of Ramie Fibre.

See Board of Trade Journal for December, p. 704.

Carbonate of Soda Deposits in India.

A communication has been received from the India Office, enclosing copy of a report from Mr. D. Hooper, Government quinologist, to the Government Botanist and Director of Government Cinchona Plantations, Nilgiris, respecting the desire of the Indian Government to know "whether fairly pure carbonate of soda can be obtained from the saline soils known as dhobies' earth, and whether such carbonate of soda can be manufactured at a price which will allow of its competition with that obtained by the chemical treatment of common salt."

The Government quinologist remarks that efflorescent salts occur in nearly every district in India. When the salt is alkaline in its nature, the surface of the soil on which it collects is known as dhobies' earth; and this earth has been used for ages for washing, dyeing, and in the manufacture of soap and glass bangles.

A large quantity of the *reh* efflorescence of Northern India, which is collected and sold in the bazaars under the name of *sajji mati*, is a mixture of salts, where very often the sulphate and chloride of sodium preponderate over the carbonate. His investigation was limited to the examination of the dhobies' earth found in non-alluvial soils in Southern India, and more especially of that obtained from the Salem district, where it occurs in some abundance.

The earth consists principally of sodium carbonate and sand; the other ingredients are organic matters and sodium chloride, with traces of sulphate of clay, oxide of iron, and lime.

Mr. Hooper made analyses of seven different samples of earth, with a view to obtain the proportion of soda crystals or crystallised sodium carbonate in their composition, with the following results:—

No. 1 sample, which came from Coimbatore, contained 57·19 per cent.; No. 2, 32·16; No. 3, 30·75; No. 4, 26·44; No. 5, 20·72; No. 6, 19·14; No. 7, 18·11.

Mr. Hooper then shows the cost of soda crystals made in England to be very near the calculated cost of soda made at a factory at Salem, and urges that if further experiments on a large scale were adopted and found to prove his calculations correct, there is no reason why its manufacture should not be carried on, and supplied for, at least, local consumption in the Madras Presidency.

The Working of the Merchandise Marks Act.

See Board of Trade Journal for December, p. 676.

Annual Tonnage Cleared at the Twelve Principal Ports of the World, excluding Coasting Trade.

From recently-compiled statistics it appears that the following are the 12 principal ports of the world, as far as regards the annual tonnage cleared, not including coasting trade:

—	Net Tonnage.	Increase during last 15 Years.
		Per Cent.
London	12,165,336	46
New York	11,866,801	94
Liverpool	9,944,918	16
Hong Kong	9,080,390	143
Malta	8,884,059	109
Gibraltar	8,609,730	123
Marseilles	8,376,871	102
Hamburg	7,578,837	85
Cardiff	7,250,376	152
Tyne	6,995,501	46
Antwerp	6,801,890	75
Port Said	5,767,656	396

—*Chemist and Druggist.*

Quicksilver.

	Imports.			
	1888.	1887.	1886.	1885.
	Bottles.	Bottles.	Bottles.	Bottles.
November	1,273	373	1,001	473
Jan. to Nov.	67,030	59,012	58,566	53,154
	Exports.			
November	4,143	6,118	3,310	1,943
Jan. to Nov.	43,949	60,105	62,222	44,971
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Average Price	8 16 0	8 18 6	7 6 0	6 0 6

Production of Mercury.

The *Handelsmuseum* states that in the year 1879 layers of quicksilver ore were discovered near the station Nikitowka, on the Kursk-Charkow-Asow Railway. In 1885 a company was formed for working this ore, and in April 1886 the constructions required for the mine were commenced. The work has now entered upon the second year of its activity, and during this short time the results have already been so important that the production of quicksilver, this new branch of the mining industry of Russia, occupies already the position due to it amongst Russian mining undertakings. During the first year, 1887, the mine produced 3,911 poods of quicksilver, which was sent to the markets in the interior of Russia, gave complete satisfaction there, and caused the importation of foreign quicksilver to be discontinued to the same extent. The mine has been thoroughly explored, and the quantity of ore contained in it is fixed at exactly 12,000,000 poods, which, on an average of 1·2 per cent. quicksilver produced therefrom, would represent a stock of 120,000 poods of quicksilver contained in this ore. All the ore is procured by means of dynamite, of which 2½ pounds are used for every 1,000 poods of ore. The quicksilver obtained is taken to a special magazine, where it is purified by pressing it, under water, through linen. As soon as it is completely pure it is poured into iron flasks each holding 84¾ pounds. These flasks are tightly closed by a screw stopper, provided with leads, and then brought into commerce. The *Russische Revue* states that the Russian quicksilver is uncommonly pure, and that its analysis proves that it contains no other metals whatever, which is a most valuable quality as regards all its technical uses.—*Ch. of Com. Journal, Dec. 5th*, 1888.

Drugs in Dominica and Montserrat.

Among the principal products of the island exported in 1887 were 892 bales bay leaves, of an average value of 20*s.* per bale; 983 gallons essential oils, at 12*s.* per gallon; 82 cwt. tamarinds, worth 8*s.* each; 24,863 gallons of concentrated lime juice, at 6*s.* each; and 20,495 gallons raw lime juice, at 6*d.* each. The perfumery used in the island comes mostly from the United States, but drugs and soaps are generally taken from Great Britain. The shipments of lime juice (raw and concentrated) from Montserrat were worth 8,553*l.* in 1886, and 6,925*l.* in 1887, and of essential oil of limes 283*l.* in 1886, and 634*l.* in 1887. The Montserrat Company have lately commenced the cultivation of arrowroot, and have imported the necessary machinery for its manufacture, but the low price of this product in the market makes it very doubtful whether it will be profitable to manufacture it in large quantities, and its introduction is mainly in the nature of an experiment, and as an adjunct to the principal industry of the firm.—*Chemist and Druggist.*

The Alkali Trade.

The event of the year has been the progress made by the "Chance Process" for recovering sulphur from alkali waste. A large number of firms have decided to adopt the process and are pushing on with the erection of the necessary plant; one or two of them will be at work in January next, the rest will, no doubt, follow as soon as they can, and before the end of next year it is expected that a considerable quantity of brimstone will be manufactured from the hitherto intractable and useless alkali waste.

As a per contra to this advantage the majority of the Leblanc makers have to face a rise of about 90 per cent. in the price of salt, which is a very serious matter for them, and if continued will tend to drive the Leblanc trade away from Widnes and St. Helen's, possibly into the hands of foreign competitors.

On the whole, the outlook of the Leblanc industry, though better than for some time past, is still gloomy and uncertain.—E. C.

On the State of the Alkali Trade in France.

Chemische Industrie, **11,** 509—511.

The situation of the alkali trade in France may be stated as satisfactory on the whole. The large works in the South, East, and North added to their extent, although their number is but small. Most of them study with great success the applicability of scientific principles to technology, whereas the small works continue to work by rule of thumb, and pay little attention to modern improvements. The manufacture of sulphuric acid has largely increased within the last two years. The greater portion of this acid is consumed in France; still the export to Belgium, Italy, and Spain is not inconsiderable. The manufacture of superphosphates requires a large amount of acid, which is chiefly delivered by rail or water from the large acid works. Only few makers of artificial manure make their own acid. The consumption of superphosphates is continually on the increase, this manure being the only phosphoric acid manure that finds a ready sale in France. The production of a new explosive, melinite, which requires a good deal of 66° B. acid, also assisted the expansion of the sulphuric acid industry. In addition to that, certain distilleries make alcohol from beetroot directly, and consume a considerable amount of sulphuric acid for this purpose. In the South, Spanish pyrites are nearly exclusively burned, whereas in the North and centre of France, French pyrites are employed, which are found in the neighbourhood of Lyons. Norwegian ore is preferred for special purposes when an absence of arsenic in the acid is desired. The price of 66° B. acid is at present from 8 to 9½ francs per 100 kilos.

	1886.		1887.	
—	Imports.	Exports.	Imports.	Exports.
	Tons.	Tons.	Tons.	Tons.
Sulphuric acid..........	6,985	6,031	8,546	17,319
Pyrites	22,172	23,518	21,321	19,615
Sulphur	59,639	4,006	70,723	5,320

In the alkali industry the Leblanc process is continually receding before its stronger rival, the ammonia-soda process, and will probably disappear, in France at least, before many years are over. The Solvay works near Nancy now produce about 75,000 tons of alkali per year, caustic soda and caustic soda ash being also made here from ammonia soda. It is, therefore, no longer the want of these two products that keeps the Leblanc works going, but rather the need for chlorine. Large quantities of salt-cake are a necessary by-product of the Leblanc process, a small and ever-decreasing portion of which is converted into alkali, whereas the largest portion is sold to glass works. Hargreaves and Robinson's process is at work at Hautmont (North). Pechiney, at Salindres, uses magnesia in his ammonia-soda works, for the liberation of ammonia from ammonium chloride. He thus recovers on the one hand the sodium chloride lost in the mother-liquors, and on the other hand produces magnesium chloride for the manufacture of chlorine by the Weldon-Pechiney process. It is said that Pechiney is about to introduce into his establishment Chance's process for the recovery of sulphur from alkali waste.

	1886.		1887.	
—	Imports.	Exports.	Imports.	Exports.
	Tons.	Tons.	Tons.	Tons.
Sulphate of soda........	1,940	11,104	1,313	17,358
Carbonate of soda.......	789	28,438	1,975	28,194
Caustic soda............	4,831	856	3,511	1,762
Hydrochloric acid	8,617	4,731	12,321	4,770

The manufacture of bleaching powder is very flourishing and lucrative. The consumption in France is very large, and several thousand tons are annually imported from England. In some works the Weldon process is at work, whereas Kuhlmann, at Lille, recently introduced the first Deacon plant into France and is said to be well satisfied with the result. It is not known whether solid bleaching powder is there manufactured by Deacon gas, this works producing large quantities of bleaching liquor, which is directly delivered to the consumers in the neighbourhood. The company of St. Gobain also intends to adopt the Deacon process. The Weldon-Pechiney process is at present only worked by the inventor at Salindres. Only two works in France are engaged in the manufacture of chlorates, viz., that of St. Gobain and that of Pechiney. The former company uses Weldon gas, whereas Pechiney employs the gas produced by his new process. The total production of chlorates amounts to 700—800 tons per year. The Weldon-Pechiney process has a special importance for this branch of the chlorine industry, as all the magnesium chloride formed by the "chlorate reaction" again returns to the chlorine process as a raw material. It is the process which is perhaps destined to create a complete revolution in the manufacture of chlorates. Chlorine is also used for the manufacture of sodium hypochlorite (Eau de Javel), for which there is a large sale amongst the bleachers of Paris and neighbourhood.

The manufacture of nitric acid has received a great impetus by the acid being required as a raw material for melinite. The French Government bought up immense quantities of nitric acid these last two years, and even started a large works at Angoulême for the manufacture of this acid. The potassium nitrate industry is very small at the present time. Only one works is still in existence at Auby (North), which produces about 10 tons of unrefined saltpetre per day. The French Government buys the unrefined salt, and the salt is refined in its own works. The consumption of this article is decreasing.

	1886.		1887.	
—	Imports.	Exports.	Imports.	Exports.
	Tons.	Tons.	Tons.	Tons.
Potassium nitrate.......	4,320	583	2,904	266

—S. H.

General Order concerning the Drawback on Exported Medicinal Spirituous Preparations.

Inland Revenue Office, Somerset House,
London, W.C., November 26.

The Lords Commissioners of Her Majesty's Treasury having sanctioned changes in the conditions under which certain tinctures, liniments, or medicinal spirits (herein-after referred to as "tinctures") may be exported, and having also authorised repayment of the duty charged on the spirits wasted in the manufacture of such tinctures, &c., which by careful investigation is estimated to amount to 4 per cent. on the quantity actually exported—

It is ordered:—

1. That certain tinctures may be exported or shipped for use as ships' stores by licensed rectifiers or compounders, in bottles varying in size from one imperial pint to half a gallon, packed in cases containing not less than five bulk gallons.

A case may contain tinctures of different kinds, but all the bottles in the same case must be of the same size, and filled by measure, with one or more exact pints.

2. The tinctures must have been made from spirits of the initial strength, either of proof spirit or of rectified spirit (*i.e.,* spirit of 56 o.p.).

3. The name of the tincture, and whether prepared from proof or rectified spirit, must be stated on a label attached to each bottle, and every case must be branded or inscribed with the progressive number and distinguishing mark, the bulk quantity contained therein, the name of the maker, and the words "medicinal tinctures."

If any of the tinctures are dangerous to life, the word "Poison" must be added on the inside labels.

4. The rectifier or compounder intending to export tinctures must give 12 hours' notice, on a new form (No. 114—1) which has been prepared for the purpose. The officer must attend at the notice hour and check the contents of the bottles by seeing one in twenty emptied into a suitable stamped imperial measure provided by the rectifier or compounder. He must take account of the

number of bottles, compare the contents of the cases with the specification in the notice, and see the cases packed and closed. Every case must be securely fastened with tape or wire sealed by the officer with a revenue seal. The full particulars of the several cases and the total bulk quantity of each consignment must be entered in a suitable page in his survey book according to the following precedent:—

Number of Cases.	Distinguishing Numbers on Cases.	Mark.	Description of Tinctures.	Number of Bottles in each Case.	Total Number of Bottles of each size.	Number of Bottles to a Gallon.	Quantity in bulk Gallons.	Whether prepared from Proof or Rectified Spirit.	Strength of Spirit as determined at the Laboratory.	Proof Gallons.

The officer should certify at the foot of the notice that the contents of the cases agree with the specification.

5. At the time of packing, one sample of not less than half a pint must be taken from each kind of tincture, of each initial strength, from any number of cases not exceeding five, and an additional sample of each kind and initial strength for every further number of five cases or fraction of five contained in the consignment. These samples are to be labelled with the name of the tincture, and whether prepared from proof or rectified spirit, and are to be sent to the Laboratory, Somerset House, and the original notice aforesaid forwarded to the Laboratory by the first post.

An ordinary spirit certificate, showing the number of cases and total bulk gallons, must be sent with the goods to the ship's side, and two full copies of the notice must be forwarded by first post to the proper officer of Customs. That officer will certify to the shipment of the goods at the foot of each document, and forward one to the collector of Inland Revenue, and the other to the principal of the Laboratory.

Bond, with one surety, for the due exportation of the tinctures, must be given by the rectifier or compounder before the removal of the goods. The bond may be a general one.

6. There is no objection to the filling up of the bottles sampled with tinctures of the same kind and strength should the rectifier or compounder desire to do so.

On receipt of the completed certificates from the Laboratory, the collector will pay drawback at the rate of 10*s.* per proof gallon on the quantity calculated from the bulk ascertained at the time of packing, and the strength shown in the Laboratory return, together with 4 per centum thereon for loss in the process of manufacture: that is, assuming the proof quantity to be 100 gallons, drawback at 10*s.* is to be paid on 104 proof gallons assumed to have been used in the manufacture, and so on in greater or less proportion.

7. The ordinary allowance of 4*d.* per gallon as on British compounded spirits is to be paid on the quantity of proof spirits actually exported.

8. When more than one sample has been taken of each kind of tincture, the average of the strength of such samples is to be taken in calculating the proof quantity.

9. It must be understood that these regulations apply only to medicinal preparations exported in bottles, and that sulphuric ether, chloroform, and chloral hydrate, or any derivative of methylated spirit, are expressly excluded.

A list of the articles which may be exported under this order is annexed. Any extension required must be the subject of application to the Board.

By the Board,

ALBERT MICKS.

Schedule of Tinctures, Liniments, or Medicinal Spirits prepared according to the British Pharmacopœia allowed to be Exported under the above Order.

Acid. sulphuric. aromatic.
Liniment aconiti.
,, belladonnæ
,, camphoræ comp.
,, opii
,, saponis
Spirit. æther. nitrosi 0·850
Pharm. Lond.
,, æther. nitrosi 0·845
Pharm. Brit.
,, ammon. aromat.
Tinct. aconiti
,, aloes
,, arnicæ rad.
,, asafœtidæ
,, aurantii
,, ,, recentis
,, belladonnæ
,, benz. comp.
,, buchu
,, calumbæ
,, camphor comp.
,, cannab. indic.
,, cantharid.
,, capsici
,, cardamon. comp.
,, cascarillæ
,, catechu
,, chiratæ
,, cimicifugæ

Tinct. cinchonæ
,, ,, comp.
,, cinnamom.
,, cocci
,, colchici semin.
,, conii
,, croci
,, cubebæ
,, digitalis
,, ergotæ
,, ferri acetatis
,, ,, perchlorid.
,, gallæ
,, gelsemii
,, gentianæ comp.
,, guaiaci
,, ,, ammon.
,, hyoscyami
,, iodi
,, jaborandi
,, jalapæ
,, kino
,, krameriæ
,, laricis
,, lavandulæ comp.
,, lobeliæ
,, limonis
,, lupuli
,, myrrhæ
,, nuc. vomicæ

Schedule of Tinctures, &c.—cont.

Tinct. opii
,, ,, ammon.
,, podophylli
,, pyrethri
,, quassiæ
,, quininæ
,, ,, ammoniat.
,, rhei
,, sabinæ
,, scillæ
,, senegæ

Tinct. sennæ comp.
,, serpentariæ
,, stramonii
,, sumbul
,, tolu
,, valerianæ
,, ,, ammon.
,, veratr. virid.
,, zingiberis
,, ,, fort.

TRADE AND NAVIGATION RETURNS.

The Trade and Navigation Returns for November are good, and indicative of progressing business, but not quite to the extent of those of the previous month. Imports increased 7¼ per cent. and exports 3¼ per cent. on the figures for November 1887. Subjoined are the summary tables for the month :—

Imports.

—	Total.	Compared with November 1887. Increase.	Compared with November 1887. Decrease.
	£	£	£
Animals living..............	521,169	149,069	..
Articles of food and drink (duty free)	11,253,388	1,138,460	..
Articles of food and drink (dutiable)	2,776,941	..	112,794
Metals......................	1,733,833	303,585	..
Chemicals	464,691	..	9,899
Raw material for textile manufactures	8,468,482	..	161,924
Raw material for other industries	3,428,423	596,817	..
Manufactured articles	4,448,924	222,876	..
Miscellaneous articles	2,128,084	247,433	..
	35,223,935	2,658,231	284,617
		284,617	
Net increase..................		2,373,614	

Exports.

—	Total.	Compared with November 1887. Increase.	Compared with November 1887. Decrease.
	£	£	£
Articles of food and drink...	1,054,820	142,223	..
Raw materials	1,324,965	316,593	..
Cotton manufactures	5,079,934	..	1,057
Linen manufactures	427,081	12,656	..
Woollen and worsted manufactures....................	1,490,957	..	104,519
Metals and ironwork........	2,914,978	..	51,606
Machinery and millwork....	1,005,502	..	44,570
Articles of personal use	972,191	111,967	..
All other articles	5,494,252	235,632	..
	19,794,680	819,071	201,752
		201,752	
Net increase..................		617,319	

Extracts from the Report of the Director of the United States Mint.

Industrial Employment of Gold and Silver.

The value of the gold bars furnished for industrial use during the calendar year 1887 was 11,672,606.40 dollars; silver bars, 5,241,998.19 dollars; total, 16,914,604.59 dollars.

On the basis of the last direct reports of the use of coin, the industrial employment of the precious metals for the calendar year 1887 is estimated as follows: Gold, 14,600,000 dollars; silver, 5,280,000 dollars.

Price of Silver.

On July 1st, 1887, the London price of silver was 44 pence. The highest price was reached August 26th, 1888, namely, $45\frac{3}{16}$ pence; the lowest, May 19th, namely, $41\frac{5}{8}$ pence. At the close of the fiscal year, June 30th, 1888, the price was $42\frac{1}{4}$ pence.

Production of Gold and Silver.

The production of gold and silver in the United States for the calendar year 1887 is estimated to have been:—

——	Fine Ounces.	Coining Value.
		Dollars.
Gold	1,596,375	33,000,000
Silver	41,268,305	53,357,000

The production of gold and silver in the world for the last four years is exhibited in the following table:—

Calendar Years.	Gold.		Silver.	
	Kilos.	Value.	Kilos.	Coinage Value.
		Dollars.		Dollars.
1884	153,017	101,694,000	2,665,386	110,773,000
1885	156,103	103,744,000	2,954,766	122,799,800
1886	149,355	99,250,877	3,027,632	125,828,400
1887	149,048	99,056,850	3,259,144	135,449,410

The production of gold has remained nearly constant, while the production of silver has increased in the last four years about 25,000,600 dollars.—*Engineering and Mining Journal.*

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

16,726. J. Cooper, Manchester. Blast or air supply pipes for gas-producers and other furnaces. November 17.

16,761. R. Reichling, London. Apparatus for condensing steam and for heating and purifying feed water. Complete Specification. November 17.

16,793. J. Laidlaw, Glasgow. Improvements in the construction of Weston's oscillating centrifugal machines. November 19.

16,794. J. Laidlaw, Glasgow. Improvements in the construction of Weston's centrifugal machines. November 19.

17,012. R. Hasenclever, London. Apparatus for subjecting pulverulent or granular materials to the action of gases. Complete Specification. November 22.

17,072. H. H. Lea, London. Means and apparatus for neutralising or destroying noxious or offensive gases, vapours, or fumes produced in the manufacture or treatment of chemical and other products. November 23.

17,425. J. Buchanan, Glasgow. Fluid pressure and vacuum gauges. November 29.

17,521. E. J. T. Digby, London. Improved means for manufacturing crucibles, or the like vessels or utensils. December 1.

17,564. Sir Lowthian Bell, Bart., London. Evaporating brine and other solutions. December 1.

17,567. W. Lezius, London. Process and apparatus for subjecting animal or vegetable matter or chemicals to liquid extraction. December 1.

17,578. S. A. de Normauville, Liverpool. Taps, cocks, and valves. December 3.

17,661. G. E. Davis, Manchester. Apparatus for the combustion of smoke and smells and of carbonaceous vapours. December 4.

17,664. G. E. Davis, Manchester. Furnaces for the evaporation of liquids from paper-mills and bleach works. December 4.

17,809. W. R. Watson and R. A. Robertson, Glasgow. Apparatus for evaporating, concentrating, and distilling liquids. December 6.

18,025. D. McColley Weston, London. Centrifugal machines. Complete Specification. December 11.

18,034. S. A. Ward, Sheffield. Generating steam and vapour, and apparatus therefor. December 11.

18,039. N. L. Hilton, Manchester. Improvements in agitators. Complete Specification. December 11.

18,085. A. E. Tavernier and E. Casper, London. An improved pressure gauge. December 11.

18,138. J. Walworth, Bradford. Furnace for the production of hot air. December 12.

18,153. J. Foxall, Newport, Mon. The control of the pressure of gas, fluids, and liquids. December 12.

18,177. H. R. Gregory and G. MacDonald, London. Manufacture of filtering material applicable to the filtration and purification of water, sewage effluents, saccharine juices, alcoholic liquors, and other liquids and fluids. December 12.

* *COMPLETE SPECIFICATIONS ACCEPTED.*

1887.

17,576. W. Varrall. An improved filter. December 8.

1888.

1589. H. E. Newton.—From E. Taeisen. Apparatus for evaporating and cooling purposes. December 8.

1923. J. A. Drake and R. Muirhead. Filter presses. December 15.

2057. H. J. Peck.—From H. G. Downton. Apparatus for subjecting substances to the action of air or gases, for drying, disinfecting, oxygenating, or otherwise treating same. November 24.

2105. B. J. Springuel and A. Bollinckx. Apparatus for removing liquid produced by condensation. December 15.

2208. J. Scott. *See* Class XIX.

2511. A. Chapman. *See* Class XVI.

4308. T. G. Pascall. A combined evaporating and propagating pan. November 24.

14,988. R. R. Hutchinson. *See* Class XVII.

15,856. R. Kennedy. Mercurial vacuum pumps. December 8.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

19,662. T. Chappell, London, and J. H. Key, Newton Abbott. A process of treating lignite, to be called "The patent lignite fuel." November 16.

16,747. J. H. Cochrane, London. Apparatus for discharging coke ovens. November 17.

16,927. R. R. Hutchinson, London. Improved method of generating gas from hydrocarbon oils, and apparatus therefor, applicable to kilns, furnaces, or the heat chambers or flues of steam boilers. November 21.

16,953. W. Hubbard, London. Improvements in the manufacture of artificial fuel. November 21.

16,958. J. E. Dowson and A. Dowson, London. Improvements in apparatus for use in the treatment of gas. November 21.

16,970. B. H. Thwaite, Liverpool. Improved methods of producing combustible gases, and apparatus therefor. November 22.

17,020. F. V. Hadlow, Buxted. An improvement in the treatment of coal. November 23.

17,074 W. B. G. Bennett, London. Improvements in apparatus or arrangements for artificial lighting by the combustion of liquid hydrocarbons while exposed to the action of a blast of compressed air. November 23.

17,1[illegible]. G. Heeley, Sheffield. A shell lime cylinder or disc, to be used for lime-light purposes. November 24.

17,176. R. Nicholls, London. Improvements in obtaining light and heat, and in apparatus employed therefor. November 26.

17,337. G. M. Westman, London. Process for the manufacture of illuminating gas and coke. Complete Specification. November 28.

17,441. G. R. Blake, Crewkerne. A fire-lighter. November 30.

17,517. F. J. Jones, Leek. An improved method and apparatus for manufacturing gas. December 1.

17,562. De Witte Stearns, London. Improvements relating to apparatus for the production of gas from liquid hydrocarbon, and to devices for the utilisation of gaseous fuel. Complete Specification. December 1.

17,583. J. F. M. Pollock, Leeds. Machinery for moulding and compressing blocks of coal dust, clay, cement, &c., with or without agglomerates. December 3.

17,609. J. Brown, London. Improvements in apparatus employed in the manufacture of gas for prevention of stoppages in pipes. December 3.

17,613. F. J. Jones and L. C. Alexander, London. Improvements in apparatus for the manufacture of gas for illuminating and other purposes, which improvements also render said apparatus suitable for other uses. December 3.

17,659. H. Baker, Derby. Improved apparatus for carburetting coal gas. December 4.

17,661. G. E. Davis. *See* Class 1.

17,738. J. A. Yeadon and R. Middleton, Leeds. Improvements in machinery for manufacturing blocks or briquettes of fuel or materials for smelting or analogous purposes. December 5.

17,822. J. V. Griffiths and C. Sureties, London. Compressed fuel. December 6.

17,869. F. B. Hill, London. Improvements in apparatus for utilising liquid hydrocarbon for lighting and heating purposes. December 6.

17,904. J. Willoughby, London. Improvements in apparatus for heating air, consuming smoke, and improving the draught of all kinds of boilers, such air being also applicable for other heating purposes. December 7.

17,954. J. Redpath, Hull. The instantaneous lighting of fires without the use of wood or paper, to be called the "Acmé" instantaneous and indestructible perpetual fire-lighter. December 8.

18,027. W. T. Bate, Conshohocken, Pa., United States. Apparatus for the manufacture of gas. December 11.

18,105. T. Shaw, London. Improvements in apparatus for testing and detecting the presence of gases or gaseous mixtures. Complete Specification. December 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

11,537. O. Bowen, A. S. Tomkins, and J. Cobeldick. Manufacture of charcoal. December 1.

16,543. F. Pool. Appliance for scraping the insides of gas retorts and the removal of the deposit therefrom. November 24.

1888.

723. J. West. Apparatus for charging and drawing gas retorts. November 24.

737. E. Schoop.—From M. Jouannique and Co. New agglomerated fuel. December 1.

2322. J. B. Terrace. Fireclay gas retorts. December 15.

2513. E. W. Harding. Manufacture of solid fuel, and production of coal gas. December 22.

2628. O. Bowen. Artificial or compressed fuel. December 22.

4114. G. H. Lilley. Porous blocks for effecting the combustion by absorption of liquid hydrocarbons and other inflammable liquids. December 15.

6123. R. Best Helliwell. Firelighters. December 8.

9437. J. Morris. Manufacture of artificial fuel. December 8.

10,157. J. Bowing. Manufacture of fuel from coal, slack, &c., and obtaining hydrocarbons therefrom. December 22.

14,872. J. McMurray Rose. Manufacture of gas. November 24.

15,197. D. P. Mudie. Preventing the choking of pipes from retort to hydraulic main in gasworks by means of baffle plates placed in mouthpiece of retort. December 8.

15,432. H. O. A. E. Grunbaum. Solidifying petroleum and other explosive oils for transport, and as fuel for lighting and heating. December 15.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

16,716. W. P. Thompson.—From C. Rave, Belgium. Improvements in or relating to the treatment of the acid residuums or tars resulting from the refining of mineral oils by concentrated acids. November 17.

17,815. W. D. A. Bost and T. F. Haldane, Glasgow. Improvements in the manufacture of acetic acid and other products from wood. December 6.

COMPLETE SPECIFICATION ACCEPTED.

1888.

607. C. Rave. Treatment of the acid residuums or tars resulting from the refining of mineral oils by concentrated acids. December 22.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

17,094. C. F. X. Noroy, London. A new or improved dyeing material, and method of employing the same. November 24.

17,333. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. A new manufacture of orange and red dyestuffs. November 28.

17,369. T. Parker and A. E. Robinson, Manchester. Improvements in the manufacture of mono-nitro-naphthalene. November 29.

17,402. C. Dreyfus, London. The production of colouring-matters. November 29.

17,403. C. Dreyfus, London. The production of colouring-matters for dyeing and printing. November 29.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

2664. H. H. Lake.—From A. Leonhardt and Co. Production of colouring-matters. November 24.

15,496. J. C. L. D. Kœchlin, D. E. H. Kœchlin, and A. J. J. d'Andiran Kœchlin. A composite indigo dye. December 8.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

17,429. G. L. P. Eyre and T. J. Hopkins, London. Improvements in the process of treating and scouring wool and other materials containing greasy, oily, or fatty matters, and in machinery applicable thereto and to other purposes. November 29.

17,571. H. Sauvage, Dundee. The conversion of jute textiles. December 3.

COMPLETE SPECIFICATION ACCEPTED.

1888.

9145. R. Haddan.—From P. Mol. Manufacturing artificial wool from ramie and other vegetable fibres. December 22.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

16,634. W. Haigh, Manchester. Improvements in the method of and apparatus for printing upon folded piece goods. November 16.

16,755. J. Hussong and H. Hussong, London. Improved apparatus for dyeing hanks or skeins of yarn, and for other analogous purposes. November 17.

16,756. C. L. Klauder, London. Improvements in apparatus for dyeing or scouring yarn. Complete Specification. November 17.

16,864. J. Clegg, Liverpool. Improvements in or relating to apparatus for cleansing, scouring, bleaching, mordanting, colouring, steaming, and dyeing textile and other fabrics, and the raw and the unspun and the spun fibrous or porous substances used in their manufacture. November 20.

17,263. E. M. H. Andreoli, London. Improvements in bleaching paper pulp and other vegetable substances. Complete Specification. November 27.

17,271. F. E. Anderson and S. Hodgson, London. Improvements in the method of and in apparatus for dyeing, scouring, or washing wool and other materials. Complete Specification. November 27.

17,347. J. W. Bannister, London. Improvements in dyeing woollen and other woven or felted fabrics. Complete Specification. November 29.

17,441. E. Bentz and G. J. Newman, jun., Manchester. New mordants and fixing agents for use in dyeing or calico printing. November 30.

17,544. G. Young, London. Improvements in mechanism or apparatus for dyeing and bleaching cotton, wool, silk, and other fibrous materials in the raw and manufactured or partly manufactured state. December 1.

18,010. J. Imray.—From La Société Anonyme des Matières Colorants et produits Chimiques de St. Denis, France. Improvements in dyeing cotton or other vegetable fibres with blended colours. December 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

988. A. McNab. Boiling, bleaching, or washing textile fabrics, and apparatus therefor. November 24.

1954. S. Spencer. Machines for mordanting, dyeing, washing, and sizing hanks of yarn. December 15.

16,756. C. L. Klauder. Apparatus for dyeing or scouring yarn. December 22.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

17,037. F. Joaquin, R. Carulla, and E. M. Glover, Derby. Improvements in the manufacture of sulphate of ammonia. November 23.

17,069. H. H. Lake.—From O. B. Peck, United States. Improvements relating to the desulphurisation of ores, and the decomposition of metallic salts and similar compounds. Complete Specification. November 23.

17,183. J. B. Thompson, London. Improvements in the reduction of hydrogen sulphide for the production of sulphur therefrom. November 26.

17,366. T. Parker and A. E. Robinson. *See* Class XVI.

17,367. T. Parker and A. E. Robinson, Manchester. Improvements in the manufacture of chlorine. November 29.

17,447. T. Parker and A. E. Robinson, Manchester. Improvements in the manufacture of cyanogen compounds from sulpho-cyanides. November 30.

17,528. J. Barrow, London. Improvements in the treatment of gases, and recovering of sulphur from sulphuretted hydrogen evolved in various manufacturing processes. December 1.

17,541. M. Flaschendräger and H. Flaschendräger, London. Improvements in flat or prismatic evaporating pans for the treatment of salt. December 1.

17,564. Sir Lowthian Bell, Bart. *See* Class I.

17,569. F. Foster, London. Improvements in apparatus for generating carbonic acid gas. December 1.

17,807. J. Y. Hewson, Stockton-on-Tees. Improvements in or relating to the treatment of salt, and in the means employed therefor. December 6.

17,945. G. C. Dymond.—From C. E. D. Winssinger, Belgium. Improvements in the process of manufacturing bicalcareous phosphate called precipitated phosphate. Complete Specification. December 8.

18,013. E. A. Mebus, London. Improvements in the plant used in the manufacture of soda crystals. December 10.

18,028. W. T. Gibbs, London. Improvements in the manufacture of the halogen compounds of boron, of silicon, and of the metallic elements. December 11.

18,036. A. Campbell and W. Boyd, Glasgow. Improvements in obtaining chlorine. December 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

17,908. M. N. d'Andria. Separating arsenic from hydrochloric acid. November 24.

17,909. M. N. d'Andria. Treating liquid acid residues from galvanising works to obtain products therefrom. November 24.

17,181. L. G. G. Daudenart. Method and apparatus for manufacturing hydrated phosphates, and recovering by-products. December 22.

17,347. E. Meyer. Production of ammonia oxalic acid, and alkaline salts from molasses or from desaccharised lyes, without carbonisation. December 22.

1888.

1371. J. Hargreaves, T. Robinson, and J. Hargreaves. Treatment of alkali waste to obtain sulphuretted hydrogen, &c. and apparatus therefor. December 15.

1495. A. M. Chance and J. F. Chance. Treating sulphides of sodium and potassium to obtain sulphuretted hydrogen, and apparatus therefor. December 15.

2104. H. W. Deacon and F. Hurter. Manufacture of chlorine. December 15.

2311. H. W. Deacon and F. Hurter. Manufacture of chlorine. December 15.

2495. A. M. Chance and J. F. Chance. Treating sulphate of lime and other oxidised sulphur compounds of calcium to obtain sulphuretted hydrogen, and apparatus employed therein. December 8.

4262. A. Boake, F. G. A. Roberts, A. Shearer, and W. B. Giles. Manufacture of sodium-meta-sulphite. December 22.

13,462. C. Glaser and C. F. W. Dambmann. Converting insoluble phosphoric acid contained in mineral and petrified phosphates into available phosphoric acid. December 8.

14,857. J. A. Just. Apparatus for the production of chlorine. November 24.

14,859. J. A. Just. Production of chlorine. November 24.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

16,614. J. B. Gamlin and J. Tinney, Bridgwater. The manufacture of marbleised enamelled vases, urns, flower-pots, and other hollow vessels of a similar description. November 16.

16,737. T. Soufflet-Leblon, London. A new or improved description of mosaic tile, and mode of manufacturing the same. Complete Specification. November 17.

16,772. H. S. Till, Newcastle-under-Lyme. The use of glass with pottery or porcelain in the construction of articles usually made of one of these materials. November 19.

17,503. J. Cadbury, Birmingham. Improvements in machinery for polishing or surfacing glass for various purposes. December 1.

17,635. W. W. Macvay and R. Sykes, London. Improvements in the manufacture of bottles and other hollow ware in glass, and in apparatus to be used therein. December 3.

17,764. W. Gibbs, London. An improvement in painting and burning the paint on to glass globes, shades, and all bent or blown glass. December 5.

17,965. W. Boulton, London. Improvements in or applicable to apparatus for blending or equivalently treating potters' clay and other substances. December 8.

18,101. P. A. Newton.—From J. Henning and F. Wrede, Germany. Improvements in the process of manufacturing bottles or other hollow bodies of glass, and in apparatus therefor. Complete Specification. December 11.

18,238. W. Ambler, London. Improvements in the manufacture of cylindrical and tubular articles of glass, and of sheet glass. December 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

17,530. J. Armstrong. Method of blowing and moulding glass, and apparatus therefor, November 24.

1888.

284. M. J. Adams. Floor tiles. December 15.

679. J. Haly. Manufacture of glass tiles, &c. November 24.

1764. R. Stanley. *See* Class IX.

14,052. E. Leak and H. Aynsley. Manufacture of "pins" used in supporting pottery ware while being baked or fired. November 21.

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

APPLICATIONS.

16,753. A. Gray, London. Grinding Portland and Roman cements and other cements of similar nature. November 17.

16,770. C. O. Weber and F. W. Follows, Manchester. Improvements in artificial stones or blocks, applicable for grinding, crushing, granulating, polishing, and other similar purposes. November 19.

16,811. W. Joy, London. Improvements in apparatus for crushing and grinding cement, clinker, and similar matters, and for separating the finer from the coarser particles of ground cement, clinker, and similar matters. November 19.

17,257. W. Cussans, London. Improvements in colouring and ornamenting Portland cement for the manufacture of imitation grained or figured marble mosaics, ornamental slabs, tiles, and other forms, either plain or in mixed colours. November 27.

17,312. R. Warwick, Plaistow. Improvements in fibrous plastering work, and in materials used in same, and in the manufacture of slabs or plaques in connexion with the same trade. November 28.

17,363. J. Hargreaves, T. Robinson, and J. Hargreaves, Liverpool. Improvements in the manufacture of cement and in apparatus employed therein. November 29.

17,563. W. Lindsay, London. Improvements in fireproof floors. December 1.

17,583. J. F. M. Pollock. *See* Class II.

17,841. E. Robbins, London. A new or improved compound cement or concrete: manufacture, use, and application thereof. December 6.

COMPLETE SPECIFICATIONS ACCEPTED

1888.

667. M. Mackay. Composition for fusible cements. December 1.

1294. J. Cliffe. Fibrous asphalt composition for rendering concrete roofs and walls, and other structures waterproof and damp proof, and method of applying same. December 1.

1764. R. Stanley. Ovens or kilns for burning bricks, tiles, &c. December 22.

1884. R. Muirhead. *See* Class XVIII.—B.

1980. M. H. Heys. Manufacture of lime and of natural and artificial cements. December 22.

2271. J. Bassett and F. N. Seyde. Construction of fireproof ceilings and partitions. December 15.

2288. H. L. Storey and I. H. Storey. Manufacture of decorative material for application to walls and other surfaces. December 22.

2641. W. E. Constable and J. Joseph. Manufacture of artificial stone. December 8.

2803. J. Brunton and L. Griffiths. Manufacture of artificial stone. December 22.

2815. M. Fawcett. Construction of fireproof floors. December 15.

10,525. A. J. Boult.—From A. F. W. Dohring. Water and fireproof floors, ceilings, &c. December 22.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

16,671. W. C. Roberts-Austen, E. J. Ball, and A. Wingham, London. Improvements in the manufacture of iron and steel. November 16.

16,674. F. W. Koffler and A. Breden, London. Improvements in the process of and apparatus for zincing metal articles. Complete Specification. November 16.

16,692. W. Anderson, London. Improvements in tempering or annealing cylinders and hollow bodies. November 16.

16,727. D. L. Davies, Bristol. An improved miners' safety lamp. November 17.

16,796. J. H. Pollok, Glasgow. An improvement in the wet method of extracting gold from crushed ores or other finely divided auriferous material. November 19.

16,800. E. Carter, London. The more economical and quicker reduction of all kinds of iron ore, with less blast and less fuel than by the methods at present adopted, by the ores being brought into a granular or atomic state, and so apportioned or treated that the earths, silica, lime, and alumina shall be in the most easily fusible proportions. November 19.

16,821. A. Arche, London. Improvements relating to the separation of lead from silver and from other substances associated therewith. November 19.

16,830. W. Ackroyd and A. Ackroyd, London. Improvements in means or apparatus for registering the supply of air to mines and other places; also for denoting the variations in such supply. November 20.

16,848. A. Gutensohn and J. M. James, London. An improved apparatus for pickling or cleaning the surface of iron and other metal, to prepare the same for coating with tin or other metal. Complete Specification. November 20.

16,854. G. M. Edwards and W. J. Griffiths, London. Improvements in machinery for use in dressing or concentrating tin and other mineral ores and for other useful purposes. November 20.

16,872. A. Ritter von Klinkosch and I. Ritter von Klinkosch, London. Improvements in the process of and apparatus for making spoons and table forks of silver and other metals and alloys. Complete Specification. November 20.

16,916. T. Parker and A. E. Robinson, Manchester. Improvements in and relating to the manufacture of sulphide of aluminium, and of aluminium and its alloys. November 21.

16,955. W. Anderson, London. Improvements in annealing gun tubes and other tubes and hoops. November 21.

17,016. J. Baxeres, London. A chlorine-acid-saline-chlorination process for the extraction by chlorinating, in the wet way, of the antimony, bismuth, copper, cobalt, gold, lead, nickel, platinum, silver, tin, zinc, from their ores, regulus, speiss, alloys, &c. November 23.

17,067. H. H. Lake.—From O. B. Peck, United States. Improvements in apparatus for separating metal and other substances from molten slag. Complete Specification. November 23.

17,068. H. H. Lake.—From O. B. Peck. An improved process of separating metals and other substances from molten slag and the like. Complete Specification. November 23.

17,106. H. Aitken, Glasgow. Improvements in obtaining metals from ores, the same being particularly applicable to the obtainment of gold. November 24.

17,120. J. D. Ellis, Sheffield. Improvements in the method of making steel castings. November 24.

17,269. G. Prout and D. Murray, London. An improved method of coating iron or steel plates with copper and other comparatively non-oxidisable metals. November 27.

17,270. M. Graff, London. Improvements in the manufacture of steel. Complete Specification. November 27.

17,321. L. H. Cahaigne, London. Improvements in apparatus for the treatment of zinc. November 28.

17,336. G. M. Westman, London. Furnace for the manufacture of zinc, iron, phosphorus, sodium, and other substances, also the process of manufacturing them. Complete Specification. November 28.

17,358. T. Parker and A. E. Robinson, Manchester. Improvements in the manufacture of silicon-bronze. November 29.

17,373. R. Middleton, Leeds. An improved mode and manner of preparing materials for carrying out the operation of smelting and the like. November 29.

17,383. R. B. Hansell, Sheffield.—Partly communicated by E. E. Ries, United States. Improvements in the method of and apparatus for beating, tempering, and toughening metals. November 29.

17,406. H. H. Lake.—From P. Manhes, United States. Improvements relating to the treatment of nickel and cobalt. November 29.

17,410. H. H. Lake.—From P. Manhes, France. Improvements relating to the treatment of nickel and cobalt, and to apparatus therefor. November 29.

17,420. A. Wylie, London. Improvements in the method of and in machinery for the manufacture of metallic pipes and rods, and for covering the same, and telegraph and telephone cables and wires, with lead or metallic compounds for electric purposes. November 29.

17,450. C. A. Burghardt, Manchester. Improvements in the recovery of zinc from its ores. November 30.

17.451. G. M. Edwards and W. J. Griffiths, London. Improvements in machinery and appliances for dressing or concentrating auriferous and other mineral oils when in a pulverised and dry condition. November 30.

17,476. W. Charnocks, Liverpool. Improvements in or connected with the coating of metals with other metals or alloys. November 30.

17.486. J. Woolford, London. Improvements in the extraction or separation of metals from ores (simple or complex or refractory), or slags, or metallic compounds, or other metals. Complete Specification. November 30.

17.505. T. G. Barlow-Massicks, Middlesbrough. Improvements in the constructive material of tuyere coils for blast or other furnaces or cupolas. December 1.

17.614. B. J. B. Mills.—From T. A. Edison, United States. Improvements in methods of and apparatus for effecting the separation of metals from their ores. December 3.

17.638. G. G. Mullins, London. Improvements in the manufacture of iron. Complete Specification. December 4.

17,738. J. A. Yeadon and R. Middleton. *See* Class II.

17.810. J. H. Pollok, Glasgow. An improvement in the wet method of extracting gold from crushed ores or other finely-divided auriferous material. December 6.

17,858. L. Q. Brin and A. Brin, London. An improved process of extracting iron from its ore, and of refining or purifying iron. December 6.

17,872. J. Dickson, Sheffield. An improved method of preparing sectional steel. December 7.

17,880. J. Dickson, Sheffield. An improved method of producing steel for shells and other projectiles. December 7.

17.909. A. J. Boult.—From W. Ross and H. D. Bush, Canada. Improvements in or relating to the upsetting of metals and in apparatus therefor. December 7.

17,930. M. H. Simpson, London. Improvements in the preparation and treatment of bromine for the extraction of gold from ore or for other purposes. December 7.

17,938. J. T. Blomfield and W. D. Bohm, London. Improvements in gold extraction. December 8.

18,004. A. Clement-Conti, London. A new or improved apparatus for treatment of auriferous sand and other matters containing free gold. December 10.

18,020. P. R. Shill, London. Improvements in machinery for crushing or reducing and amalgamating auriferous quartz or ores, and for crushing or reducing other materials. December 10.

18,024. H. A. Hunicke, London. Improvements in and relating to the extraction of zinc from its ores. Complete Specification. December 10.

18,088. L. Keyling, London. Process and apparatus for producing fragments or pieces of iron, steel, and metal. Complete Specification. December 11.

18.114. H. Aitken, Glasgow. Improvements in obtaining gold or other metals from their ores or other materials. December 12.

18,178. D. Davy, London. Improved apparatus for traversing and turning ingots and blooms upon the feed rollers of rolling mills. December 12.

18,191. J. McCann, Millom, Cumberland. The Excelsior blast furnace tuyere. Complete Specification. December 13.

18,211. G. E. Vaughan.—From L. Weiller, France. Improvements in the manufacture of metallic alloys or compounds. December 13.

18,218. G. Proul and D. Murry, London. An improved method of coating iron or steel with copper and other comparatively non-oxidisable metals. December 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

16,853. W. L. Wise.—From The Schweizhusche Metallurgische Gesellschaft, Switzerland. Apparatus for producing aluminium and other metals and their alloys, and operating the same. December 8.

17,033. A. Parkes. Extracting gold and silver from ores or compounds, and solvents for such metals. December 15.

17,111. M. Gledhill. The casting of hollow metal ingots, and apparatus therefor. December 1.

17.412. H. H. Lake.—From C. Netto. Manufacture of potassium, sodium, and metals of the alkaline earths, and apparatus therefor. November 21.

17,532. H. H. Lake.—From C. Netto. Manufacture of aluminium, and apparatus therefor. December 22.

1888.

191. J. M. Bennett. Smelting and refining furnaces. December 8.

767. M. N. d'Andria. Recovering tin from tinned metal. November 24.

1068. J. W. Wailes. Apparatus for cutting and shaping heated metal. December 22.

1886. W. H. Beck.—From A. Sentex, C. Marechal, and A. Saunier. Manufacture of bronze. December 15.

1914. J. Hornsby and G. E. Coupe. Apparatus for separating gold from its ores. December 15.

4254. E. W. Gillon, F. P. Smith, and G. W. Wales. Treating and tempering open-hearth or Bessemer steel wire. December 15.

6879. E. G. Chamberlain. Compound railway rail. December 1.

11,620. M. F. H. Lintz. Manufacture of tin and terne plates, and apparatus therefor. December 1.

13,830. O. M. Thowless. Production of manganese alloys. November 24.

14.937. E. Norton and J. G. Hodgson. Manufacture of sheet metal, and apparatus therefor. November 24.

15,156. H. S. Blackmore. Manufacture of sodium. December 8.

16,848. A. Gutensohn and J. M. James. Apparatus for pickling or cleaning metals to be coated with tin or other metal. December 22.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

16,629. F. Cramer, Berlin. Improvements in galvanic batteries. November 16.

16,666. W. P. Thompson.—From P. Naef, Switzerland. Improvements in or appertaining to the manufacture of peroxide of lead. November 16.

16.728. N. G. Thompson, London. Improvements in dynamo-electric machines. November 17.

16,809. H. I. Harris and J. Garford, London. Improvements in voltaic batteries. November 19.

17,002. T. Cond, London. An improved fluid for primary batteries. November 22.

17,008. F. V. Schiodt, London. Improvements in dynamo machines. Complete Specification. November 22.

17.223. L. Paget, London. Improvements relating to electric secondary batteries or accumulators, and to the manufacture of electrodes therefor. Complete Specification. November 27.

17,225. L. Paget, London. Improvements relating to the generation of electricity and the simultaneous production of zinc chloride and other by-products. Complete Specification. November 27.

17.340. P. M. Justice.—From E. L. Smith, United States. Improvements in electro depositing cells. Complete Specification. November 28.

17.489. L. Fouque, London. Improvements in electric batteries. November 30.

17,537. M. Bailey and J. Warner, London. Improvements in cells for secondary batteries. December 1.

17,623. H. J. Kirkman, London. Utilisation of flux skimmings from galvanising works. December 3.

17,694. H. I. Harris and J. Garford, London. Improvements in voltaic batteries. December 4.

17.777. Sir C. S. Forbes, Bart., London. An improved ammeter. December 5.

17,783. G. A. Sweetser, London. Improvements in the manufacture of wire or tape from electro-deposited metal, for electrical or other purposes. December 5.

18,022. C. E. L. Brown, London. Improvements in dynamo-electric machines. December 10.

18,116. A. B. Atkinson and H. Metcalf, Brighton. Improvements in electrical primary batteries. December 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

17,138. R. H. Courtenay. Apparatus for generating and converting electric currents. December 8.

1888.

2368. M. Bailey and J. Warner. Manufacturing woven plates for secondary batteries. December 22.

3312. E. Tyer. Voltaic batteries. December 8.

10,694. I. A. Timmis. Elements for secondary batteries. December 22.

11,681. C. E. Liebert and S. A. Rosensthal. Electric batteries, and exciting liquids or compounds therefor. December 1.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

16,845. J. Gott, London. Improvements in the manufacture of soft soap for laundry, cleansing, and other purposes. November 29.

17,621. J. Baxeres, London. Camphene and borneol soaps. December 3.

17,628. W. Michell and S. Picard, London. An improved process and composition for extracting oil from and cleaning cotton waste. December 3.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

550. R. Hunt. Purification of cotton-seed oil, and apparatus therefor. December 15.

2306. O. H. von Wilke. Manufacture of soap soluble in sea water. December 15.

2796. J. Meek. Improved soap tablets or cakes. December 22.

9796. J. M. McCallum. Improved soap powder and method of manufacturing same. December 1.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

17,554. M. A. Harrach, London. An improved polish for furniture and other articles. Complete Specification. December 1.

17,679. A. J. Boult.—From W. Kiel, United States. Improvements in vulcanised plastic compounds. Complete Specification. December 4.

17,865. J. Hickisson, London. Improvements in the manufacture of solid ink pencils for marking upon cotton, linen, and other textile fabrics, and in mordants for use therewith. December 6.

17,946. F. J. Binns and R. J. Paris, Liverpool. New or improved covering composition, applicable for protecting ships' bottoms and the like. December 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

15,771. F. Crane.—From W. D. Field. Varnishes. November 24.

1888.

618. C. P. Dimitry. Indelible ink. November 24.

14,854. B. F. McIntyre. Fireproofing and preserving compounds. December 1.

15,997. A. J. Boult.—From C. H. Eichler. Manufacture of paint. December 8.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

16,734. E. Edwards.—From J. Gautier, France. An improved cement to be used as a substitute for glue. November 17.

17,706. A. A. Blandy, London. Improvements in the treatment of leather waste suitable for being applied to the manufacture of boots and shoes and to other useful purposes. December 4.

17,782. P. A. Jesson, London. Improvements in machinery for treating hides, skins, leather, and other materials. December 5.

XV.—AGRICULTURE, MANURES, ETC.

APPLICATION.

17,037. F. Joaquin, R. Cirulla, and E. M. Glover. *See* Class VII.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATIONS.

16,703. C. Steffen, London. Improvements in lixiviating batteries for raw sugar or sugar mass. Complete Specification. November 17.

17,339. A. Baumgarth, London. Improvements in refining sugar and apparatus therefor. November 28.

17,366. T. Parker and E. A. Robinson, Manchester. Improvement in the method of and apparatus for burning sea-weed, and recovering the products of the combustion. November 29.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

642. E. Easton and S. Hoyland. Apparatus for extracting juice from sugar canes. December 15.

1392. B. J. R. Newlands and J. B. Alliott. Apparatus for filtering saccharine or other solutions, and appliances for cleaning the said apparatus. December 8.

2511. A. Chapman. Apparatus for evaporating saccharine or other solutions or liquids. December 1.

16,397. F. Bauder. Refining sugar, and treatment of syrup obtained therefrom. December 15.

16,703. C. Steffen. Lixiviating batteries for raw sugar or sugar mass. December 22.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

16,885. H. H. Lake. From J. W. Tree, United States. Improvements in apparatus for the manufacture of malt. Complete Specification. November 29.

17,018. A. Gough, jun., London. Improvements in the making of malt. November 23.

17,338. H. E. Sorel, London. Improvements in the treatment of commercial alcohols. November 28.

17,549. E. Barbe, London. Improvements in or relating to the manufacture of vinegar. Complete Specification. June 1, 1888; ante-dated under section 103 of Patents Act of 1883.

17,968. J. Lennox and A. B. Lennox, London. An improved method for purifying and maturing whisky and other spirits, and apparatus employed therein. December 8.

17,972. I. Traube, London. Improvements relating to the separation of mixtures of ethyl alcohol and water from fusel oil and other impurities, and to apparatus therefor. December 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1528. C. D. Abel.—From E. Kiderlin, J. W. van Leenhoff, A. Wernicke, A. Wilhelmi, and A. Kohlmann. Preparation of materials containing starch for direct treatment in brewing processes, the production of malt, and other saccharifying processes. December 8.

1558. W. S. Squire. Manufacture of yeast. December 8.

1622. R. P. Preston and R. W. Preston. Improvements in or relating to stills. December 8.

6869. J. Y. Johnson. La Société Française des Alcools purs, of Paris. Process for purifying alcohol and obtaining aldehydes and acetones. November 24.

14,988. R. R. Hutchinson. "Mashers" and "mixers" as employed in brewing and other processes, and applying electricity as a motive power for the same. November 24.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

17,226. H. T. Champney, London. An improved alimentary compound. Complete Specification. November 27.

17,531. E. Acres, London. A new and improved process for preserving meat, fish, and other articles of food in tin and other boxes. December 1.

17,899. A. A. Brehier, London. Improvements in the method of preserving fresh meat, fowl, game, fish, eggs, cheese, fruit, vegetables and other alimentary substances. December 7.

18,079. G. D. Wheaton, London. Improved means to be used in the preservation of perishable substances. December 11.

B.—SANITARY CHEMISTRY.

16,774. B. R. Phillipson, Dublin. The distribution of sewage, which he has named "The terrace system of sewage distribution." November 19.

17,793. H. H. Lake.—From J. Hirshfeld, United States. Improved methods and apparatus for the treatment of human excrement and other feculent matter. Complete Specification. December 5.

17,962. J. Wilkinson and J. B. Alliott, London. Improvements in destructors, or apparatus for treating refuse. December 8.

18,243. H. H. Lake.—From S. de Melho Ascrappa, Ceylon. Improvements relating to the treatment of human excrement and to apparatus therefor. December 13.

C.—DISINFECTANTS.

16,762. E. Smith, Manchester. Improvements in soap to be used as an insecticide and for cleansing plants, dogs, and other animals. November 17.

17,042. G. R. Tweedie, Liverpool. New or improved compositions for disinfecting, deodorising, or antiseptic purposes. November 23.

17,843. W. H. Daniels, London. An improved antiseptic compound for preserving perishable articles. Complete Specification. December 6, but ante-dated (under sec. 103, Patents Act, 1883) June 2.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1888.

16,335. H. Stachelhaus. Manufacturing conserved meats. December 15.

B.—SANITARY CHEMISTRY.

1888.

1161. A. J. Capron. Purification of sewage and impure waters. December 1.

1884. R. Muirhead. Apparatus for separating liquids and semi-liquids from solids, especially applicable to sewage sludge, slip, slurry, and such bodies. December 15.

9312. B. Jagger. Means for purifying sewage and other water. December 22.

C.—DISINFECTANTS.

1888.

1696. W. Black and W. L. Rennoldson. Preparation of antiseptics. December 8.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

16,932. G. Tidcombe, London. Improvements in rolls for pulping fibres for the manufacture of paper and like uses. November 21.

16,943. J. Mactear, London. Improvements in or applicable to the treatment of esparto grass. November 21.

17,060. F. C. Danvers, Ealing. Improvements in the manufacture f artificial ivory. November 23.

17,227. H. H. Lake.—From C. H. Atkins, United States. Apparatus for removing metallic particles from paper pulp. Complete Specification. November 27.

17,263. E. M. H. Andreoli. *See* Class VI.

17,168. A. Lundberg, Northfleet. Improvements in and relating to boilers for use in treating wood or other fibrous matters with acid solutions. Complete Specification. November 30.

17,581. A. Johnston and C. G. Hayward, Ipswich. Uninflammable paper. December 3.

17,692. O. Imray.—From J. R. France, United States. Improvements in manufacture of celluloid and similar compounds, and apparatus therefor. Complete Specification. December 4.

17,766. W. H. Caldwell, London. Improvements in the manufacture of paper. December 5.

17,779. J. von der Poppenburg, Berlin. Improvements in the method of manufacturing papers coated with metallic foil. December 5.

17,828. J. H. Shorrock, London. Improvements in or relating to machines for straining pulp employed for making paper, and in automatic apparatus connected therewith. December 6.

17,876. A. Lundberg, Northfleet. Improvements in and relating to boilers for use in treating wood or other fibrous matters with acid solutions. Complete Specification. December 7.

18,003. F. Salomon and H. Brungger, London. Improved method of and means for protecting apparatus used in the manufacture of sulphite cellulose. December 10.

18,174. G. F. Stickings, London. Improvements in the manufacture of paper, and in machinery or apparatus employed therein. December 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

2208. J. Scott. Strainer-plates for straining pulp in the manufacture of paper or other industries. December 8.

12,687. C. W. J. L. Robert. Filigranes for water-marking paper. December 8.

16,465. O. Imray.—From J. R. France. Manufacture of collars, cuffs, &c. from celluloid, xylonite, and other pyroxyline compounds. December 15.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

17,075. J. Y. Johnson.—From F. von Heyden, Germany. Improvements in the manufacture or production of paroxybenzoic acid. November 23.

17,627. R. I. Hunter, London. Improvements in dental anodynes or obtundents. December 3.

COMPLETE SPECIFICATION ACCEPTED.

1888.

12,179. C. Liebermann and F. Giesel. Treatment of amorphous alkaloids obtained in the preparation of cocaine. December 1.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATION.

16,715. A. R. Brown, London. Improvements in or relating to printing photographs, especially "blue printing," and in apparatus therefor. November 17.

COMPLETE SPECIFICATION ACCEPTED.

1888.

8508. W. Guttenberg. A lamp for photographing by magnesium light. December 22.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

16,693. T. Nordenfelt, London. Improvements in torpedoes. November 16.

16,839. H. J. Allison.—From C. W. Valney, United States. Improvements in explosive compounds. Complete Specification. November 20.

16,997. H. M. Chapman. Improvements in or relating to percussion caps or fuses. November 22.

17:027. J. G. A. Kitchen, St. Helens. A new explosive intended as a substitute for gunpowder as now generally used for blasting and other like purposes, and also for fire-arms and ordnance of all classes. November 23.

17.192. T. Nordenfelt, London. Improvements in percussion fuses. November 26.

17.212. J. Sayers, Glasgow. Improvements in explosive compounds. November 27.

17,327. A. V. Newton.—From A. Nobel, France. Improvements in the manufacture of explosive compounds. November 28.

17,456. W. R. Hodgkinson, London. Improvements in the manufacture or treatment of explosives to better control combustion or prevent detonation. November 30.

17,631. H. Ritter von Dahmen, London. An improved manufacture of nitro-glycerin and dynamite. December 3.

17.719. T. Parker and A. E. Robinson, Manchester. Improvements in the manufacture of phosphorus. December 5.

17,772. W. S. Simpson, London. An improvement connected with explosive shells. December 5.

18,181. T. Nordenfelt, London. Improvements in base fuses for projectiles. December 12

18,241. G. Trench, London. Improvements in explosives. December 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

187. A. Orr. Forming solutions and compounds of nitro-cellulose. December 1.

1031. J. Pain and A. A. Craig. Signal-lights and other fireworks for use at sea and elsewhere. November 24.

1119. G. Quick. Cartridges for ordnance. November 24.

1153. A. Greenwood. Machines for the compression of gunpowder, &c. December 1.

1685. A. Brock. Ships' signal-lights, rockets, Roman candles, and other fireworks. December 8.

4310. E. Turpin. Manufacture of explosive. December 1.

6198A. J. W Graydon. Preparing high explosives for use, and charges or cartridges made of such explosives. December 8.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATION.

16,697. N. G. K. Husberg, Arboga, Sweden. Improvements in the means of determining the percentage of fat in milk. November 17.

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